Proceedings of International Conference on

POWER OF DIGITAL TECHNOLOGIES IN SOCIETAL EMPOWERMENT

IETE CHENCON2021

June 4 & 5, 2021

THE INSTITUTION OF ELECTRONICS AND TELECOMMUNICATION ENGINEERS

CHENNAI CENTRE

37, Conran Smith Road, Gopalapuram, 600066

Proceedings of International Conference on

POWER OF DIGITAL TECHNOLOGIES IN SOCIETAL EMPOWERMENT
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Online

Google Platform

THE INSTITUTION OF ELECTRONICS AND TELECOMMUNICATION ENGINEERS

CHENNAI CENTRE

37, Conran Smith Road, Gopalapuram, 600066

ChenCon2021 - Keynote Talks and Technical Sessions

Join Google Meet: https://meet.google.com/qvr-nous-roe

Phone Numbers (US)+1 575-322-8513 PIN: 414 809 668#

Date & Time		Details	
Friday, 4th June, 2021, 8.30AM -9.00AM Inaguaration			
Day 1: Friday, 4th June, 2021	09.00 – 10.00	Talk-1	Prof. Dr. S.J. Thiruvengadam, Professor, ECE Department, Thiagarajar College of Engineering, Madurai 625015. Reconfigurable Intelligent Surface Assisted 6G Wireless Communications: Physical Layer Perspective
	10.00 – 11.00	Talk-2	Dr. Ajay Agarwal, Professor, Indian Institute of Technology Jodhpur & Chairman, IETE PILANI– 333 031. Digital Sensors for the Environmental and Healthcare
	Break		
	11.05 – 13.00	Technical Session	PTS 11: Communication and Networking Paper IDs: IC19,25,26,35,49 meet.google.com/rgg-gxep-ixv
			PTS 12: Machine Learning and Artificial Intelligence Paper IDs: IC-08,14,39,41,44,46 meet.google.com/fjg-kbzq-myc
	Lunch		
	14:00 - 15:00	Talk-3	Dr. Anand Lakshmanan, SMIEEE, Edu-Tech and Consulting IOT Solutions for Betterment of Society
	15:00 - 17:00	Technical Session	PTS 13: Signal, Image and Video Processing Paper IDs: IC-20,21,23,37,42 meet.google.com/rgg-gxep-ixv
			PTS 14: IOT and Embedded Systems Paper IDs: IC-03,16,22,34,48 meet.google.com/fjg-kbzq-myc
Day 2: Saturday, 5th June, 2021	09.00 – 10.00	Talk-4	Prof. Dr. V.S.N. Rao Tatavarti, Director, Dean - Industrial Consultancy and Sponsored Research, GVP-SIRC Indigenous Design and Development of Photonic System for Real Time Air Quality Monitoring
	10.00 – 11.00	Talk-5	Prof. Dr Tanya Singh, Professor (CSE), Dy. Director (Academics), Amity University, Uttar Pradesh Social Empowerment of Rural India through Digital Technologies
	Break		
	11.05 – 13.00	Technical Session	PTS 21: Emerging Digital Technologies Paper IDs: IC-11,27,29,31,40,47 meet.google.com/rgg-gxep-ixv
			PTS 22: Sensors, Circuits and Healthcare Paper IDs: IC-06,24,28,32,36,53 meet.google.com/fjg-kbzq-myc
	Lunch		
	14:00 - 15:00	Talk-6	Prof. Dr Fakhrul Hazman Yusoff, Senior lecturer, Faculty of Computer and Mathematical Sciences, Universiti Teknologi, MARA Online Community - Its Peril and Opportunity
	15:00-16:30	Technical Session	PTS 23: Micro wave, Antennas and Fibre optics Paper IDs: IC-05,09,10,54 meet.google.com/rgg-gxep-ixv
	16.30 -17.000 – Valedictory		

PROF (DR) J W BAKAL

PRESIDENT IETE

On behalf of the Institution of Electronics and Communication Engineers, I welcome all the attendees to IETE ChenCon2021, International Conference on Power of Digital Technologies in Societal Empowerment which provides vibrant opportunities for the delegates to exchange new ideas, applications, practical challenges encountered and to leverage digital technologies.

The Institution of Electronics and Telecommunication Engineers has always been a forerunner in providing able and quality education. Our vision is to reach the unreached and empower the youth through Technical Conferences to celebrate their ideas with a Mission for Advancement of Electronics, Telecommunication, Information Technology & other related disciplines.

Being the president, with a noble cause of establishing the apex class of education and research through IETE and various ISF corresponding to the respective centers, I appeal to all the IETE centers and ISF's to be an active member, participating with vigor and enthusiasm. Our vision is to reach the unreached and empower the youth through Technical Conferences to celebrate their ideas with a Mission for Advancement of Electronics, Telecommunication, Information Technology & other related disciplines.

With complete preparedness and dedication, the organizing team has planning to deliberate the power of Digital Technologies in Societal Empowerment. I extend my best wishes to Chennai Centre and I am sure ChenCon2021 would be a grand success.

Prof (Wg Cdr) P Prabhakar (Retd)

Vice President, Chairman (BoRIS)

Warm greetings to the organizing committee, peers, friends, participants and fellow colleagues. The pandemic has created an unprecedented situation around the world, yet despite several situations and circumstances. It gives me immense pride in welcoming the fraternity of IETE and participants on this elite ChenCon2021. The ChenCon2021 by IETE Chennai dwells upon *Power of Digital Technologies in Societal Empowerment*.

It is the fraternity, which unites us all. Having people with different mindset, different views on a topic, a conference such as this gives us and immense and immersive learning experience. However, what matters the most is, what do we take away from this conference, what part of the information we can associate ourselves with and consistently strive towards self-development and enhancing our knowledge towards the field.

I wish the organizing committee and the participants a wonderful and thoughtful session.

Dr D C Pande

Co-Chairman (BoRIS), Zonal Mentor (South)

I am extremely happy and honoured to be the part of this Virtual International Conference on *Power of Digital Technologies in Societal Empowerment* (IETE ChenCon2021) organised by The Institution of Electronics and Telecommunication Engineers, Chennai Centre. My heartfelt sincere greetings to the Organising Committee Members, Peers & Friends, Fellow Colleagues and dear Participants.

The Institution of Electronics and Telecommunication Engineers (IETE) has always been a renowned and credible Institution which was established in 1953 in the pursuit of advancement in Science and Technology in endeavouring to embrace quality education. I record my appreciation to IETE Chennai Centre for hosting ChenCon2021 International Conference. The ChenCon2021 focuses on *Power of Digital Technologies in Societal Empowerment*.

The multidisciplinary conference with objectives of exposing the delegates and participants with all round advances in the field of Digital Technologies in the present scenario is an excellent opportunity for one and all. Besides the ChenCon2021 provides an excellent forum for scientists, engineers, researchers and students to present and discuss their findings and design innovative in the field of Digital Technologies with the emphasis in the Social Empowerment.

I am sure the ChenCon2021 would be a success and would provide a useful platform for interaction of experts and research community towards evolving fruitful recommendations.

I convey my best wishes to the organizing team for their committed and dedicated efforts in organizing ChenCon2021.

Dr.N. Venkateswaran

Chairman, IETE Chennai Centre

On behalf of the organizing committee of IETE ChenCon2021, I would like to extend a warm welcome to the distinguished members of the IETE Governing council, Honourable researchers and engineers of the telecommunication community. The theme of the conference this year *Power of Digital Technologies in Societal Empowerment* is particularly appropriate during these times when the world is reeling from the effects of a pandemic. Digital technologies are significantly transforming number of aspects of our daily lives. Not only it enhances our knowledge but also expands our horizons. It offers unprecedented opportunities in terms of connecting to people, information, services, and resources. Researchers and academicians have a pivotal role to play, to leverage the technology and empower us with an attitude of excellence and service.

We have received over 65 papers from all around the country and have accepted nearly 37 of these contributions to be presented over the course of the conference. With six eminent speakers delivering keynote address on ground breaking topics, many researchers presenting productive and dynamic ideas. I would also like to thank all the keynote speakers and reviewers who have enriched the proceedings of this conference. Thanks to all the participants who have shown great patience and perseverance as we worked through this difficult time. I hope all the participants will have a fruitful and beneficial experience.

I compliment the conference convener and the Co-conveners and the huge efforts of the reviewers to bring out the proceedings in such a short time.

Mr. Shakthi Murugan K H

Honorary Secretary, IETE Chennai Centre

The concept of education has changed in a big and seemingly unmanageable way in the recent time. Man's adherence to and rejection of certain practices have thrown up new challenges. Today education has opened new vistas in this digital era. Improvement of 'Self' and 'Society' remains not only a non-changing factor but has assumed greater significance. Conferences are knowledge platforms where many new trending research ideas are shared.

It fills me with immense pleasure as our IETE Chennai Centre is organizing an International Conference titled ChenCon2021, on the theme *Power of Digital Technologies in Societal Empowerment*, a virtual platform for sharing the knowledge among researchers.

I wish the conference be a big success.

Ms.T.J. Jeyaprabha

Honorary Treasurer, IETE Chennai Centre

I would like to thank all my organizing team members of the IETE ChenCon2021 - International Conference under the theme, *Power of Digital Technologies in Societal Empowerment* for bringing together various researchers, students, faculty and industry professionals in an online mode on account of the prevailing pandemic. Virtual platforms never hinder the researchers to share their ideas.

It gives me an immense pleasure that IETE Chennai Centre is able to organize various technical activities for the benefit of student's community. I am sure that this conference will serve as a platform for researchers, professionals and academicians to get an exposure in the latest digital technologies and applications, share innovative ideas and their implementation aspects.

This forum would help the researchers across the globe to share practical challenges faced during the implementation of new technologies and their solutions. The E-proceedings of this conference will benefit the participants to understand ongoing research areas and help them to think adversely.

I wish the conference IETE ChenCon2021 a great success.

Mr. M. ARUN

Convener, IETE ChenCon2021

It is a great honour and privilege to host this IETE ChenCon2021 - International Conference under the theme, *Power of Digital Technologies in Societal Empowerment* during 04 and 05 June, 2021. The prime focus of this conference is cantered towards Specialists, Researchers, Experts, Teachers and Students to share their experience, creative thoughts, issues, late patterns and future bearings in the field of Engineering and Technology.

The purpose of this conference is to provide a forum for the exchange of creative thoughts, specialized mastery for innovative headways, latest technical information, the dissemination of high-quality research papers and discourses for shaping future developments. It incorporates keynote address from Academicians and paper presentations by Scholarly Researchers. It is truly a pleasure to welcome you all.

I sincerely hope that this meeting will deliberate and discuss all the different facets in Engineering and Technology. I am confident that you will enjoy a stimulating conference here and your presence and participation will help contribute to this vibrancy and enrich discussions around the theme Power of Digital Technologies in Societal Empowerment developing professional knowledge, exchange insights and collaborations.

I also appreciate the efforts taken by the conference organizing team. I take this opportunity to thank all the delegates, supporting institutes/industry and above all, volunteers without whose efforts, the conference would not have been possible. I hope all the participants will have a fruitful and beneficial experience. I wish the conference a grand success.

Dr. S. J. Thiruvengadam

Reconfigurable Intelligent Surface Assisted 6G Wireless Communications: Physical Layer Perspective

Dr. S. J. Thiruvengadam holds Bachelor Degree in Electronics and Communication Engineering, Master's Degree in Applied Electronics and Doctoral Degree in the field of Signal Processing for Communications. He carried out postdoctoral studies at Stanford University, USA in the area of MIMO Wireless Communications under Technology Information Forecasting and Assessment Council (TIFAC) Postdoctoral Fellowship. He is one of the members in establishing TIFAC Centre of Relevance and Excellence in Wireless Technologies at TCE, Madurai.

He has completed many sponsored research projects in the area of Signal Processing for Defence Laboratories and Industries. 11 students were awarded Doctoral Degree under his guidance. He has completed IUCEE Engineering Education Certification Programme with Distinction and got IUCEE Engineering Educators and institutional leadership Awards. He is Senior Member in IEEE and recognized as Margadarshak by AICTE, New Delhi. Currently, He is Dean (Academic Process), CDIO Core Group Coordinator and Professor in Electronics and Communication Engineering at TCE, Madurai. His areas of research interest include Engineering Education, Wireless Communications and Statistical Signal Processing.

Abstract

Futuristic 6G wireless technologies will supposedly accomplish the expectations not met with 5G. In infrastructure aspect, the key enablers of 6G are envisioned to be Reconfigurable Intelligent Surfaces (RIS), ultra-massive Multiple Input Multiple Output (MIMO) communications, and user-centric networking. Currently, the research focus is on investigating the customization aspect of the wireless propagation environment. Controllable intelligent channels, enabled by RIS, are utilized to adjust the phase of incident signals such that the signals are added constructively at the end-user. In RIS, arbitrary incident waves are phase tuned by the discrete reflecting elements, and the reflected waves out of RIS, reach the end-user as a coherent wave. In this way, operators can have certain control over the random channel behaviour. It is proved that the RIS aided communications would provide a more favourable path than the free space when the direct link is obstructed. The utilization of RIS for assisting wireless communication has numerous benefits such as facilitation of ultra-reliable link even at very low Signal to Noise Ratio (SNR), low-cost implementation, and energy-efficient hardware.

In this keynote address, the physical layer perspectives of RIS assisted Wireless Communications will be presented in detail.

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Dr. Anand Lakshmanan

IOT solutions for betterment of Society

A Senior Member of IEEE, **Dr. Anand Lakshmanan** is a technical professional in the areas of Communications, Embedded Systems and Database applications. Over the 25+ year of his career, Anand has been associated with many organizations, including IBM, Motorola, Cisco Systems, Symbol Technologies, Hewlett Packard, and Ericsson India, that have been significant contributors to the ICT Industry in India. In Jan 2020, quitting the corporate industry, he has been focusing on Edu-Tech and Consulting, offering technical consultations and trainings in the areas of Industrial IOT, Smart Infrastructure and Innovations, through a start-up that he co-founded.

On the academic front, Anand completed his Masters in Electronics and Communication Engineering, and Doctorate in Distributed Computing from Indian Institute of Science, Bangalore and a Management in Finance from Symbiosis, Pune. He is a recipient of the best thesis award for his PhD Thesis on "Load Scheduling Algorithms in Distributed Computing Systems".Anand has been giving Lectures in the Colleges affiliated to the Anna University in Tamil Nadu, in IIIT-DM Kanchipuram and in IIT-Madras, over the past decade. He was a member of the Senate at IIIT-DM, Kanchipuram between 2015 and 2021 besides being a member of the Board of academic studies in a few other institutions. Currently he is also a Visiting Faculty in IIIT-DM, Kanchipuram. Dr. Anand regularly feature on ICT Academy's monthly newsletter, ICT Connect with his articles.

Abstract

Technology evolution has always been intertwined with advances in applications of the technology, often each appearing in alternate phases. And all through these developments, Communications has always been at the forefront of either of the phases, enabling rapid transformations in allied industries.

We are going through one such phase where the Technology has presented with a lot of power to leverage on, and develop applications and use-cases for the betterment of humankind. The Internet-of-Things (IOT) opened a Pandora's box, and as if that were not sufficient, 4G and 5G standards of mobile communication proved to be just the booster that was needed to give a thrust to IOT. And developments in Data sciences have enabled the processing and visualizing the large volumes of data that is created.

The IOT with 5G is poised to bring in a lot of changes – Smart Homes, Smart Offices, Smart Hospitals, Smart Cities, and everything that one can think of. One's creativity is the limit to the applications that we could come up with. Let us sample a few of these!

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Prof Ajay Agarwal

Digital Sensors for the Environmental and Healthcare

Dr. Ajay Agarwal is Professor at Indian Institute of Technology, Jodhpur. Earlier, he worked at CSIR Central Electronics Engineering Research Institute, Pilani as Sr.Principal Scientist & Coordinator-Smart Sensors Area; Associate Dean, Engineering Sciences at Academy of Scientific & Innovative Research (AcSIR), New Delhi; Member of Technical Staff at Institute of Microelectronics, Singapore for over 9 years and SCL, Chandigarh & USHA India, Faridabad for over six years.

He is involved in the development of Nano- microtechnologies, MEMS, micro fluidics and Micro-sensors. His engagement with semiconductor industries, research institutes and academics is for over 3 decades. He has ~290 research publications in peer reviewed journals or international conferences, 86 invited/ plenary/ keynote talks and over 35 patents (granted or filled). He has supervised 15 Ph.D. students so far.

He is Senior-member of IEEE, USA since 2006 and Vice-Chairperson, IEEE Rajasthan Subsection; Life Fellow & Chairman, Pilani of IETE (India) and Semiconductor Society of India; Life Fellow of MSI (India), & The Institution of Engineers (India), and member IAAM-International Association of Advanced Materials, Sweden & MRS, Singapore [till 2009], etc. and Associate Editor, Healthcare Technology Letters, etc.

Prof. Agarwal is bestowed with various awards including Outstanding Engineering Services to Society Award 2021, The Institute of Engineers (India) Rajasthan State Centre, Jaipur; 2020 CSIR Technology Award (Innovation); 2013 DST UKIERI Thematic Partnerships Award, India; 2008 National Technology Award, Singapore; 2009 Excellence Award, IME Singapore; “Collaboration Development Award” British High Commission, Singapore for year 2005 and 2006, Super Kaizen(4 times) and Best Kaizen (7 times) at USHA (India) Ltd., etc. His biography is included in the Who's Who in the World, which profiles the most accomplished men and women in the world since 2010 and in Who's Who in Asia since 2012.

Abstract

The pandemic Coronavirus disease 2019 (COVID-19) has disrupted the economic activities of the entire world including India. The scenario has also generated immense opportunities, to re-visit our core capabilities and innovatively plan for new technologies and products. The requirements from the healthcare sector have come to the priority followed by environmental care needs.

The micro and nano-technologies are paving the path for the highly sensitive sensors along with micro-fluidics, which are enabling numerous innovative solutions, suitable for healthcare and environmental care applications. The healthcare markets cover Point-of-Care (PoC) devices, pharmaceuticals and biotech, in-vitro diagnostics, medical devices, medical imaging, and healthcare IT. The point-of-care and early diagnostics requirements are primarily in kits for glucose monitoring, infectious diseases testing, cardio-metabolic monitoring, coagulation monitoring, urinalysis, cholesterol test strips, tumour/ cancer markers, pregnancy and fertility testing and many other products. Environment care includes its monitoring, recycling and minimization of the resource utilization.

Nanotechnologies in consort with micro-fabrication and micro-electromechanical systems (MEMS) have enabled novel nano-dimensional materials, structures and eventually devices which find several applications in the field of earlystage diagnosis, point-of-care diagnostics and real-time environmental monitoring.

Among various nano-materials realized, CNT, Nano-Gap and Nanowire based bio-chemical sensors are most utilized for the diagnostic applications. Nano-Gap sensors works on two principles; either on the 'change of the conductivity' of the sensing layers between the nano-electrodes when exposed to analytes or based on 'Electro-magnetic enhancement' using micro-Raman spectroscopy. Nanowire sensors work on the principle of 'Field Effect Transistor' (FET) where charges associated with the chemical molecule or the biological specie is attached on the nanowire surface and acts as chemical or bio-gate; the devices are hence termed as CHEM-FET or BIOFET. MEMS based gas detectors, as breathe and ambient analyser are also being explored for various applications.

The sensor realization technologies details, their point-of-care, early diagnostic and environmental monitoring applications will be discussed.

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Prof. Dr. Rao Tatavarti

Indigenous Design and Development of Photonic System for Real Time Air Quality Monitoring

Prof. Dr. Rao Tatavarti had his Masters from the Indian Institute of Technology Madras and Ph D from the Dalhousie University, in Canada; and possesses more than 35 years of professional R&D and teaching experience at various national and international institutes, having worked with leading Scientists, Engineers and Technologists in Asia, North America, Europe and Russia. After 19 years of R&D in DRDO India, he voluntarily retired as a Senior Scientist and Program Director, to join the academia as a Senior Professor and Director at VIT University. Dr. Tatavarti is now Director and Senior Professor at GVP Institutes.

Dr. Tatavarti's research interests are varied, covering many interdisciplinary disciplines. He had supervised many PhDs and Masters' students in various fields of Engineering & Sciences, interlaced with many years of graduate level teaching at Dalhousie University, Canada; Cochin University, VIT, U of H and at Gayatri Vidya Parishad, India. Dr. Tatavarti has contributed more than 180 research publications in refereed journals, conference proceedings, and peer reviewed research reports. Dr. Tatavarti published two monographs, 1 book chapter and has 7 International / National Patents.

Dr. Tatavarti was the recipient of many national and international fellowships and awards. In October 2010, Dr. Tatavarti founded CASTLE, a non profit scientific society and think tank at Visakhapatnam and is currently its Executive Director. Since December 2010, Prof. Tatavarti is member of Gayatri Vidya Parishad Senior Management. Prof. Tatavarti served as the Regional Director of National Maritime Foundation - a think tank of the Indian Navy during 2011-2013. Prof. Tatavarti founded CATS group of companies dealing with advanced Technologies and Systems company in 2015.

Prof. Tatavarti was elected as Fellow of AP Academy of Sciences in 2017.

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Prof. (Dr.) Tanya Singh

Social Empowerment of Rural India through Digital Technologies

Prof. (Dr.) Tanya Singh, has wide experience of over 20 years in the field of Teaching, Research, Consultancy & Planning and Development in Education and Operational role outs in Academics, she has emerged as Technical Evangelist for Networking, Cyber Security and IoT. Her primary motivation is teaching and learning new technologies, assist and develop the knowledge amongst students, instructors by encouraging critical thinking, implementation and ability to convert technologically innovative ideas into social and sustainable innovation. She has many awards to her credit. She was Awarded by Cisco Inc. for 10 years of active participation and service in the Cisco Networking Academy Program in the year 2018 and 2019 again.

Awarded "Instructor Excellence Award" from Cisco Networking Academy in 2018. Awarded "Instructor Expert Advanced Award" from Cisco Inc. in 2019. Awarded by Cisco Inc. for contribution to the Skill Development Program in Rajasthan, India in the year 2016. She is an Expert in ISO 9001:2008 /ISO 14001:2004 Quality Systems. She was awarded with a Certificate of Appreciation for Contribution towards building Quality by Amity University in 2008. She is a Serving member for Bureau of Indian Standards – LITD 14 (Software and Systems Development) Serving member for Bureau of Indian Standards – LITD 27 (Internet of Things) /LITD – 30 (Artificial Intelligence). She is also an Expert in Outcome Based Education/Implementation of Outcome Assessment Plan.

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Dr Fakhrul Hazman Yusoff

Online Community Its Peril and Opportunity

Biography

Dr Fakhrul Hazman Yusoff is a senior lecturer in Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA. He is also a recipient of US-Asean Fulbright visiting Scholar for 2017/2018 and Visiting Full Professor at Southern University, Baton Rouge, Louisiana. He graduated with B.Sc. (Management – Information System) from Case Western Reserve University, Ohio, USA (1998). He earned his M.Sc. (Information Technology) from Universiti Putra Malaysia, Malaysia (2001) and obtained his Ph.D. in Computer Graphics (2010) also from Universiti Putra Malaysia, Malaysia.

He was the Chair of the IEEE Malaysia Computer Chapter from 2014-205 and Computer Society IEEE Distinguish Visitor under IEEE Distinguish Visitor Program for the term 2017-2019 whereby he gave lectures to institutions around the world under the banner of IEEE. He is currently the President for Fulbright Alumni Association Malaysia for the term 2020-2022. In term of research, he is focusing on several areas including Gamification, IoT and Blockchain with his latest endeavour includes implementation of the said areas in supply chain and cloud environment. He is an AWS Certified Cloud Practitioner since 2020. All and all he is always on the look-out to leverage the knowledge he acquired through-out his 20+ years of working experiences for the betterment of society in general.

Abstract

The vision of having an enabling platform for the purpose of formal and informal human socialization has been touted since the day of telecommuting in 1970's. The growth of Internet beginning from mid-80's made this vision inches nearer towards reality. In the span of 35 years, as Internet grow by leap and bound, concepts such as cloud sharing and video conferencing are no more out of reach. In fact, their usage has become ubiquitous in the society. The pandemic of Covid-19 has revolutionized its usage forever. With the mandate of Work from Home, Teaching & Learning from Home and international physical travel ban, everyone turn to online technology for their work life and social need. Being in such a revolutionary situation, certain conventional non-online practices have been by-passed and disrupted to make way for online parallels.

Therefore, the question will be doing the change lead to a more positive outcome for the community or the opposite. The keynote will look at the growth of the online community post pandemic and highlights its positive and negative aspects. The keynote also will look at research opportunities as well as innovations that can be introduced to suit these phenomena.

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IETE CHENCON2021

International Conference on Power of Digital Technologies in Societal Empowerment

JUNE 4 & 5, 2021

JUNE 4, 2021, Time: 11.20 – 13.00
PTS 11: Communication and Networking
meet.google.com/rgg-gxep-ixv

Technical Program at a Glance

JUNE 4, 2021, Time - 11:20- 11: 40, Paper ID: IC 19

Comparison *and Analysis of Pietra-Ricci Index Detector for Cooperative Spectrum Sensing*
PL. Uma Maheswari, G.T. Bharathy
Jerusalem College of Engineering, Chennai

JUNE 4, 2021, Time - 11:40- 12:00, Paper ID: IC26

6G with Quantum Technology and Intelligent Reflecting Surfaces
Charu Jain, Gundepudi V Surya Sashank, Indu S, Venkateswaran. N
Sri Sivasubramanya Nadar College of Engineering, Chennai.

JUNE 4, 2021, Time - 12:00- 12: 20, Paper ID: IC35

Analysis of OFDM Based Orthogonal and Non-Orthogonal Modulation for Cognitive Networks
G.T. Bharathy, V. Rajendran
Jerusalem College of Engineering, Chennai.

JUNE 4, 2021, Time - 12:20- 12: 40, Paper ID: IC49

Performance Analysis of TSTW FD-NOMA Cooperative Communication with SIC for 5G Wireless Systems and Beyond

Ganapathy Ram B, Shalini Punithavathani D, Tamil Selvi S
National Engineering College, Kovilpatti, Thoothukudi, Tamil nadu.

JUNE 4, 2021, Time - 12:40- 13: 00, Paper ID: IC25

Sea Border Detection and Ship Tracking System
Geethy Mary Sam, K.Anusudha
School of Engineering and Technology,Pondicherry University

JUNE 4, 2021, Time: 11.00 – 13.00
Track PTS 12: Machine Learning and Artificial Intelligence
meet.google.com/fjg-kbzq-myc

JUNE 4, 2021, Time - 11:00- 11:20, Paper ID: IC46

Improved Navigation and Positioning Using Machine Learning
Eswaran Parthasarathy, Aman Agarwal, N. Diwakar
SRM Institute of Science and Technology

JUNE 4, 2021, Time - 11:20- 11:40, Paper ID: IC08

Audio Visual Emotion Recognition in Children
Kiruthiga P, Rajavel R
SSN College of Engineering

JUNE 4, 2021, Time - 11:40- 12:00, Paper ID: IC14

Fortification of Commercial Buildings with Improved Security System by Integration of GSM Module with the Yolov5 and OpenCV
R.G.Sharath Kumar, S.Adithya Subramani, V.Rithika, N.Jayapreetha, D.Swetha
Sri Sairam Engineering College

JUNE 4, 2021, Time - 12:00- 12: 20, Paper ID: IC39

Recognition of Facial Expression Based on Multi Branch Structure
Agilan G , Akash A , Aswath Subramonian K
Rajalakshmi Engineering College

JUNE 4, 2021, Time - 12:20- 12: 40, Paper ID: IC41

Data Visualization Tool for AI Orange - A Contextual Study
Dr. Sagaya Aurelia P, Dr. Felcy Judith
Christ University

JUNE 4, 2021, Time - 12:40- 13: 00, Paper ID: IC44

Weather Prediction Using Machine Learning
Thondapu Tusharika, A Vinnarasi , Devalam Sree Sai Bindu, Prasanth Reddy Duvvuru
SRM IST, Chennai

JUNE 4, 2021, Time: 15.10 – 16.30
Track PTS 13: Signal, Image and Video Processing
meet.google.com/rgg-gxep-ixv

JUNE 4, 2021, Time - 15:10- 15:30, Paper ID: IC20

3D Image Segmentation using Deep Learning Techniques
Anusuya V, Madhushree J, Rajee K
Ramco Institute of Technology

JUNE 4, 2021, Time - 15:30- 15:50, Paper ID: IC21

Deep Learning Architectures for Multi-Class Artefacts Segmentation in Endoscopic Images: A Review
Kirthika N, Sargunam B
Avinashilingam Institute for Home Science and Higher Education for Women

JUNE 4, 2021, Time - 15:50- 16:10, Paper ID: IC23

Segmentation and Classification of Brain Tumour Using Convolutional Neural Network and Arduino
Agnes Shifani S, Dhuvaridha V, Lalitha M ,Maniyammai L, Nivetha N
Jeppiaar Maamallan Engineering College

JUNE 4, 2021, Time - 16:10- 16:30, Paper ID: IC37

A Secret Key Generation Using Double Chaotic Maps and Hash Algorithms for Image Encryption
Guda Venkata Kaushik, Giridaran S, G Naga Lohith Reddy, Dr. G.A Satish Kumar, T J Jeyaprabha, R Kousalya
Sri Venkateswara College of Engineering

JUNE 4, 2021, Time - 16:30- 16:50, Paper ID: IC42

Image Dehazing by Using Laplacian Approach with Contrast Adjustment
Mrs.R.Dharani ,Archana.K, Nivetha.K, Dhatri.E.R
Panimalar Institute of Technology

JUNE 4, 2021, Time: 15.10 – 16.30
Track PTS 14: IOT and Embedded Systems
meet.google.com/fjg-kbzq-myc

JUNE 4, 2021, Time - 15:10- 15:30, Paper ID: IC03

Smart Handbag for Women Safety Using Raspberry Pi and Arduino
Ilakiya G
IFET College of Engineering

JUNE 4, 2021, Time - 15:30- 15:50, Paper ID: IC16

IOT Based Automated Energy Meter with Multiple Applications
Aarthi S, Adheeba Vaseela M, Induja N, Vanmathi M.
B S Abdur Rahman Crescent Institute of Science and Technology

JUNE 4, 2021, Time - 15:50- 16:10, Paper ID: IC22

Implementation of SHA Algorithm
Abisha A, Devapriya G S , Suganthi Evangeline C
Karunya Institute of Technology and Sciences

JUNE 4, 2021, Time - 16:10- 16:30, Paper ID: IC34

FPGA based Implementation of Real Time Event Mark for Video Surveillance
Chappidi Sai Sudha, Keerthana G S, Shaik Adil Hussain, Janani.S, S. Anusooya
B.S.Abdur Rahman Crescent Institute of Science and Technology

JUNE 4, 2021, Time - 16:30- 16:50, Paper ID: IC48

Implementing Smart Farming Based on IOT Using Machine Learning
Puli Santhosh Siddartha, Paruchuri Bhargav Sandeep, Ambati Sujith Raju, A Vinnarasi
SRM IST

JUNE 5, 2021, Time: 11.00 – 13.00
Track PTS 21: Emerging Digital Technologies
meet.google.com/rgg-gxep-ixv

JUNE 5, 2021, Time - 11:00- 11:20, Paper ID: IC11

Social Distancing Kit
Challa Rishika , R Preethi , Mopuru Lakshmi Likhitha , Mrs Suganthi Evangeline
Karunya Institute of Technology and Sciences

JUNE 5, 2021, Time - 11:20- 11:40, Paper ID: IC27

Digital Signature Verification for Cloud Storage using ECC
Vimalraj P, Vishnu Vardhan H, Vuppalapati Chenchu Ujwal
Sri Venkateswara College of Engineering

JUNE 5, 2021, Time - 11:40- 12:00, Paper ID: IC29

Décor: Augmented Reality Based Application to Enhance Interior Designing using Marker-Less Tracking
Gullapalli Lakshmi Swaraj, Gayatri Kp, Kavitha Subramani
Panimalar Engineering College

JUNE 5, 2021, Time - 12:00- 12: 20, Paper ID: IC31

Block chain in Food Supply chain
Shivaanivarsha N,Shyamkumar M,Devipriya P,Dharini V K
Sri Sairam Engineering college

JUNE 5, 2021, Time - 12:20- 12: 40, Paper ID: IC40

Analysis of Texture Features of Normal Brain and Glioma in MRI Images
Vaishali P, Jaspin K, Shirley Selvan
St.Joseph's College of Engineering

JUNE 5, 2021, Time - 12:40- 13: 00, Paper ID: IC47

Faculty Attendance Monitoring System Using Facial Recognition
Akram Mohammed, Abhishek.S, Misbahullah Sheriff & S.Sadhish Prabhu
B.S Abdur Rahman Crescent Institute of Science and Technology

JUNE 5, 2021, Time: 11.00 – 13.00
Track PTS 22: Sensors, Circuits and Healthcare
meet.google.com/fjg-kbzq-myc

JUNE 5, 2021, Time - 11:00- 11:20, Paper ID: IC06

Electronic Nose System for Protecting Workers in Sewage System
Vidhya G, Subiksha C.P, Rajalakshmi B, Vanitha K
Sri Sairam Engineering College, Chennai

JUNE 5, 2021, Time - 11:20- 11:40, Paper ID: IC24

Monitoring Bio Parameters of Sea Researcher Using LIFI
Liya George, K Anusudha
Pondicherry University

JUNE 5, 2021, Time - 11:40- 12:00, Paper ID: IC28

First Response Drone
S. Prem Raj, Lokesh S, S.V. Kumaran, Dr. S. Ganesh Vaidyanathan
Sri Venkateswara College of Engineering

JUNE 5, 2021, Time - 12:00- 12: 20, Paper ID: IC32

An Ultra-Low Power integrated circuit design for Implantable Medical Devices (IMDs)
B Sathyabhama, M Kannan
Panimalar Engineering College

JUNE 5, 2021, Time - 12:20- 12: 40, Paper ID: IC36

Implementation of Smart Vehicle Collision Warning System under V2V and V2P concepts using BLE and GPS
Syed Ameer Abbas S, Mahalakshmi Pm, Janani Ch
Mepco Schlenk Engineering College

JUNE 5, 2021, Time - 12:40- 13: 00, Paper ID: IC53

Detecting Brand Level Extremist Reviewers and Obstructing False Promotion
Nithya S, Sripriya N
Prathyusha Engineering College

JUNE 5, 2021, Time: 15.10 – 16.30
Track PTS 23: Micro wave, Antennas and Fiber optics
meet.google.com/rgg-gxep-ixv

JUNE 5, 2021, Time - 15:10- 15:30, Paper ID: IC05

Using ITOS with Mixed Silver for Different Perspex Thickness in a Solar Cell Antenna
Mr. Ramkumar V, Dr.Vennila.C , Mr.Syed Akbar S
K Ramakrishnan College of Technology

JUNE 5, 2021, Time - 15:30- 15:50, Paper ID: IC09

Design of Dual-Band Microstrip Antenna for Bluetooth and Wimax Applications
Surendra Kumar Painam, Gafoor Baig, Sri Bindu Ch, Harish Kumar D, Sai Teja D, Mahesh Babu A
Bapatla Engineering College

JUNE 4, 2021, Time - 15:50- 16:10, Paper ID: IC10

Design and Analysis of Dualband U-Slot Microstrip Antenna for Bluetooth and Satellite Applications
Surendra Kumar Painam, Viswasree Marri, Siva Kumar Palavalasa, Aslesha Reshma Macherla, Lakshmi Mounika Karani, Teja Kumar Kadem
Bapatla Engineering College

JUNE 4, 2021, Time - 16:10- 16:30, Paper ID: IC54

Analysis of SURF Algorithm in Copy-Move Forgery Detection
Ms. S Monika and Ms. R Kannamma
Prathyusha Engineering College

Smart Handbag for Women Safety Using Raspberry Pi and Arduino

Ilakiya G.[1], and K. Sagadevan[2]

[1,2]ECE Department, IFET College of Engineering, Villupuram, India

[1]ilakiyasowmiya@gmail.com, [2]sakakec@gmail.com

***Abstract*–IoT is the network of related devices which are embedded with sensors, computing and digital devices which can communicate among themselves for sharing information across the globe over the internet. Women Safety is a crucial thing that lacks in our country. Even a small kid also got raped by some heartless fellows. Even though the Government frames a lot of laws against women abuse still it is happening as usual and also there is no strict action taken against it. The rape victim only got affected by this worst incident and faces lot of discriminations. But the person who is the reason for abusing will be set free and also there is no strict laws to punish them. A recent research says that for every 29 minutes a woman got raped in our country. So our idea will be very effective as it automatically gets activated with a single pull of a handle of the bag or by pressing the button. This paper suggests a smart handbag that will help them in an emergency situation. It consists of GPS module, GSM module and camera module which are being connected with Raspberry Pi board and Arduino. So women in trouble situation can make use of this device and even harm the attacker and escape from them.**

***Index Terms*–Women safety, IoT, GPS, GSM, electric teaser, smart handbag, shock absorber.**

I. INTRODUCTION

Nowadays women come across many physical harassment are happening these days which is increasing day by day. Many women are facing physical and sexual harassment in public places, streets and public transport. Even in working areas, they face a lot of issues. Crime against ladies like threats, sexual assault, emotional abuse, management and masterful, intimidation, stalking and economic deprivation, rape, abduction, snatch and murder .But despite the introduction of stricter laws, around one hundred sexual assaults square measure according to police within the country daily. Rape is that the chop-chop increasing crime within the Republic of India. Personal safety has become a major drawback for everybody, however particularly for ladies. A recent survey created by United Nations agency indicates 5% of girls are globally facing some style of abuse and physical assault. The count of victim is step by step increasing. Because of these issues, some of the women get discouraged and feel demotivated. This is largely happening in developing countries when compared to developed countries. Though women have done a lot of achievements, serviced in high accomplishments and have even served India as higher officials still they require some security. The security won't be a 24 * 7 guard protection around them. So it's better to have some sort of safety device which they are comfortable to have with them without expecting other's help and protection. There are many apps developed to help women in alerting the family members and also some apps show their locations in an confidential manner.

Reach 360 [11] is an app developed by girl students which is useful in sending the exact location of the person who is in trouble using GPS. We can also use this app for searching our stolen phones. Tahmidul kabir, Mamun mizan and Tasneem developed an IoT device with an android app [1]. Whenever an incident occurs, this app will send the user's location to the nearby police station and volunteers. The device is capable of work with or without internet .So that without internet, victim can get to know the safest location nearer to them. WoSApp(Women's Safety App) [12] is a mobile app which helps women to contact the police. They can call the police by simply shaking their mobile phone and also alert the guardian of the person by just pressing the panic button. At the moment of pressing it, it sends the geographical location immediately to the pre-selected contacts.

This project introduces a smart handbag to the users that they can use it to warn their family members, get help easily and immediately. Section 2 consists of the related works. Section 3 of this paper has the existing methodology followed by proposed methodology in section 4. Section 5 has the conclusion.

II. RELATED WORKS

Prottasha Ghosh, Tanjim, Muhib, Emran, Rabuil, Rokib, Tanvir designed a smart security device using raspberry pi. It helps to collect evidences related to the incident and also sends the location along with an alert message [3]. It's very compact and comfortable to wear as their undergarments. Kavitha and Sivachidambaram developed an IoT based Women self protecting system [4] which will help the victim whenever an abnormal situation is predicted using biosensors and send the victim's location immediately. A smart band[7]

which is united with several sensors to sense the victim's location, body posture, pulse rate through SMS to alert their family members.

NitiShree described a smart GPS device[8] to safeguard the individual by using the image and vedio metadata. An IoT based smart wearable device[2] will help the victim to get help in emergency situation with the help of various sensors and the device automatically sends the location along with a emergency message to the police station. A fitness band[5] to sense the sudden rise and fall attack in heart rate of the affected patient by various sensors and alert the trusted contacts and emergency services automatically even after if the band destroyed it is able to send the alert.

A smart shoe[10] which will send the location of the victim along with an emergency message and shock circuit is also there to distract the attacker. A smart ring (SMARISA)[6] was activated by a button and sends the victim's location along with the picture of the attacker using Raspberry Pi. Vijayalakshmi proposed a smart watch[9] which will increase the safety of women by using the GPS and GSM devices along with a buzzer and microcontroller.

A smart safety wearable band [14] for women which is a integration of many devices with a Bluetooth connected webcam facility. It continuously tracks some data like movement, heart rate, O_2 level, call log, messages etc. On few seconds continuous pressing of SOS button, it makes a signal to generate corresponding to the data and send it to the smart phone. Then location and emergency message with the culprit photo to their relatives or nearby police station.

A smart security technology [13] was designed with stable continuous communication with a smart phone with an internet facility. It gets activated based on human behavior and reactions so that it can generate signal accordingly and sends it to the smart phone. On self-activation of the device, it sends the location and alert message to the predefined numbers.

III. Existing System

This paper introduces a smart device which is used to safeguard women. It mainly concentrates on the security of women so that they don't need to worry about their safety. It includes some modules which are the GPS module, GSM module and camera module etc. The core idea of this project is alerting the already stored emergency contacts by simple press of an emergency switch which is present in the side bottom of the shoe. At the moment of pressing the alert switch, the GSM and the GPS modules will together send the location of the victim who is in danger to the specified contacts. In addition, the device is provided with the shock circuit which will be useful to give shock about 400KV to the attacker and buys the enough time to flee from them.

At the event of pressing the switch the camera starts to record the incident happening around the victim and it is also used for future reference to catch the attackers. Then a link will be sent to the guardian using Amazon net Services which enables live streaming otherwise we can use our google drive to store the video and send it as a link to the guardian. The battery utilized in this shock circuit will be self-charged using piezoelectric sensors which is connected nonparallel at the side of shoe. The frequently utilized controllers are the Arduino and Raspberry pi. If a girl or a women travelling alone and faces a danger that time she can make use of this device.

IV. Proposed System

This paper introduces a smart handbag which consists of an automatic activation system within to protect woman from dangerous situation. It consists of shock absorber in the handle bar of the handbag. So which when forcefully pulled by the attacker the shock absorber will convert the pulled force into electrical energy which enough to automatically activate the emergency switch. The shock absorber will convert the kinetic energy into electrical energy. Because of this automatic activation we don't need manually switch on this device. Even with the tied hands we can able to activate the system by just forcefully pulling the handle.

- After this automatic activation, the emergency switch get turned on by utilizing the electric supply provided by the shock absorber.
- Then, the GPS and GSM module will work together to send the exact location of the victim to the pre-stored contacts.

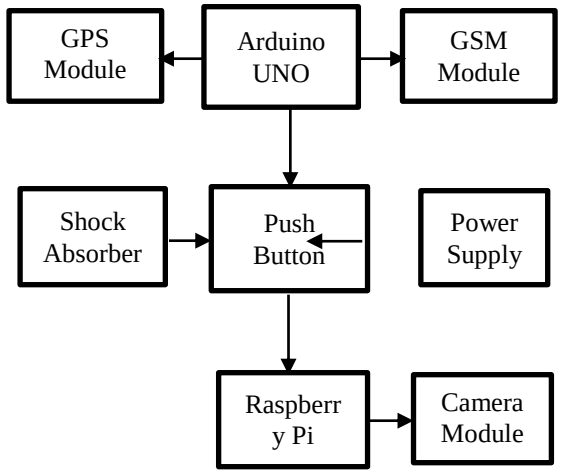

Fig. 1. Block Diagram of the proposed model.

- The camera module also started to record the video. The 30sec video clips get stored in the google drive using Motioneyeos.
- So that with the help of the GSM, we send the video clips as a link to the pre-stored emergency contacts.
- This video will be very helpful for police department to find the culprit or attacker quickly.
- Additionally, a electric stick will be attached with the handbag. At the moment of pressing the emergency switch, the electric stick will be coming out from the handbag.
- So women can use this electric stick to give shock to the attacker and will get enough time to escape from the dangerous situation.

- The stick will generate 400kV shock. The electric stick will be compact and very handy to keep it in the handbag.

Fig. 2. Circuit diagram of the model.

If a woman is travelling alone and when faces some danger can press the emergency and ask for help. The proposed system is very handy and it will not be extra weight carried for the safety purpose.

Fig. 3. Camera module.

V. CONCLUSION

The life securing effective handbag can be available in an exceedingly good value and provides advantages for its lifetime. Women can no longer worry about their safety while travelling alone. They can carry this safety device with them which will provide confidence and greatly help them out in a critical situation. With the help of GPS tracking technique, the process for finding the victim become more simple. Also an alert message will be send to the preprogrammed numbers so that the victim will get help from nearby police station. Ladies won't tend to feel helpless any longer and might walk out whenever they desire to go out during day or night without bothering about their safety and security. Our projected system is extremely sturdy and provides good, fast and consistent results.

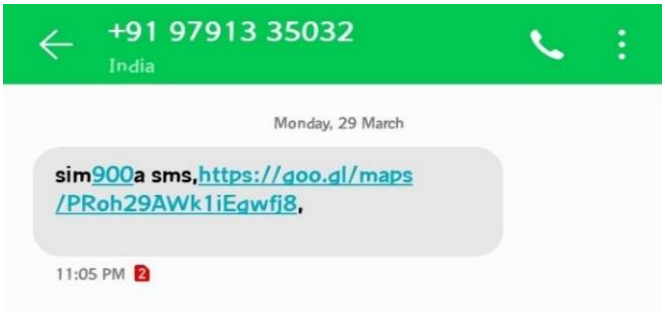

Fig. 4.Sample SMS.

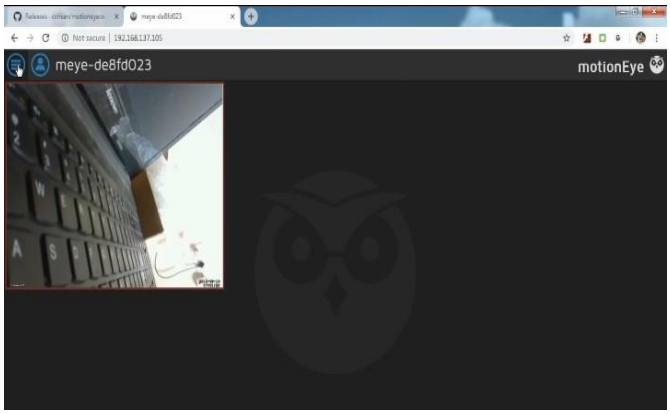

Fig. 5. Vedio streaming.

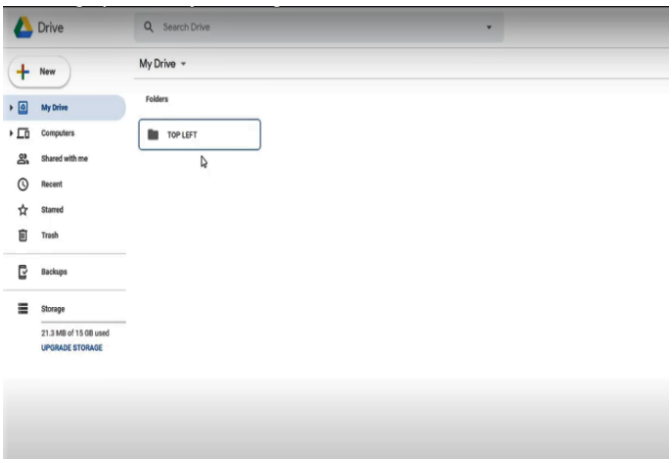

Fig. 6. Files stored in google drive.

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Using ITOS with Mixed Silver for Different Perspex Thickness in a Solar Cell Antenna

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***Abstract*—Solar cell antenna is defined as the combination of solar cell and microstrip antenna. This is used for transceiver communication. To design the solar cell antenna, it requires RF and optic. To generate DC power supply and produce RF signals, it used the indium tin Oxide mixer silver hybrid patch and then compare for different Perspex thickness. The experimental results calculated the reflection coefficient, power gain and directivity for the proposed technique as circular hybrid patch using ITOS with mixed silver and respective graph also plotted.**

***Index Terms*—Solar cell, microstrip antenna, ITOS, reflection co-efficient, indium Tin oxide mixed silver, hybrid patch.**

I. Introduction

The major application of the solar cell antenna is satellite, vehicular system and environmental monitoring system. There are different types of antennas are used in the car windshield. The types are gridded circular patch [1], optically transparent microstrip patch [2], optically transparent microstrip slot and meshed patch integrated antenna [4]. For satellite communication, combine the antennas and solar cell. Meshed patch antenna [7] can use for the satellite communication. Metal plate solar cell antenna [9] is used for the Pico cellular base station for cellular communication [11]. Generally antenna is made up of conductive transparent films, through this can transmit the data using optical communication. For optical transmission [8], it used the ultra-wideband antenna. It can achieve higher bandwidth. This study is used to design and performance of the flexible UWB [10] antenna is analysed. Silicon solar cell antenna [12] used the full band optical absorption. This technique will increase the polarization and it uses the plasmatic back contact grating [13].

II. Comparison of Solar Cell and Antenna

In solar cell and micro strip antenna, subtract, coaxial port and ground plane is similar for both the solar cell and microstrip antenna. Microstrip antenna is used the upper part silicon wafer of solar cell. That will be used to receive the light from the solar cell. Microstrip antenna's metallic plate is used to Trans receive the electromagnetic waves. Solar cell antenna has the structure as microstrip antenna is placed above the solar cell. Indium tin oxide mixer silver is placed in the microstrip antenna. This will help to interleave the light from the solar cell. From this light and electromagnetic waves can generate the DC and RF.

III. Solar Cell Equivalent Circuit

Simulation results of solar cell antenna equivalent circuit are high compared with the solar cell antenna electronic work bench. Compared parameters are current, voltage and power. Current is denoted as I and the unit is amperes I=872.8mA. Voltage is denoted as V and the unit is volts V=8.728mV. Power is denoted as P and the unit is watt P=7.6177984mW. Using this parameters can able to design the solar cell antenna.

IV. Analysis of Solar Cell Antenna Parameters Using Circular Hybrid Patch ITOS with Mixed Silver ads Simulated Results Comparison for Different Perspex Thickness

A. Comparison of Reflection Co-efficient ITOS with Mixed Silver Hybrid Patch Solar Cell Antenna for Perspex thickness t=3,3.5 mm

TABLE I. Reflection co-efficient values in DB of ITOS with mixed silver hybrid patch comparison

Frequency (GHz)	ITOS with Mixed Silver Hybrid Patch S11 (dB), t=3 mm	ITOS with Mixed Silver Hybrid Patch S11 (dB), t=3.5 mm
1.5	-1.5	-1.2
2	-2	-0.7
2.5	-2.05	-0.5
3	-2.1	-0.55
3.5	-2.2	-0.6
3.9	-3	-1.4
4	-4	-1.5
4.5	-5	-1.55
4.6	-6	-3.9
5	-14	-2.5
5.4	-15	-1.75
5.5	-14	-1.76

Table I shows that the reflection coefficient of indium tin oxide mixer silver hybrid batch solar cell antenna for Perspex thickness t=3,3.5 mm is ADS simulated results comparison. This frequency ranges from 1.5GHz to 5.5GHz. Radiation is inversely proportional to the reflection coefficient. ITOS with mixed silver hybrid patch gives the high reflection coefficient. When the radiation decreases, reflection coefficient will increase. This will be shown in Fig. 1.

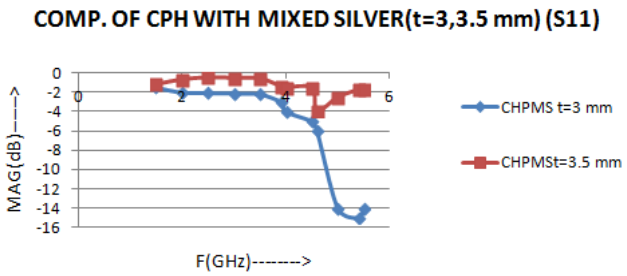

Fig. 1. Comparison reflection co-efficient values of ITOS with mixed silver Hybrid patch for Perspex thickness t=3,3.5 mm.

B. Comparison of Gain of ITOS with Mixed Silver Hybrid Patch Solar Cell Antenna for Perspex Thickness t=3,3.5 mm

Comparison of Gain the proposed technique hybrid patch ITOS with mixed silver is simulated with the ADS is shown in Table II. It will give the better gain and signal strength. The proposed technique gives the high signal strength and high gain.

TABLE II. COMPARISON GAIN VALUES IN DB OF ITOS WITH MIXED SILVER HYBRID PATCH

ITOS with Mixed Silver Hybrid Patch G(dB) t=3 mm	ITOS With Mixed Silver Hybrid Patch G(dB) t=3.5 mm
-3.0716	-3.0716

C. Comparison of Power ITOS with Mixed Silver Hybrid patch Solar Cell Antenna

Likewise, power of the ITOS with mixed silver hybrid patch value is simulated using ADS which is shown in Table III. This results shows that the proposed ITOS with mixed silver hybrid patch gives the high power and high signal strength. High power provides the high signal strength.

TABLE III. POWER VALUES IN WATT OF ITOS WITH MIXED SILVER HYBRID PATCH FOR PERSPEX THICKNESS T=3,3.5 MM

ITOS with Mixed Silver Hybrid Patch P(W) t=3 mm	ITOS with Mixed Silver Hybrid Patch P(W) T=3.5 mm
0.00000431572	0.00000431572

D. Directivity of ITOS with Mixed Hybrid Patch Solar Cell Antenna for Perspex Thickness t=3,3.5 mm

Here, compare directivity of ITOS with mixed silver hybrid patch for Perspex thickness t=3,3.5 mm is simulated using ADS which is shown in Table IV. This results shows that the proposed technique gives better directivity. When the directivity increases, signal strength will increase. This signal strength will be high in one direction.

TABLE IV. COMPARISION OF DIRECTIVITY VALUES IN DB OF ITOS WITH MIXED SILVER HYBRID PATCH FOR PERSPEX THICKNESS T=3,3.5 MM.

ITOS with mixed silver Hybrid Patch D(dB) t=3 mm	ITOS with mixed silver Hybrid Patch D(dB) t=3.5 mm
6.53603	6.53603

E. Simulated ADS Model of ITOS with Mixed Silver Hybrid Patch Solar Cell Antenna Comparison

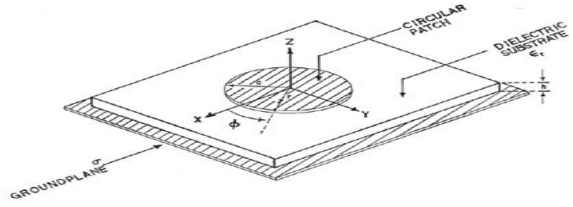

Fig. 2. Circular patch.

Figure 2 shows the circular patch Microstrip antenna. Fig. 3 shows that the design of ITOS with mixed silver hybrid patch using ADS simulation software in two or three dimensional. Two dimensional of ITOS with mixed silver hybrid patch solar cell antenna and three dimensional of ITOS with mixed silver hybrid patch solar cell antenna has designed in Fig. 3.

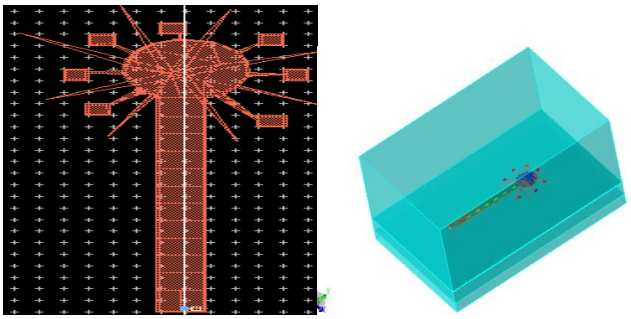

Fig. 3. Shows that the design of ITOS with mixed silver hybrid patch for Perspex thickness t=3,3.5 mm for comparison.

$$a = \frac{F}{\left\{1+\frac{2h}{\pi\varepsilon F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right\}^{\frac{1}{2}}} \quad (1)$$

$$a_e = a\left\{1+\frac{2h}{\pi\varepsilon_r a}\left[\ln\left(\frac{\pi a}{2h}\right)+1.7726\right]\right\}^{1/2} \quad (2)$$

$$\text{Where } F = \frac{8.791\times10^9}{f_r\sqrt{\varepsilon}} \quad (3)$$

The radius a, effective radius a_e is denoted in equation 1and 2, equation 3 shows that the frequency formula for the comparison of ITOS with mixed silver hybrid patch solar cell antenna for Perspex thickness t=3,3.5 mm.

V. CONCLUSION

Proposed technique of ITOS with mixed silver hybrid patch solar cell antenna is simulated using ADS simulation software and then compare for different Perspex thickness. From that it obtain the results. This experimental results gives the better performance of the ITOS with mixed silver hybrid patch solar

cell antenna comparison to choosing different application. This proposed technique has high transparent conducting film. Due to this better results can used this ITOS with mixed silver hybrid patch solar cell antenna for many communication applications. This proposed technique of ITOS with mixed silver hybrid patch solar cell antenna is used to generate direct current DC and this will be used for the transceiver for radio frequency RF signal.

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Electronic Nose System for Protecting Workers in Sewage System

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***Abstract*—In many parts of the country, the sewage system is not properly maintained, cleaned and kept hygienic. The toxic gases underground is the root cause of the health impact on workers as they are being exposed to it in various situations and eventually leads to death. These gases have to be monitored such that increase in the normal level of them could be known and proper precaution measures can be undertaken. The hazardous gases can be sensed using methane gas sensor and air Quality monitoring gas sensor and, tracking heart beat rate sensor and respiratory rate sensor helps to monitor the condition of the sewer laborers. If one of the gas sensors' value or one of the worker's health condition monitoring sensors exceeds the normal level, then an alarm is generated immediately at the worker side and also the data is sent to the authorized administrator of the health center by logging in to the webpage with authorized user ID and password and also the worker is facilitated with necessary first aid through oxygen supply system in case of emergency.**

***Index Terms*–Methane gas sensor, air quality gas sensor, temperature sensor, respiratory sensor, heart beat rate sensor**

I. INTRODUCTION

Manual scavengers continue to lose their lives due to the inhalation of toxic gases inside the drainage. Also, leaks and bursts are unavoidable aspects that account for significant loss if left undetected for long period. This proves inadequacy of proper drainage monitoring system. It is very important that drainage system should be maintained to keep the city clean, safe and healthy. So different kind of work has been done to detect, maintain and manage this drainage system. In the existing system, the sewage system is monitored only through an algorithm-based approach and the lives of sanitation workers are not given much importance. In the proposed system, there are two objectives. The first objective is to obtain an effective low-cost and flexible solution for checking the sewage system and sensing the toxicity of gases and updating in the real time using IoT. The second objective of this system is to provide proper safety measures for the workers working in the same environment and updating the data through IoT. This system uses methane gas sensor and an air quality monitoring sensor for determining the toxic gases and a temperature sensor to find out the humidity of the surroundings. On the worker side, we have a heartbeat rate sensor and a respiratory sensor that keeps track on the worker's health condition. All these data, displayed in a webpage are continuously monitored by the nearby health department. In case of any emergency, we have Zigbee transmitter and receiver section that stimulates an alarm and a support system for providing immediate oxygen supply to the workers.

II. LITERATURE SURVEY

Smart sewage alert system for workers in real time applications using IoT [1]. This paper provides a method to measure the water level and the toxicity of gases. The alert message is sent through GSM module.This method identifies the toxic gases but does not give importance to worker's life.

IoT based smart safety monitoring system for sewage workers with two-way communication[2]Smart sewage monitoring system for sewage workers with two-way communication [3] have designed a real time health monitoring device that monitors the gas levels and the worker's health condition. It provides alert message to the worker and exterior unit while in our proposed system, the real time values are updated in a webpage.

Sewage level maintenance using IoT [4] IoT device for sewage gas monitoring and alert system [5]. In this paper, various gas sensors are used to monitor the parameters. The GSM module and Thing-Speak (IoT) in this system is replaced by Zigbee module and Webpage in our proposed system.

IoT based sewage monitoring system [6]

IoT based underground drainage monitoring system [7] In these papers, whenever the gas level crosses the threshold value, the information with different gas ppm values is displayed in the smart phone through an app. In our proposed method, a Webpage has been created for this purpose which is accessible from anywhere and by anyone.

IoT based smart drainage worker safety system [8] In this paper, Remote sensor frameworks (WSN) is used for monitoring the level of water and to check if any blockage has occurred. The MQ4 sensor and raspberry pi 3 are used for monitoring the gas levels. The results are updated in graphical format and a SMS is sent through GSM module which

becomes a disadvantage because in our proposed system, the webpage clearly provides the gas ppm values and can be accessed through a simple user ID and password.

Wireless sensing system for the welfare of sewer laborers [9] In this paper, an alert warning message is sent to the nearby health center to provide necessary first aid by the authorized team members. But in our proposed system, a support system providing immediate oxygen supply for the workers is arranged at the workplace location.

III. Existing System

In the existing system, monitoring the conditions of the sewage system is made possible and, the data is given to the control unit but the sewage workers working in the same environment is not given any protection. For the monitoring of the sewage system, algorithm-based approach is being utilized.

IV. Proposed System

In this paper, the system is divided into two categories: workplace side and worker side. The workplace side consists of gas sensors like Methane gas sensor(MQ4), air quality monitoring gas sensor(MQ135) which are used to determine the toxic gases under the drainage system. In addition, a temperature sensor is also used to monitor the temperature of the surroundings underground. The data is sent to the Arduino uno board and the output is displayed inthe IoT module(web page) through a wi-fi based ESP8266 microcontroller. The worker side provides security to the workers life by using the respiratory sensor and the heart beat sensor and the data is displayed in the IoT module. The webpage is continuously monitored by the nearby health department. When the gas sensor values in workplace side reach an abnormal level, the Zigbee transmitter sends a signal to the Zigbee receiver on the worker side which stimulates the alarm to alert the workers. There is also a support system for the worker which is driven by a SMPS battery and a compressor valve to supply oxygen. The diagram of the entire proposed system is as shown in the Figs. 4.1, 4.2, 4.3 respectively.

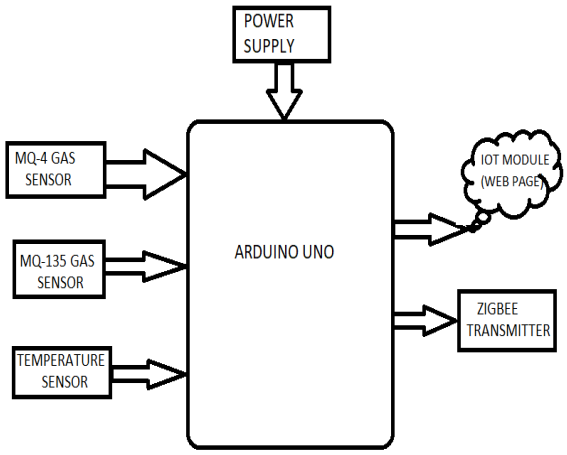


Fig. 4.1. Block diagram for workplace side.

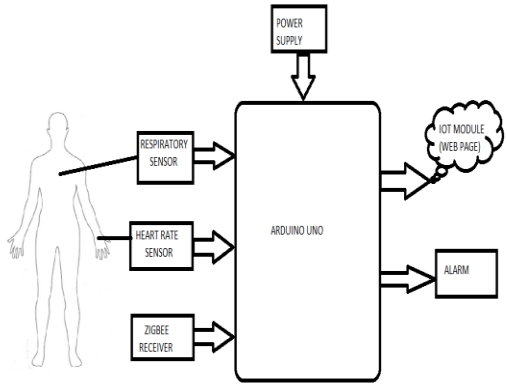


Fig. 4.2. Block diagram for worker side.

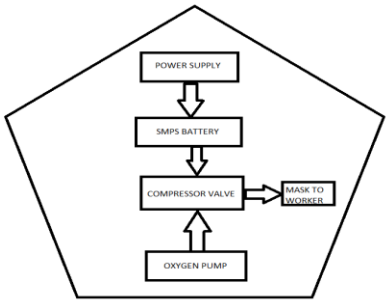


Fig. 4.3. Block diagram for support system.

V. Working Model

A. *Workplace Side*

The Methane gas sensor (MQ4) and the air quality monitoring gas sensor (MQ135) are used to detect the toxic levels of methane, ammonia, nitrous oxide and carbon-di-oxide inside the sewage system. The threshold level of the MQ4 sensor is about 300 to 10000 ppm and that of the MQ135 sensor is about 1000 to 10000 ppm. Above these range, the Zigbee transmitter sends a signal to the Zigbee receiver on the worker side. The temperature sensor on the other hand monitors the surrounding temperature underground. These data are updated in real time in the IoT webpage, monitored by the nearby health department.

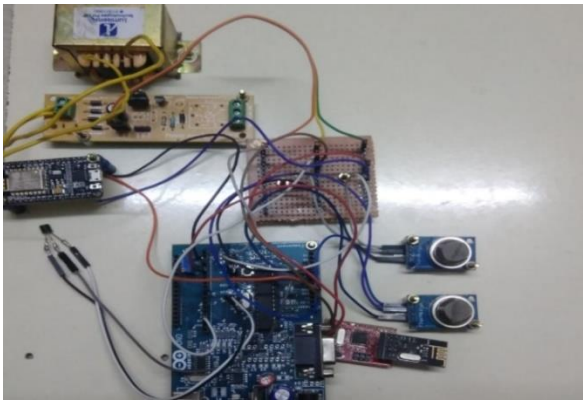


Fig. 5.1. Workplace side.

B. *Worker Side*

The respiratory sensor and the heart-beat rate sensors are used to observe the worker's health condition. The normal rate of the respiratory sensor is considered to be 12 to 16 breaths per minute and that of the heart-beat rate sensor is considered to be 60 to 100 beats per minute. If these values become high or low, the workers can be given first-aid through the external support system.

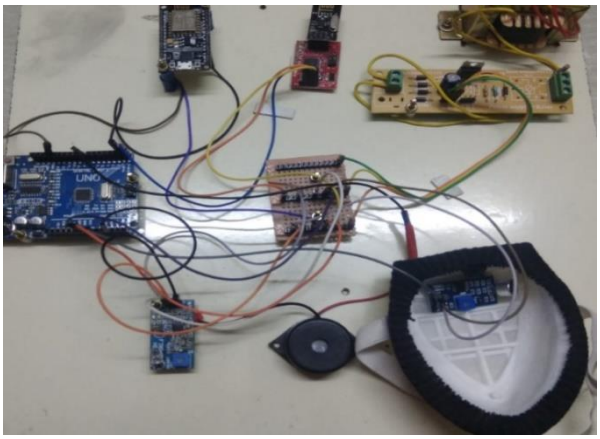


Fig. 5.2. Worker side.

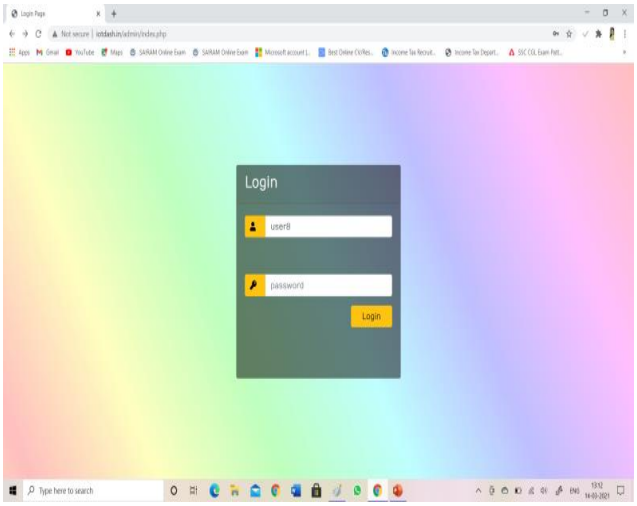
C. *Support System*

The support system consists of an oxygen pump, SMPS battery and a compressor valve. The SMPS battery provides power supply to the compressor valve, which in turn drives the oxygen from the oxygen pump and delivers to the worker via a mask.

Fig. 5.3. Support system.

VI. RESULT

To access the webpage, click the below link



www.iotdash.in/admin/index.php

Fig. 6.1. Webpage login.

After providing the required user id and the password, the data for the workplace side and the worker side can be seen.

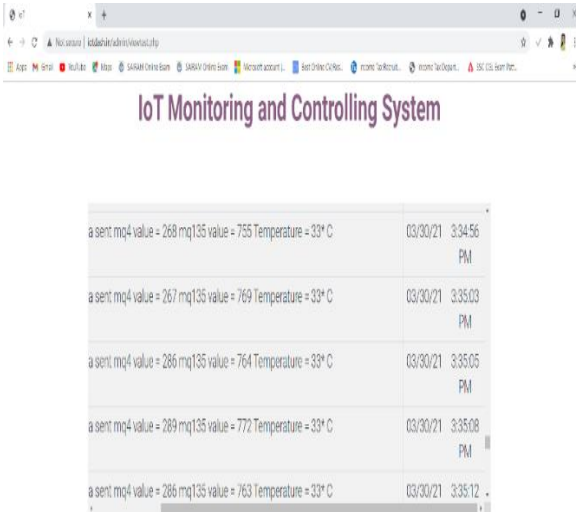


Fig. 6.2. It shows the abnormal values of thegas sensors, when the gas sensors are exposed to the burning of vermicompost and it creates an alarm on the worker side.

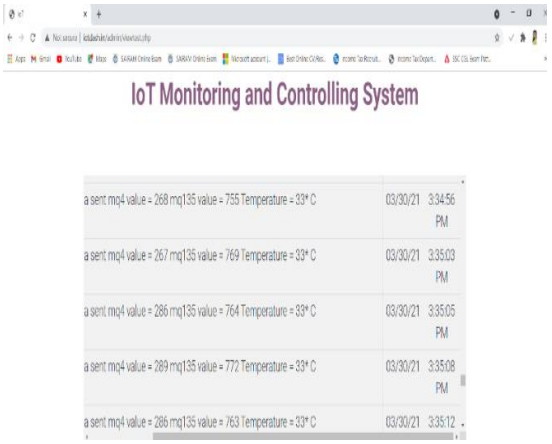


Fig. 6.3. It shows the after-effect of the gas sensors (i,e when the burning of vermicompost stops).

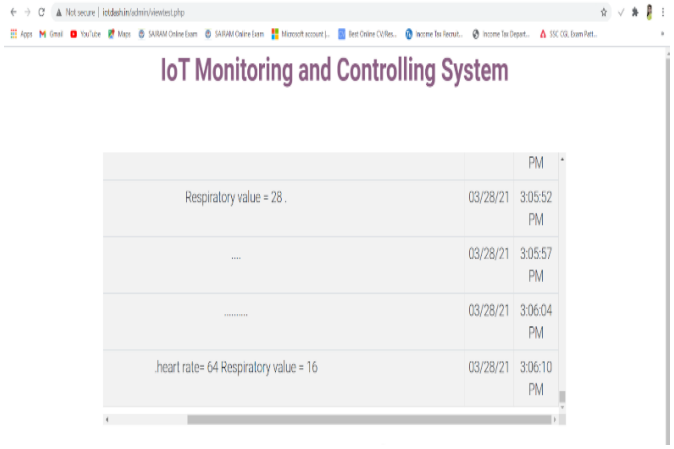


Fig. 6.4. It shows the values of the heart rate sensor and the respiratory sensor on the worker side.

VII. CONCLUSION

We have proposed a system for identifying gases that cause death using a IOT system. The system has high accuracy because of the calibration procedure that is followed. The system is able to detect multiple gases at the same time. The sensor data are uploaded to the database continuously, each value is compared with the reference data. If there is any major deviation, then the system alerts the user depending on the levels of the hazardous gases. The system gives the user warnings, along with the health hazards that may be caused due to continuous exposure to the gas at a particular concentration. There is also a monitoring system which is used to track the heartbeat of a laborer. By using database, an alert message will be sent to the proximal health center for rescuing the laborer in the case of emergency. Further in the future, this method can be extended to remove the toxic gases when toxicity increases beyond safety limits and the support system can be automatically operated with the help of touch sensor attached to the mask and a pressure gauge.

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Audio Visual Emotion Recognition in Children

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***Abstract*—Emotion is an important aspect in the interaction and communication between people and sometimes between people and computer. This project work focuses this direction to recognize the human emotions using speech signal and facial expressions. Four basic human emotions such as disgust, happiness, neutral and sadness are consider in this work to recognize the emotions. This project uses the "EmoReact" multimodel emotional AV speech dataset of children of age between four and twelve. For speech signals, features such as MFCC, Spectral Flux, Spectral Centroid, Spectral Spread and Spectral Crest are extracted from the speech signal. For FER, Haar feature-based cascade classifier is used to obtain facial locations and CNN is chosen for feature extraction of images. Both speech and facial features are separately given to the DNN to train, validate and recognize the human emotions. Nearly 80% of data is used for training and 10% for validation and 10% for testing the developed DNN model. We obtained a test accuracy of 50.25% on speech signals and 61.33% on FER.**

***Index Terms*—Deep learning, audio signal processing, facial expression recognition (FER), convolutional neural networks (CNNs), feature extraction.**

I. Introduction

Emotion recognition is the process of identifying human emotions based on input features. People vary widely at recognizing the emotions of others. Using technologies to help people with emotion recognition is a wide research area. Audio analysis research is multidisciplinary and different parts of the audio classification task are interesting for different research domains, including physics, psychology, speech and music signal processing and cognitive science. It is natural that one can design and build a computer based listening system that can recognize the audio patterns. Feature extraction plays a very important role in computer based audio classification systems, especially in describing the content of audio.

Emotion detection technology uses computer vision, to precisely identify facial expressions and uses machine learning algorithms to analyze and interpret the emotional content of those facial features. The categorical approach in psychology tends to recognize classes such as fearful, angry, sad, happy, cry, disgust and surprise. Different kinds of machine learning classification models can be used for producing continuous or discrete labels. Sometimes models are can allow combinations across the categories, e.g. a happy-surprised face or a fearful-surprised face and many other types of emotions [1]. The data gathered is analogous to the human expressions, used to perceive emotions in others.

For example, video camera captures facial expressions, body posture and gestures, while a microphone captures only speech signals. Recognizing emotional information from deep learning requires the extraction of meaningful patterns from the gathered input data. This is done using machine learning techniques that process different modalities by extracting the features regarding speech recognition and facial expression detection. For example, if a person makes a facial expression by furrowing their eyebrow, then the computer vision system label their face as "confused" or as "concentrating" or "slightly negative". These labels may or may not recognize what the person is exactly feeling.

Speech produced in a state of fear, anger, or joy are fast and loud one with wider range in pitch, whereas emotions such as tiredness, boredom, or sadness tend to generate slow and low-pitched speech. Some emotions are more easily and computationally identified by the system, such as happy, anger or approval.

Generally, the technology works best if it uses the different kinds of features from multiple modalities in context and also it leads to increase in accuracy of the model and predict the emotions even more accurately.

II. Related Work

A. Audio Related Work

Margarita Kotti and Yannis Stylianou proposed that visual and auditory changes have a great importance for human-human interaction, human-machine interaction and human-computer interaction as they include critical information about human emotionas [2]. In emotion recognition system, the auditory information is analyzed and classified in order to recognize human emotion. Emotion recognition from audio signal requires the process of feature extraction and classifier for training process.

Girija Deshmukh, Apurva Gaonkar proposed that the feature vector consists of elements of the audio signal which characterize specific features of the speaker such as tone, pitch, energy, which make the classifier model to train the network and recognize a particular emotion accurately [3]. Speaker vocal tract information, represented by Mel-frequency cepstral coefficients (MFCC), was extracted from the audio

samples of the training dataset and then deep learning-based LSTM algorithm is used for classification process, then emotions such as anger, happiness, and sadness were obtained. The achieved accuracy for Indian English speech dataset was 80%. John Gideon, Soheil Khorram utilized deep neural networks, DNN extracts high level features from raw data and show that they are effective for speech emotion recognition [4].

Rached Zantout and Samira Klaylat proposed that the first process is to produce an emotion state probability distribution for each speech segment using DNN [5]. By effectively learning emotional information from high-level features leads to 20% improvement of accuracy compared to the state of the art approaches. Xue.Y, Chen.L, Mao.X, and Cheng.L.L proposed that Children's emotions expression concentrates more in the acoustic aspects such as the tones and timbres of the speech instead of the semantics, and also there are lots of lengthy fragments in their speech [6].This paper proposes an emotion recognition model using Bi-directional Long Short-Term Memory (CNN-Bi-LSTM) network to extract the emotional features.

B. Visual Related Work

The challenging yet powerful task in social communication is facial expression recognition, as in non-verbal communication. Fnaiech. A, Sayadi. M and Gorce. P proposed that the facial emotion classification is done by evaluating the best distance between facial feature points using degree of characterization [7]. Then, emotions were classified using neural networks. As the demand for systems with human computer interaction grows, need for automated systems with human gesture and emotion recognition capabilities increases.

Facial imagery provides a constructive option to interpret and analyze human emotional issues. Kundu Tuhin and Chandran Saravanan captured images containing the emotions: surprise, happiness, disgust, normality, drowsiness, through automated machinery. Recent developments in facial expression recognition techniques have focus on artificial neural networks and SVM in emotion classification [8]. The technique analyzes the information conveyed by the facial regions of the eye and mouth of the image. Then, it is given as an input to a neural network trained by back propagation.

In the field of Artificial Intelligence, Facial Expression Recognition (FER) is an active research area and the facial features are obtained using Convolutional Neural Networks (CNN). Singh, Shekhar and Fatma Nasoz demonstrated the classification of FER based on static images, using CNNs, and used techniques to improve future accuracy in this area by using pre-processing, which includes face detection and illumination correction [9]. Feature extraction can extract the most prominent parts of the face, such as jaw, mouth, eyes, nose and eyebrows. The usage of max-pooling and dropout layer, eventually aids in better performance [10]. The test accuracy of 61.7% is obtained for on FER in seven-class classification task.

C. Audio-Visual Fusion Related Work

Ilia Ivanov and Maxim Sidorov proposed that people express their emotions through different modalities. Utilization of both verbal and nonverbal communication channels allow to the system to express the emotional states more clearly and therefore easier to understand [11]. The class precisions achieved by applying algorithms on unimodal and multimodal datasets reveal that different data-classifier combinations are good at recognizing certain emotions by means of decision fusion.

These data classifier combinations were fused on the decision level using several approaches, which helps to increase the accuracy by 3% compared to the best accuracy achieved by feature level fusion. Avots. E, Sapiński. T, Bachmann. M *et al.* analysed that the audiovisual information to recognize human emotions through audio and facial features [12]. Emotional speech is represented by audio and spectral features as well as MFCC coefficients. In case of facial expression, facial image emotion classification is done by CNN and this multimodal emotion recognition is based on decision-level fusion.

III. METHODOLOGY

Major technical challenges of automatic emotion recognition are human-computer interfaces, extraction of emotion relevant features, classification of emotions and training the databases [13].

A. Dataset Description

This project uses a database called “EmoReact”, which is a newly collected multimodal emotion dataset of children between the ages of four and twelve years old. To obtain the labels in EmoReact, crowd workers from the online crowd sourcing platform, Amazon’s Mechanical Turk were recruited for recording videos. Each video was annotated by three different workers from online platform.

This dataset consist of about 1102 videos labeled with 16 affective states, including six basic emotions (happiness, sadness, surprise, fear, disgust, and anger), neutral, valence and nine complex emotions including curiosity, uncertainty, excitement, attentiveness, exploration, confusion, anxiety and embarrassment are shown in Fig. 1. Among those, 1100 audio samples and 3551 images are extracted from the video samples and taken into consideration.

Fig. 1. Audio-visual emotional database.

Out of those, four basic emotions such as happy, sad, disgust and neutral are labeled as separate classes. Dataset is based on the reactions of children playing video games and their reactions towards specific food items and some electronic devices used in old times. The average length of these videos is 5 seconds. Emotions have been expressed by 63 different children, 32 female and 31 male with some diversity in ethnicity.

B. Emotion Recognition by Speech

Audio sample is given as an input for the process of feature extraction. The audio features extracted to build the speech recognition system are MFCC (Mel-Frequency Cepstral Coefficient), spectral flux, spectral centroid, spectral spread and spectral crest.

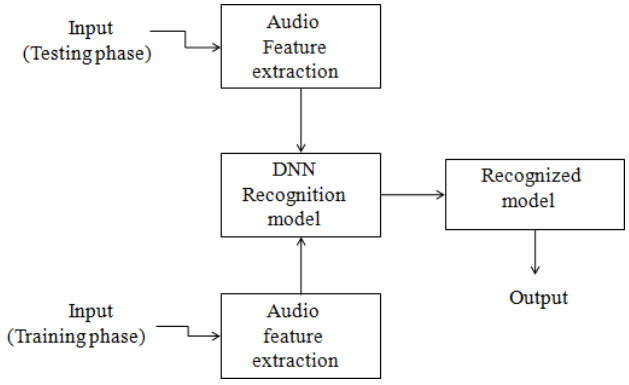

Fig. 2. Block diagram for audio emotion recognition.

The MFCC (Mel Frequency Cepstral Coefficient) extraction technique includes the following steps: windowing the signal, applying the DFT, taking the log of the magnitude and then warping the frequencies on a mel scale, by applying the inverse DCT. The MFCC value is calculated by,

$$C_n = \sum_{n=1}^{k} (\log S_k) \cos\left[n\left(k - \frac{1}{2}\right)\frac{\pi}{k} \right] \tag{1}$$

Spectral centroid is a measure of the spectrum used in digital signal processing and it has robust connection with impression of pitch of the sound and it is calculated by,

$$\text{Spectral Centroid}(\mu_1) \frac{\sum_{k=b_1}^{b_2} f_k s_k}{\sum_{k=b_1}^{b_2} s_k} \tag{2}$$

Crest factor is a parameter of a waveform of sound, showing the ratio of maximum of the spectrum to the arithmetic mean of spectrum and it is calculated by,

$$\text{Spectral Crest} = \frac{\max(s_{k \in b_1 b_2})}{\frac{1}{b_2 - b_1}\sum_{k=b_1}^{b_2} s_k} \tag{3}$$

Spectral spread describes average deviation around its centroid, which is commonly associated with the bandwidth of signal and it is calculated by,

$$\text{Spectral Spread} = \sqrt{\frac{\sum_{k=b_1}^{b_2} (f_k - \mu_1)^2 s_k}{\sum_{k=b_1}^{b_2} s_k}} \tag{4}$$

Spectral flux is a measure of change in power spectrum of a signal, calculated by comparing power spectrum for one frame against power spectrum from previous frame and it is calculated by,

$$\text{Spectral flux} = \sum_{k=b_1}^{b_2} [|\, s_k(t) - s_k(t)\,|^p]^{1/p} \tag{5}$$

First, the audio features are extracted from the input audio signals and then the input samples are divided into 70% of training and 30% of testing dataset as shown in Fig. 2. The obtained features from both training and testing dataset are given into the Bi-LSTM network (DNN). Adam optimization algorithm is used for training deep learning models.

C. *Emotion Recognition by Facial Expressions*

From the video sequences, frames are extracted for each second. In the extracted frame, Haar feature-based cascade classifier is used to obtain the facial locations of the input images shown in Fig. 3. The cropped image of face is given as input to the CNN.

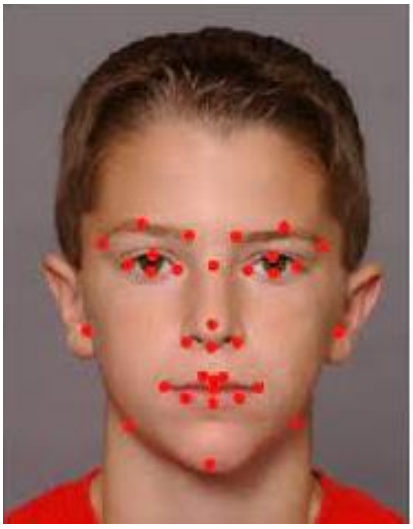

Fig. 3. Facial points for feature extraction.

Pre-processing can be used to enhance FER system performance and can be done previous to the feature extraction process as shown in Fig. 4. Image pre-processing includes various processes, such as the detection and alignment of faces, correction of illumination, pose, occlusion, and data augmentation.

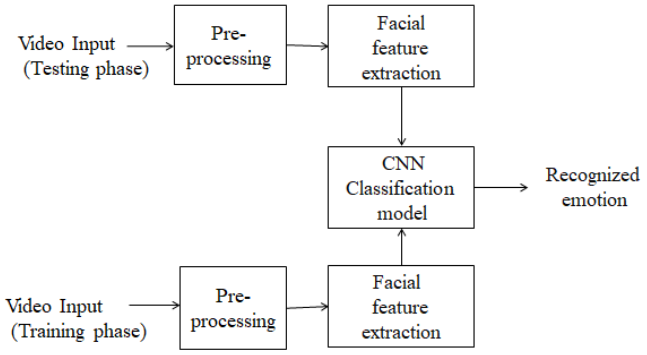

Fig. 4. Block diagram for visual emotion recognition.

Convolutional neural network is chosen for feature extraction of images. The CNN learns basic shapes in first layer and learn features of image in deeper layers, results in more accurate image classification. Stochastic gradient descent with momentum (SGDM) is used to update network weights iteratively based on training data. Then, train the network using the architecture defined by layers, training data and training options.

D. *Emotion Recognition by Decision Fusion*

Decision level fusion combines decision of two classifiers into a common decision about the activity and creates a single decision from integrating the outputs of audio classifier model and video classifier model is shown in Fig. 5.

Decision level fusion combines the data which increases the accuracy by 3% compared to the best accuracy achieved by feature level fusion. It also achieves higher recognition rate than only facial expression recognition or using only audio emotional recognizers.

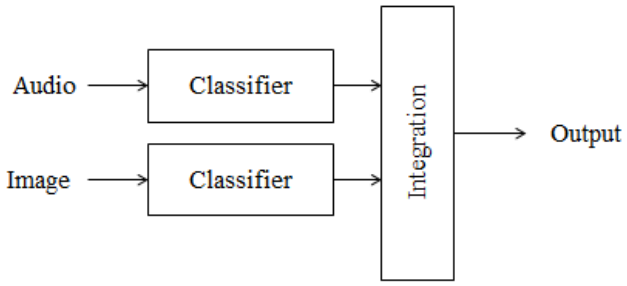

Fig. 5. Block diagram for decision fusion recognition.

IV. Experimental Results and Discussion

The accuracy of the respective features are given as below by means of percentages,

- MFCC 37.624%
- Spectral flux 36.634%
- Spectral centroid 36.634%
- Spectral spread 37.129%
- Spectral crest 37.624%

The confusion matrix consists of true class and predicted class. In both class, it contains all emotions such as happy, sad, disgust and neutral. It also defines the number of occurrence of utterances of speaker in all emotions. And also the percentage of emotion is mentioned in both true and predicted class. Tables I and II represents confusion matrix obtained from both audio and visual data respectively.

TABLE I. Confusion Matrix for Audio Data

Emotion	Disgust	Happy	Neutral	Sad
Disgust	27	32	60	11
Happy	16	53	65	8
Neutral	27	21	109	10
Sad	26	30	55	15

TABLE II. Confusion Matrix for Visual Data

Emotion	Disgust	Happy	Neutral	Sad
Disgust	111	27	33	44
Happy	78	286	60	22
Neutral	50	39	85	46
Sad	48	10	39	72

Confusion matrix is the tabular way of visualizing the performance of each class in the prediction model. Each entry in the confusion matrix gives the number of predictions made by the model whether it classified the classes correctly or incorrectly.

The metrics of the Confusion Matrix are as follows,

True Positive (TP): It refers to the number of predictions wherever the classifier correctly predicts the positive class as positive in a proper manner.

True Negative (TN): It refers to the number of predictions wherever the classifier correctly predicts the negative class as negative in a proper manner.

False Positive (FP): It refers to the number of predictions wherever the classifier incorrectly predicts the negative class as positive in a proper manner.

False Negative (FN): It refers to the number of predictions wherever the classifier incorrectly predicts the positive class as negative in a proper manner.

The most common and intuitive measures derived from the confusion matrix based on the values of TP, TN, FP, FN are as follows,

i) Accuracy

Accuracy is calculated as number of all correct predictions divided by total number of the dataset and it is given by the equation 4.1.

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{TP + TN + FN + FP} \tag{6}$$

ii) Error rate

Error rate is calculated as number of all incorrect predictions divided by total number of the dataset and it is given by equation 4.2.

$$\text{Error rate} = \frac{FP + FN}{TP + TN + FN + FP} \tag{7}$$

iii) Sensitivity (Recall)

Sensitivity is calculated as number of correctly predicted positives divided by the total number of positives in the confusion matrix and it is given by equation 4.3.

$$\text{Sensitivity} = \frac{TP}{TP + FN} \tag{8}$$

iv) Specificity

Specificity or True negative rate is calculated as the number of correct negative predictions divided by the total number of negatives and it is given by the equation 4.4.

$$\text{Specificity} = \frac{TN}{TN + FP} \tag{9}$$

v) Precision

Precision or Positive predictive value is calculated as number of correct positive predictions divided by the total number of positive predictions and it is given by the equation 4.5.

$$\text{Precision} = \frac{TP}{TP + FP} \tag{10}$$

The Tables III and IV give the performance metrics of all emotions such as happiness, neutral, sad and disgust for audio and visual data respectively. Comparison of accuracy between speech data and visual data on taking four emotions such as happy, neutral, sad and disgust on different classifiers using the same database is shown in the Fig. 6.

TABLE III. PERFORMANCE METRICS OF AUDIO DATA

Class	Happy	Neutral	Sad	Disgust
Accuracy	0.718	0.677	0.656	0.69
Error rate	0.282	0.323	0.344	0.31
Sensitivity	0.389	0.377	0.340	0.275
Specificity	0.813	0.869	0.831	0.78
Precision	0.373	0.468	0.118	0.207

TABLE IV. PERFORMANCE METRICS OF VISUAL DATA

Class	Happy	Neutral	Sad	Disgust
Accuracy	0.701	0.674	0.726	0.664
Error rate	0.298	0.325	0.273	0.335
Sensitivity	0.552	0.391	0.391	0.386
Specificity	0.626	0.776	0.832	0.809
Precision	0.641	0.386	0.433	0.516

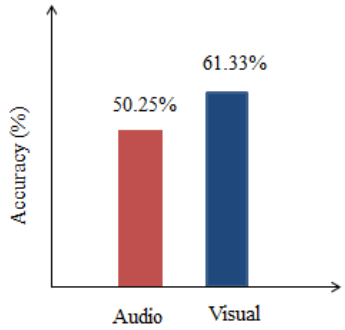

Fig. 6. Graphical representation of accuracy.

By means of decision fusion, the class precisions achieved by applying algorithms on multimodal datasets reveal that different data classifier combinations are good at recognizing certain emotions.

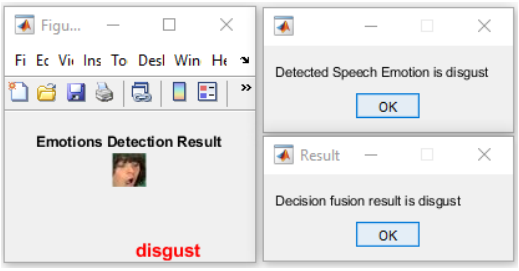

Fig. 7. Recognized output.

Decision fusion compares the emotion obtained from audio and video classifier and gives the recognized emotion as output is shown in Fig. 7.

V. Conclusion

In this project, a human emotion recognition system is proposed to recognize four basic emotions such as disgust, happiness, neutral and sadness using speech signal and facial expressions. The performance of the project is evaluated using "EmoReact" a multi model emotional AV speech dataset of children. The DNN is used to train, validate and recognize the human emotions. The speech features such as MFCC, spectral flux, spectral centroid, spectral spread and spectral crest are used to train the speech signals and facial features for FER. The proposed model in this project gave nearly 50.25% accuracy on speech signals and 61.33% on FER. Decision level fusion classifier combines multiple classifiers resulting in further improvement of the recognition performance.

VI. Future Work

In future, multiple modalities like text format or direct video input will be integrated using separate classifiers to enhance the recognition accuracy of the model. These data classifier combinations were fused on the decision level using several approaches in order to increase the recognition rate.

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Design of Dual-Band Microstrip Antenna for Bluetooth and WiMAX Applications

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***Abstract*—As technology is growing rapidly, it has created a need for the antennas to transmit/receive at faster rate, with more than one frequency at a time. This is possible with the use of dual-band antenna. In this work, a dual-band microstrip antenna for Bluetooth (2.4 GHz) and WiMAX (5.3 GHz) applications is designed and simulated on FR-4 substrate using HFSS (High frequency structure Simulator) software. The designed antenna shows exceptional results in terms of return loss (dB), VSWR (Voltage Standing Wave Ratio), radiation pattern bandwidth and gain. The achieved gain for Bluetooth applications is 1.75dBi and for WiMAX is 4.33 dBi. The results conclude that the proposed antenna is well suited for Bluetooth and WiMAX applications.**

***Index Terms*—Dual-band, inset feed, bluetooth, WiMAX microstrip antenna.**

I. Introduction

In the recent times, the cost and size factor are dominant in the field of wireless communications. In this regard, microstrip antenna takes the upper hand in comparison to other antennas. It provides compact and planer configuration and ability to work on high-frequency applications [1-4]. In addition to dual-band, a triple-band design is also possible with fractal [5]. The other advantage of fractal is to generate the multiband frequencies [6]. There are different ways to design an antenna that can operate for dual frequency, in which slotted H-shaped circular patch and circular monopole is used [7, 8]. The concept of fractal can be extended to MIMO design to enhance the isolation [9]. Different patch configurations maybe employed along with fractal to generate dual- frequency [10, 11]. The use of dual band antennas is their ability to provide a strong and stable wireless connection in often difficult to reach locations [12, 13]. A dual-band antenna can use two frequencies at a time or switch between the dual frequencies depending on which option offers a stronger connection in the given area. These antennas provides us an alternative to avoid signal interference among different devices operating in the similar frequency. Therefore, dual-band antennas are a stable, easy way to connect between our day-to-day wireless communications [14].

Rectangular microstrip antenna being simple in its geometry and construction can be used for the construction of dual-band antenna by creating slots along with defected ground[15]. In this work, a dual-band microstrip antenna for Bluetooth (2.4 GHz) and WiMAX (5.3 GHz) applications is presented. The proposed antenna has been designed and simulated using low cost FR4 substrate. The theoretical simulations are performed using HFSS software.

The research paper is organized as follows section II presents details about the design methodology. In section III, the antenna performance parameters are explained. Finally, the work is concluded in section IV.

II. Antenna Design Methodoly

The first step is to design the proposed antenna consisting of a patch printed on a top layer of the FR4 substrate. For the proposed antenna, the substrate has a thickness h = 1.6 mm and a relative permittivity ε_r = 4.4 for FR-4 Epoxy dielectric. A 50Ω microstrip inset feed line is designed with a width of 3mm. The length and width of the patch are L=21mm and W=24mm and the length and width of the substrate are L=41mm and W=44mm respectively. The given dimensions of the antenna are calculated using the following equations [6],

Step 1: The width of the rectangular patch is given by

$$W = \frac{c}{2 * fr}\sqrt{\frac{2}{\varepsilon r + 1}} \tag{1}$$

Step 2: The effective dielectric constant is

$$\varepsilon reff = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2}\sqrt{1 + 12\frac{h}{w}} \tag{2}$$

Step 3: The effective length is calculated from

$$Leff = \frac{c}{2\,fr\sqrt{\varepsilon reff}} \tag{3}$$

Step 4: The length of extension is given as,

$$\Delta L = 0.412h\frac{\left(\varepsilon_{eff}+0.3\right)\left(\frac{W}{h}+0.264\right)}{\left(\varepsilon_{eff}-0.258\right)\left(\frac{W}{h}+0.8\right)} \tag{4}$$

Step 5: The actual length of top patch is obtained by using expression,

$$L = L_{eff} - 2\Delta L \tag{5}$$

Step 6: The input resistance within the patch at distance from patch edge is calculated as,

$$R_{in}\left(y = yo\right) = \frac{1}{2\left(G_1 \pm G_{12}\right)}cos^2\left(\frac{\pi}{L_p}yo\right) \tag{6}$$

The proposed dual-band rectangular microstrip patch antenna consists of a rectangular metallic (copper) radiating patch of size *L*p×*W*p incorporated to one side of a dielectric substrate of size *L*s×*W*s with relative permittivity (Ɛr) and substrate thickness *h*, which has a metallic ground plane on the other side. The metallic patch, which can use any possible shape as well the feeding network. Feeding can be implemented with different techniques are usually photoetched on the dielectric substrate. The substrate should be chosen carefully because the substrate height as well as its dielectric constant play great rules on the antenna performance and its total size [14]. Thick substrates are most desirable for better antenna performance whose dielectric constant is low, these provide better radiation efficiency, higher directivity, and wider bandwidth, but at the expense of larger element size.

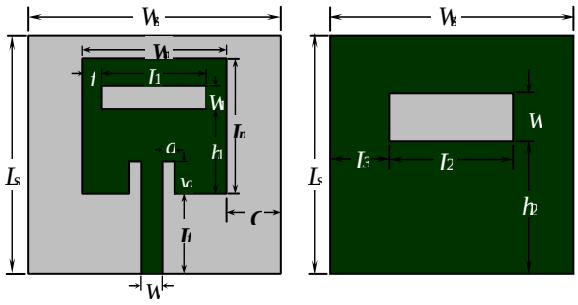

Fig. 1. Schematic diagram of the antenna.

The equations from (1) to (6) are used to get the antenna parameters which are summarized in the following table,

TABLE I. DESIGN PARAMETERS

Variables	Value (in mm)
Ws	44
Ls	41
Wp	24
Lp	21
Wf	3
Lf	10
g	2
yo	5.2
C	10
h1	13.5
f	2.3
L1	20
W12	4
L12	22
W12	2
L12	12
H12	29.5

The schematic diagram of the proposed dual-band antenna is as shown in Fig. 1. For the proposed antenna, microstrip feed line is used to excite the antenna. The antenna is fabricated on FR4 substrate with dimensions of 44×41×1.6 mm^3, thickness of 1.6 mm and a relative dielectric constant ε_r of 4.4. A rectangular slot of $L_1 \times W_1$ size is incorporated in the patch while a slot of $L_2 \times W_2$ size is incorporated in the ground plane. The proposed antennas are simulated using HFSS software. The configuration of the design is depicted in Fig. 1. The second resonance is generated by the slot technique within the radiating patch as well as a slot in the ground plane [15]. The slot dimensions are discreetly varied to allocate both resonances at the desired frequencies. The final optimized design parameters of the proposed dual-band antenna are listed in Table I.

III. SIMULATION RESULTS

The proposed dual-band antenna is designed with the help of Ansys HFSS Software. The below figures are the results of the simulations done on Ansys HFSS Software based on the specifications given in the Table I. A low cost FR4 substrate material with standard thickness of 1.6mm is used to simulate the dual band design.

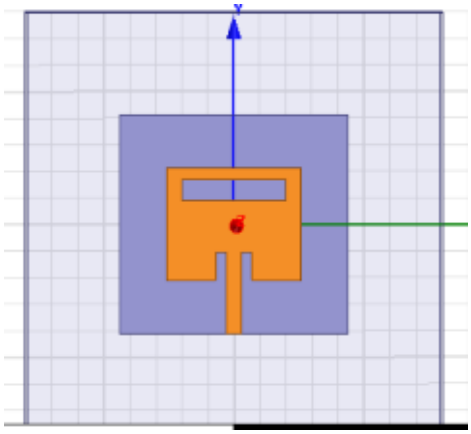

Fig. 2. Front view of the proposed antenna.

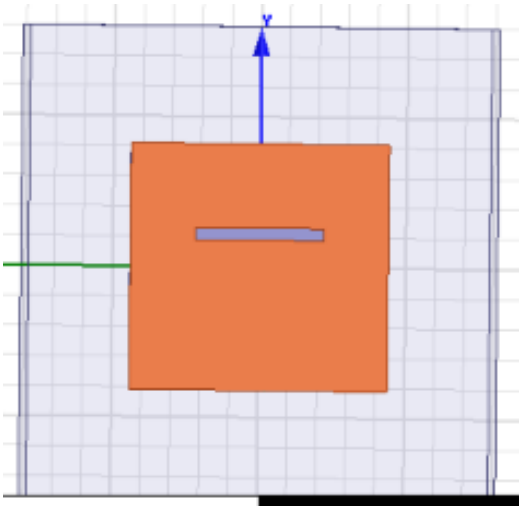

Fig. 3. Back view of the proposed antenna.

The antenna performance parameters are explained as follows

A. *Return Loss*

The antenna should maintain the input-output relationship between ports which is described by return loss or S_{11} curve. S11 represents how much power is reflected from the antenna. For a better antenna performance, S_{11} should always be less than -10 dB [5].

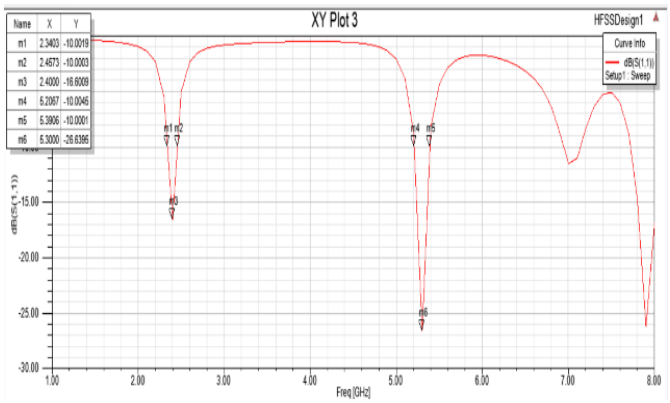

Fig. 4. Return loss vs frequency Plot.

B. *VSWR*

Voltage-standing wave ratio (VSWR) is a quantity that tells how best the impedance of antenna is matched [9]. Smaller the VSWR, better the impedance matched. For better performance, VSWR reading should be near to 1. The VSWR of the proposed dual band microstrip antenna at 2.4 GHz and 5.3 GHz frequencies are about 1.3471 and 1.0977 respectively. This qualifies the theoretical limit of VSWR given by VSWR≤2.

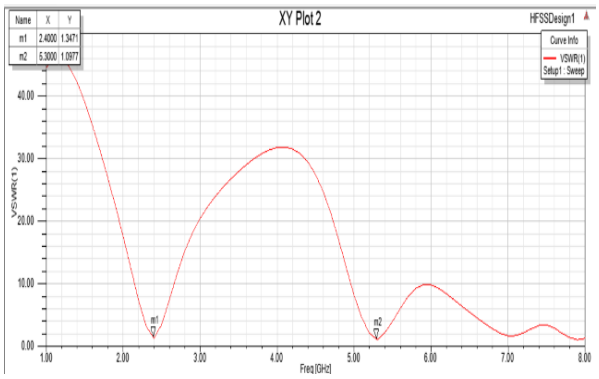

Fig. 5: VSWR plot for the proposed design.

C. *Radiation Pattern*

The radiation pattern describes the relative strength of the radiated field in various directions from the antenna at a constant distance. It also describes the receiving properties of the antenna. The radiation pattern is of both two-dimensional and 3-dimensional.

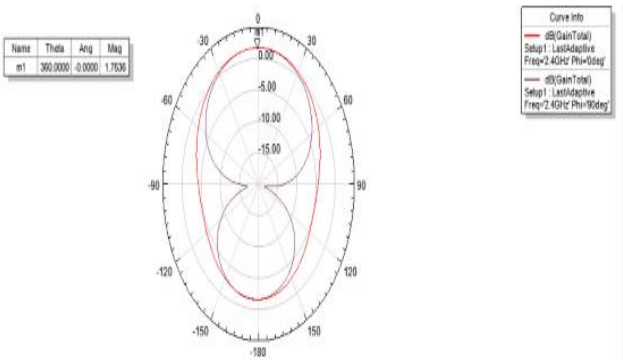

Fig. 6. 2D radiation pattern at 2.4 GHz.

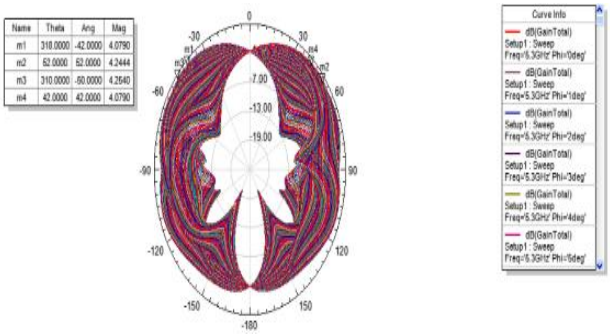

Fig. 7: 2D radiation pattern at 5.3 GHz.

From the Fig. 6 and 7 the gain achieved for Bluetooth applications is 1.75 dBi. Both E-plane and H-plane patterns are specified. Similarly, for WiMAX applications the obtained gain is 4.33 dBi.

TABLE II. SIMULATED RESULTS OF PROPOSED ANTENNA

PARAMETERS	Resonant Frequency (GHz)	
	2.4 GHz	5.3 GHz
Return Loss (dB)	-16.60 dB	-26.63 dB
Bandwidth (GHz)	0.11 GHz	0.19 GHz
VSWR	1.3471	1.0977
Gain (dBi)	1.75 dBi	4.33 dBi

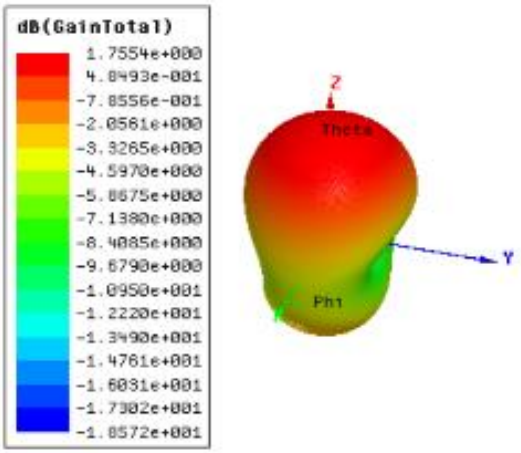

Fig. 8. 3D radiation pattern at 2.4 GHz.

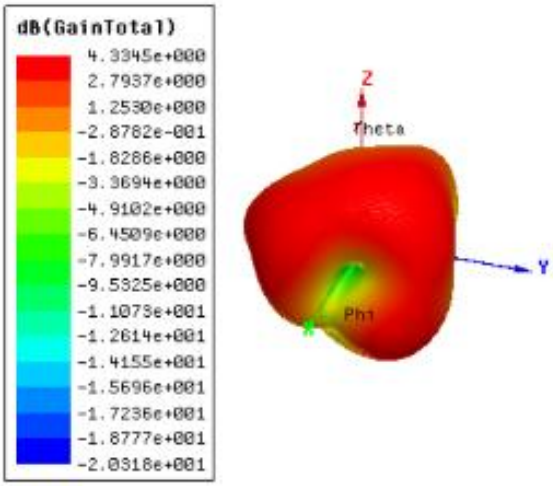

Fig. 9. 3D radiation pattern at 5.3 GHz.

From the above 3D radiation pattern Figs 8 and 9, the gain at 2.4 GHz and 5.3 GHz are 1.75 dBi and 4.33 dBi respectively. The average gain achieved for the proposed design is 3.04dBi. The results obtained by the simulations of the proposed dual-band antenna is consolidated in the following Table II.

From the above table it is observed, that with respect to dual-band operation the proposed design satisfies the theoretical limitation of return loss (RL≤10dB) and VSWR (VSWR≤2). The gain achieved for both frequencies are 1.75 dBi and 4.33 dBi. These results shows that the proposed antenna can effectively useful for Bluetooth and WiMAX applications.

IV. CONCLUSION

The antenna is designed for dual-band of frequencies of 2.4 GHz and 5.3 GHz. The proposed antenna is a rectangular patch microstrip antenna with two rectangular slots on the patch and a ground substrate of FR-4 Epoxy. Given antenna, design is realized through simulation and optimization by Ansys HFSS 15 (High-Frequency Structural Simulator) software. Many aspects affect the performance of the antenna such as dimensions, the shape of patch, slots, feeding technique, and substrate. These parameters are varied to get optimized results. It is found that the results obtained after simulation are matching the expected results. The average gain (dBi) is 3.04dBi is achieved for the proposed design. The advantage of the proposed design is easy to design, simple design steps, low cost, ease of integration, single layer design, dual-frequency operation such as Bluetooth and WiMAX applications.

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Design and Analysis of Dual-Band U-Slot Microstrip Antenna for Bluetooth and Satellite Applications

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***Abstract*—The concept of slot antenna has been used in the designed dual-band microstrip patch antenna. The slot antenna is more preferable because slot can be cut out of any surface they are to be mounted on. A simple and compact dual-band U-slot antenna for Bluetooth and satellite applications is proposed. This proposed antenna is composed of U-shaped slot on the patch. The bandwidth, directivity and gain of the antenna were simulated. The results shows that the antenna covers Bluetooth (2.44 GHz) and satellite (7.89 GHz) bands. The Substrate material used is FR4 epoxy with dielectric constant 4.4. The antenna dimensions were calculated and simulated results have been presented and analyzed using HFSS (High Frequency Structure Simulator) software. The achieved gain (dBi) for Bluetooth applications is 2.21 dBi and for satellite applications is 4.5 dBi.**

***Index Terms*—Rectangular microstrip, HFSS, U-slot, dielectric constant, return loss, VSWR**

I. Introduction

The modern wireless communication requires different band of operations such as dual-band, triple-band, multi-band and ultra-wide band (UWB). These type of antennas reducing the size of the device and increasing the portability in terms of communication systems. The reduction in the size of the patch suffers from low bandwidth and gain. The planar patch antenna can be used to generate multi-band operation due to its low Q-factor to provide easy generation of dual-band, triple band, and multi resonating paths.

A well-known approach to effectively increase operating bands is by loading shaped slots to the patch [1-3]. A compact, single layered dual-band antenna for WLAN and WAVE applications has been reported in [4] with coplanar waveguide (CPW) feed. A compact dual-band antenna using spiral shaped (EBG) electromagnetic band gap structures for high-speed wireless networks has been discussed in [5]. It is shown in [6] that bandwidth enhancement and dual-band operation of a microstrip line fed printed wide-slot antenna with a parasitic center patch. Design and characterization of reduced size patch antennas loaded with metamaterial structures have a dual-band with dual polarization has been discussed in [7]. Double L-slot on rectangular patch antenna array for WiMAX and WLAN applications has been reported in [8]. By using circular symmetric EBG structures dual-band antenna can be designed with improved gain [9]. The combination of rectangular patch and circular patch with microstrip feed generates dual-band operation [10]. The tunable microstrip antenna using varactor diode operates at the dual frequency for supporting different wireless applications [11]. However, most of these reported antennas have complicated structures which lead to increasing fabrication complexity and some of the designs have negative gain values. The proposed dual-band antenna has simple structures with a single layer which leads to increase antenna performance in terms of gain (dBi).

The rest of the research work is presented as follows. The design of proposed dual-band antenna is discussed in section 2. In Section 3 presents the simulated results of the proposed antenna and includes a discussion on the obtained results. The paper is finally concluded in section 4.

II. Design and Analysis of Proposed Antenna

Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has the ground plane on the other side. The metallic patch is mostly made of conducting material such as gold or copper and can use any possible shape. The metallic patch and the feed lines are usually photo etched on the low cost dielectric substrate such as FR4. The selected patch is very thin to this extent $t << \lambda o$ (where t is the patch thickness). The height h of the dielectric substrate is usually $0.003\ \lambda o \leq h \leq 0.05\lambda o$. The dielectric constant of the substrate (ε_r) is typically in the range $2.2 \leq \varepsilon r \leq 12$. The telemetry and communication antennas on missiles need to be thin and conformal and are often microstrip patch antennas. Another area where they have been used successfully is in satellite communication.

In the design of a rectangular microstrip patch, two important parameters are length and width of the patch. These

two parameters are dependent on the resonating frequency, the dielectric constant of the substrate used and it's thickness. The dimensions are calculated based on the lowest operating frequency. Low cost substrate material FR4 is used for the design to simulate to get dual-band operation. The reason for selecting FR4 is more frequent availability with standard thickness of 1.6 mm The dimensions are calculated as follows [8].

The length of the patch antenna $L = \frac{1}{2fr\sqrt{\varepsilon eff}\sqrt{\mu 0 \varepsilon 0}} - 2\Delta L$	(1)
The extension length $\Delta L = \frac{(\varepsilon eff + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon eff - 0.258)\left(\frac{W}{h} + 0.8\right)} \times 0.412h$	(2)
The effective dielectric constant $where\ \varepsilon eff = \frac{\varepsilon r + 1}{2} + \frac{\varepsilon r - 1}{2\sqrt{1 + 12\frac{h}{w}}}$	(3)
The width of the patch antenna $W = \frac{1}{2fr\sqrt{\mu 0 \varepsilon 0}} \times \sqrt{\frac{2}{\varepsilon r + 1}}$	(4)
The characteristic impedance $Za = 90\frac{\varepsilon r^2}{\varepsilon r - 1}\left(\frac{L}{W}\right)^2$	(5)
Impedance of the transition Section $ZT = \sqrt{50 + Za}$	(6)
Width of the edge feed $ZT = \frac{60}{\sqrt{\varepsilon r}} ln\left(\frac{8d}{WT} + \frac{WT}{4d}\right)$	(7)
Length of the edge feed $l = \frac{\lambda}{4} = \frac{\lambda 0}{\sqrt{\varepsilon eff}}$	(8)
Length of the microstrip transmission line x_o is calculated from $Rin(x = 0) = \frac{Z0}{ZT} = \cos^2\left(\frac{\pi}{2}\right)xo$	(9)
Width of 50 Ω Microstrip line ($W50\Omega$) is calculated from $Z0 = \frac{120\pi}{\sqrt{\varepsilon eff\left(1.393 + \frac{W}{h} + \frac{2}{3}ln\left(\frac{W}{h} + 1.44\right)\right)}}$	(10)

Where λ = Wavelength, f_r =Resonant frequency, L = the length of the Patch, W = the width of the Patch, ε_r = Dielectric constant, W_r = Width of the edge Feed, l = the length of the edge feed, x_o= the length of the feed line, $W_{50\Omega}$ = the width of the feed line. By using above 1 to 10 equations the dimensions of rectangular patch antenna are calculated and tabulated. The substrate material used in the design of proposed microstrip antenna is FR4-epoxy with ε_r = 4.4. The substrate material has dielectric loss tangent = 0.02 and Mass density=1900. Table I shows the geometrical parameters of the proposed antenna. Fig. 1 shows the geometry of the proposed antenna. The proposed antenna is designed at 2.4 GHz. By loading U-slot the proposed design resonates at 2.44 GHz and 7.89 GHz. This is due to the increase of current length by radiating patch loaded with U-slot which result in the variation of designed operating frequency.

TABLE I.GEOMETRICAL PARAMETERS OF THE PROPOSED ANTENNA.

S. No	Antenna design parameters	Dimensions in mm
1	Length of the patch (L)	13.75
2	Width of the patch (W)	18.24
3	Height of the ground plane (H)	1.60
4	Width of the Edge feed (W_T)	0.56
5	Length of the edge feed (l)	6.5
6	Length of the feed line (x_0)	14.86
7	Width of the 50Ω line	3.05
8	U-slot horizontal length	7
9	U-slot vertical length	5

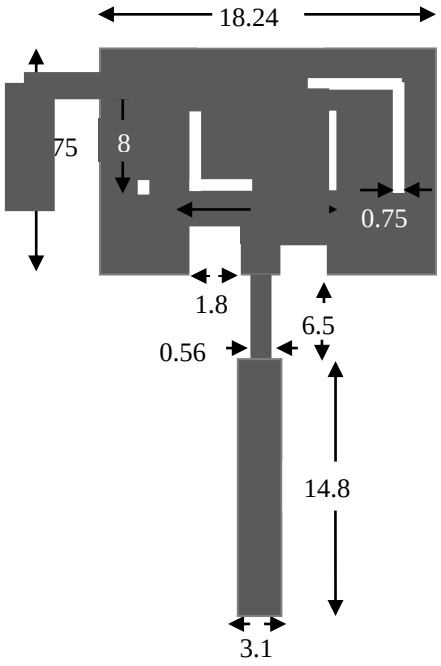

Fig. 1. Geometry of the proposed dual-band antenna.

III. Results and Discussion

The software used to model and simulate the microstrip slot antenna is HFSS. This full wave electromagnetic field simulator has high performance so this may be used for arbitrary three-dimensional volumetric passive device modeling. The simulator integrates not only simulation, solid modeling and visualization but also automation in an easy-to-learn environment. The solutions to 3D electromagnetic problems are quickly and accurately achieve. This employs the Finite Element Method, adaptive meshing and brilliant graphics to give you unparalleled performance. This simulation tool is very effective to analyze the antenna performance.

Simulation results are obtained by using HFSS 15.0 software. Various parameters i.e., return loss (dB), VSWR, radiation pattern, gain (dBi) and directivity are simulated and their variation over frequency is presented in Figs 3, 4, 5, 6 and 7 respectively. The performance parameters are explained as follows.

Return loss (dB): Return loss is the negative of the magnitude of the reflection coefficient in dB since power is proportional to the square of the voltage; return loss (RL) is given by,

$$\mathrm{RL} = 20\log|r|\,\mathrm{dB} \tag{11}$$

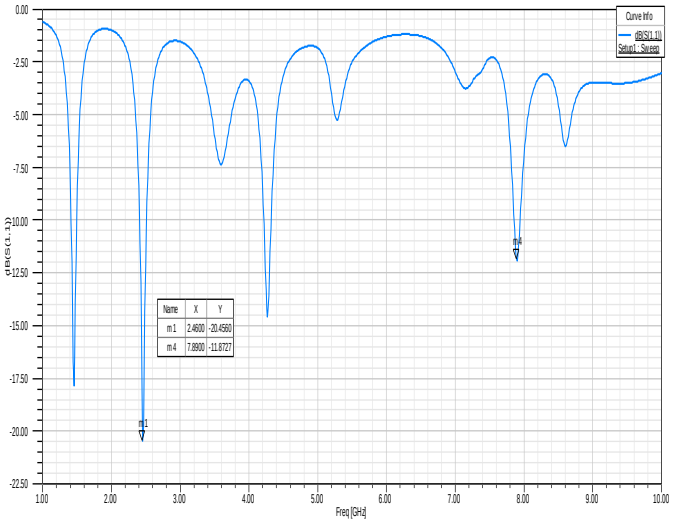

Fig. 2. Variation of reflection coefficient (dB) with frequency.

RL is the negative sign of the magnitude of the reflection coefficient in dB and whereas power is proportional to the square of the voltage, the obtained return loss is -20.4dB at 2.4GHz and -11.87dB at 7.89GHz.

VSWR: The incoming signal mixes with the reflected signal to result a voltage standing wave pattern on the transmission line. The deviation of the maximum voltage from minimum voltage is known as voltage standing wave ratio (VSWR).

$$\mathrm{VSWR} = \frac{1+r}{1-r} \tag{12}$$

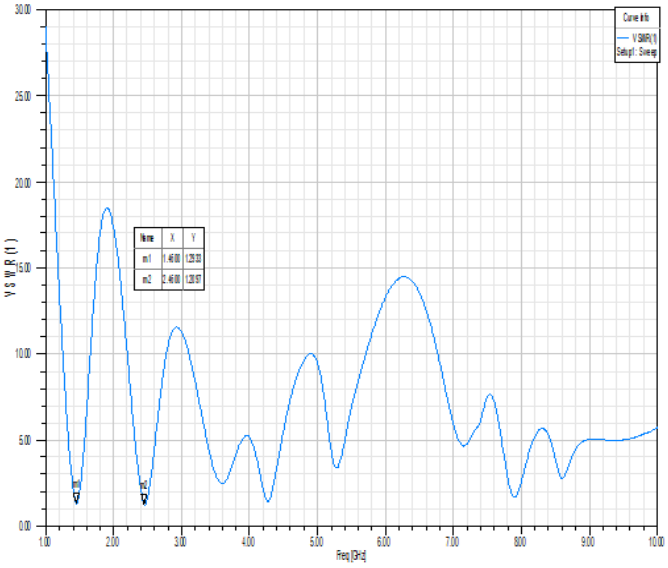

Fig. 3. Variation of VSWR with frequency for the antenna.

The Voltage Standing Wave Ratio is defined as the division between the maximum voltage and the minimum voltage. Here the obtained VSWR at 2.44 GHz is 1.29 and at 7.89 GHz it is 1.95. VSWR is the sign of how capably an antenna's terminal input impedance is matched to the characteristic impedance of the transmission line. These values satisfies the theoretical limitation of VSWR≤2 at both frequencies.

Radiation pattern: The radiation patterns of any antenna provide the information that describes how antenna directs the energy while it radiate. Radiation patterns are generally presented in the form of a polar plot for a 3D angular pattern in one of two sweep planes. As shown in Fig. 4 and Fig. 5 the directivity is 6.74dBi at 2.44 GHz and 7.88dBi at 7.89 GHz.

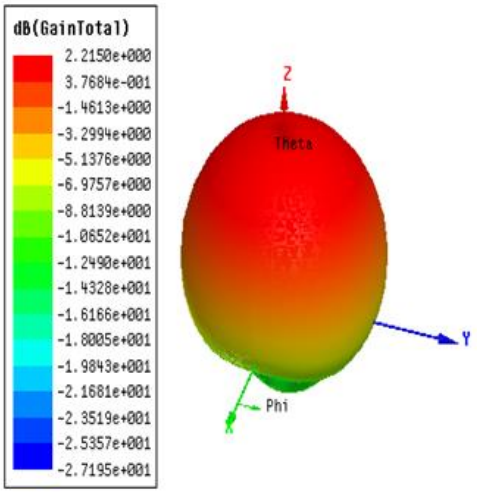

Fig. 4. 3D radiation pattern for gain at 2.44 GHz.

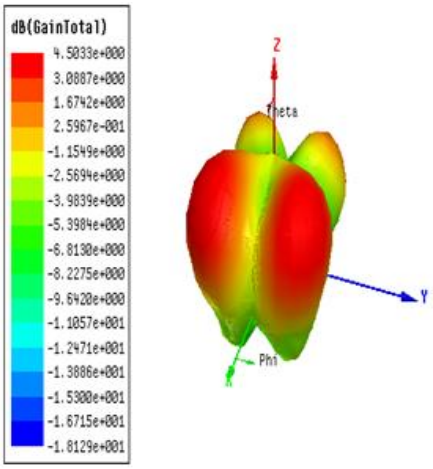

Fig. 5. 3D radiation pattern at 7.89 GHz.

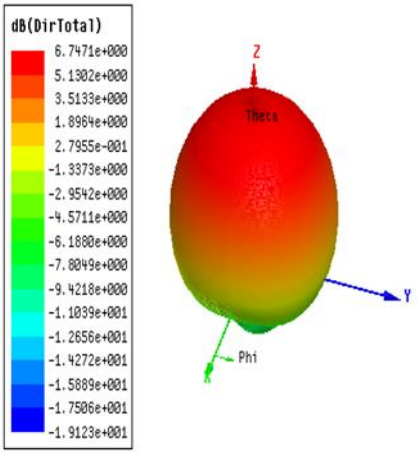

Fig. 6. 3D radiation pattern for directivity at 2.44 GHz.

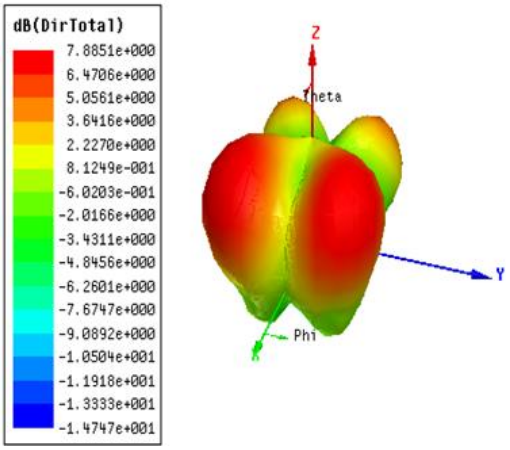

Fig. 7. 3D radiation pattern for directivity at 7.89 GHz.

The gain and directivity of a proposed antenna is essentially a measure of the antenna's overall efficiency. It tells about how strong a signal coming out from an antenna or receive in intended direction. The gain (dBi) which is obtained from designed U-slot antenna is 2.21dBi at 2.44GHz frequency and 4.50dBi at 7.89 GHz frequency as shown in Fig. 4 and Fig. 5. Similarly, the directivity at 2.44 GHz is 6.74 dBi and at 7.89 GHz, this value is 7.89 dBi from Fig. 6 and 7.

TABLE II. ANTENNA PERFORMANCE PARAMETERS

Antenna parameters	2.44 GHz	7.89 GHz
Return loss (dB)	-20.40	-11.87
VSWR	1.29	1.70
Bandwidth (MHz)	90	90
Gain (dBi)	2.21	4.50
Directivity (dBi)	6.74	7.88
Radiation Efficiency	48.45%	56.52%

TABLE III. COMPARISON OF PROPOSED ANTENNA WITH EXISTING WORKS

Authors	f_r **(GHz)**	**Reflection coefficient (dB)**	**Gain (dBi)**	**Average Gain (dBi)**
Wen-Chung Liu[4] et.al.	2.4	12	2.4	2.70
	5.5	30	3	
A. Ameelia Roseline[5] et.al.	1.8	22.05	3	2.25
	2.4	13.8	1.5	
R. Jothi Chitra[8] et.al.	5.2	14	-5	-1.50
	5.8	9	2	
M. SalarRahimi[9] et.al.	1.8	15.2	2	2.15
	2.4	26.13	2.3	
K. George Thomas [10] et.al.	2.4	17.5	2.11	2.81
	5.6	22.31	3.5	
A.F. Sheta[11] et.al.	0.94	12.34	0.1	0.70
	1.8	14.33	1.3	
Proposed	2.44	20.40	2.21	3.36
	7.89	11.87	4.50	

The efficiency of the proposed antenna can be calculated from the following equation

$$G=\eta D \tag{13}$$

Where G-gain of the antenna, D be the directivity and η is the efficiency.

$$\eta=\frac{G}{D} \tag{14}$$

From the above (13) and (14) equation the efficacy at 2.44 GHz is 32.79%. Similarly, at 7.89 GHz the efficiency is 57.03%. The proposed dual-band design used the rectangular radiating patch with loading U-slot, which have special importance, due to its simple configuration. It has low conduction loss and provides better isolation between the feed network and radiating patch. The substrate material used in this design is very cheap and available frequently with required thickness.

The proposed antenna performance is compared with the existing works specified in the literature and it is presented in Table III. From this table, it is observed that gain is improved compared to existing designs.

IV. IV. Conclusion

The designed dual-band antenna is providing acceptable performance in terms of return loss (dB), bandwidth, VSWR, radiation pattern, gain (dBi), directivity (dBi) and efficiency (%). In addition, the gain and directivity shows that the antenna is perfectly matched for Bluetooth and satellite applications and achieved bandwidth is 90MHz at 2.44GHz as well as at 7.89GHz. The proposed dual-band antenna will be fabricated easily with low cost due to its size and substrate material. FR4 epoxy is the cheapest material, which provides optimum performance for antenna fabrication. The proposed antenna is having the return loss of -20.4dB and -11.87 at 2.44 GHz and 7.89GHz. It is observed that the proposed antenna achieved good performance for Bluetooth and Satellite applications.

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Social Distancing Kit

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***Abstract* — During COVID-19, the term 'social distance' is having huge attention all over the world as well as in the internet community. It was supported by the government as a defence to control the spread of coronavirus. This paper gives the tracking down of people with social distancing kit as a safety measure in reducing physical contact between people. This study focuses on tracking people in public places like shopping malls, ticket or bill counters etc. If there is an over crowd and not following social distance, the alert message will be sent to the mobile belonging to the head of the particular area. Besides there will be buzz sound and a display board too, to alert the public**

***Index Terms* — Covid-19, pandemic, social distancing, precaution, raspberry Pi, raspberry Pi camera, python3, OLED, haarCascade.**

I. Introduction

Due to the COVID-19 outbreak, 'social distancing' has been made as a mandatory rule which can be helpful to reduce the spread of disease. It is nothing but 'Physical Distancing. This disease spreads rapidly when a person who is covid positive coughs or sneezes. Life of Covid-19 depends upon the surface it is on ,it may stay alive for hours or days. One of the precautions that prevents the spread of disease is maintaining Social Distance. People who are stepping out of their home has to follow the guidelines from MHO (Ministry of Health Malaysia) and WHO (World Health Organization).

Figures 1 and 2 show the measures that have been taken in public areas to stop the spread of Virus. social measures taken in public places. Secretary General, Dr Tedros Adhanom Ghebreyesus of WHO adapted a new term 'physical distancing' in his announcements.

Fig. 1. Social Distancing in metro.

Fig. 2. Social Distancing near the shops.

Government has announced that involvements in social gatherings like Conferences, Cinema halls, Shopping malls, Sports etc are prohibited. If we are supposed to go out because any emergency wearing a mask is mandatory and has to maintain a distance of at least 6 feet from each other. The main motive of this project is finding people who are not maintaining social distance in public areas such as banks, ticket counters, Clinics etc.

Detecting people who are not in maintaining minimum distance with others in the public areas and notifying them through an alarm sound and a display screen too. Besides the alert message is sent to the head of the management. As Social-Distancing is more important to avoid the spread of virus, this will help to decrease the corona virus to an extent.

II. Literature Review

Now a days Social Distancing has become mandatory to reduce the spread of diseases. So many people are working for a prototype that can help people to maintain social distance. We have taken a few references to make a prototype.

One of the prototypes help the blind people to maintain social distance, in which they used real time semantic segmentation algorithm on RGB camera, bone conducting headphones etc.[2] Second prototype used Deep Neural networks Procedure combined with Inverse Perspective Mapping Technique and SORT tracking Algorithm with use of common CCTV.[3] Third prototype is a wearable Oscillating magnetic-field based proximity sensing system which can be helpful in maintaining social distance.

Fourth prototype is made using Artificial Intelligence, monocular camera with deep learning based real time object detectors and audio-visual signal as the warning.[5] AI, Machine learning, Computer Vision, Ultrasounds etc., can be used for making social distance prototypes.

III. METHODOLOGY

In this study, the project was done based on OpenCV, Python and Haarcascade. OpenCV is nothing but Open Source Computer Vision. This library used to make use of the image processing methods. OpenCV mainly focuses on image processing, video capturing and analysing features like face and object detection. The main objective of this system is for human detection and taking care of social distancing. So, the starting stage of this project starts with reading the faces that are captured through a raspberry pi camera. This is shown in Fig. 3 is the flowchart of the proposed system.

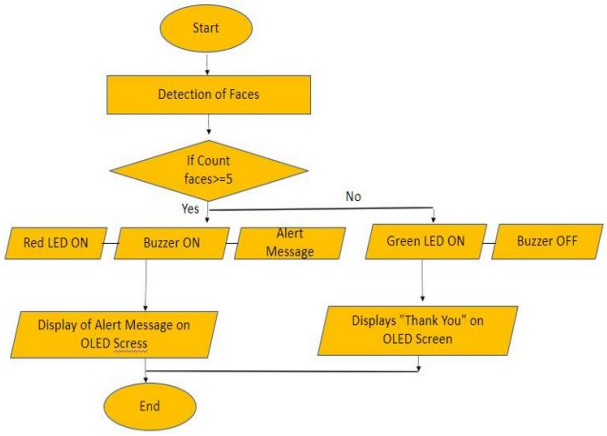

Fig. 3. Flow chart.

The most important trait of this proposed system is Haar Cascade. In this paper, Viola Jones algorithm is adapted for face detection. Both the algorithms of AdaBoost and Viola Jones algorithm to make a strong classifier. Haar like features are adapted by Viola -Jones for face detection. The components that are used in this project.

For face detection, Viola Jones algorithm is a beneficial method. Besides, this algorithm is not only limited for face detection but can also be utilized for many rigid structured object detection tasks. The Viola-Jones algorithm is composed of three main concepts that make it possible to develop a real time face detector: Haar-like features, Image integral, Adaboost training and Cascading classifier. By applying these features, the system can determine the presence or the absence of a human face.

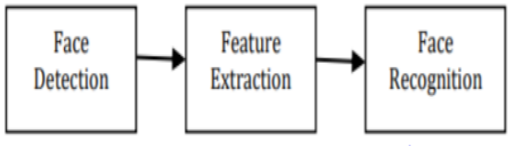

Fig. 4. Face detection.

Examples for Haar-like features are used to identify dissimilarities in dark and white regions of the images as shown in Fig. 5. From that representation, the light region explains “to add” and the dark region is “to subtract”. For “Feature extraction”, Linear binary pattern histogram is mainly preferred. It operates with powerful discrimination. Based on this algorithm, features from the image will get extracted in live stream. Linear Binary Pattern Histogram algorithm involves two steps, one is training period and the other one is evaluation period. In training period the image samples are to be recognized and later in estimation period, the image is to be tested and will be compared with the samples trained in the dataset.

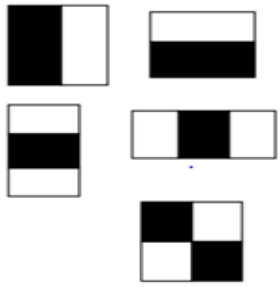

Fig. 5. HaarCascade features.

In the local binary pattern, binary number is considered as an outcome . This algorithm became popular in various face recognition applications based on its powerful discernment and mathematical simplicity,

In Raspberry pi to stream a live stream video Raspberry pi camera is connected. The captured image from the camera will get detected first and then counts the number of faces it detected. Haar cascade classifier. Using a python based Open CV software, faces that are getting captured are saved in Raspberry Pi.

Based on the count and given condition the devices will let us know about social distancing in particular areas through a message that has been sent to the mobile. Besides, it will display an alert message (OLED) and give an alarm sound to alert the public. The message has been sent to the management through pushbullet. It is an open source which connects multiple devices such as mobile, tablet, desktop. It manages all text messages, remainders and more.

This involves few steps. By sending both the ID of the sender and application, registration takes place on Google Cloud Messaging (GCM) of mobile. After registering, ID is sent to the mobile device by the server. GCM receives a registered ID and message from the app server when there is a need of sending notification. GCM which receives an ID will send particular message to particular mobile device.

A Server is needed to maintain all the push notifications. PushBullet, Pushsafer, Pushettat etc are few platforms. Where PushBullet is easy to use and free. Besides PushBullet has many inbuilt libraries (for python) which are easy to use and explore.

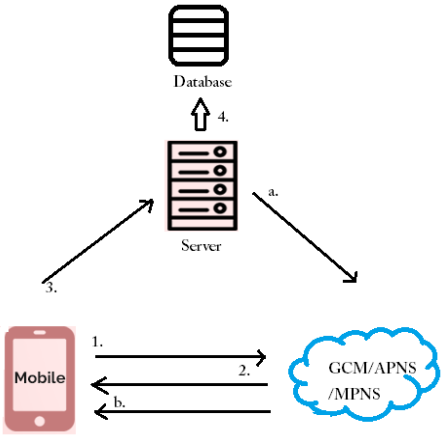

Fig. 6. Working of pushbullet.

IV. Conclusion

Social Distancing Kit will Assist people to maintain Social Distancing in crowded places like Banks, Shopping Malls, Market Places etc., which will reduce the rapid spread of various viruses like Covid-19, bacteria from person to person. This will reduce the Spread of diseases.

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Fortification of Commercial Buildings with Improved Security System by Integration of GSM Module with the YOLO V5 and OpenCV

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***Abstract*—The fortified security system is an ultra-modern security system with the latest hybrid technology of artificial intelligence. This system overcomes all the major problems that are faced by other security systems. This idea is created to prevent heists in highly protected places. This is an eccentric idea, which uses two-step security protection. Object detection software and an A.I. cameras are created to detect intruders. After which it sends a picture to the authorities through a telegram application with an alert message. Laser security protection is installed at all the possible entry points and tear gas guns inside the highly protected places. As the GSM module plays an important role it is placed in a safe place. Once the beam gets interrupted tear gas guns, siren, and GSM module gets activated. The module makes a call to the authorities about the heist and Tear gas gives out eye irritation gas which produces a burning sensation to the eyes which distracts them. Ultimately this results in detaining the intruders and does not allow the intruders to go in further and helps the authorities to arrive at the location on time. This security system must be implemented in highly protected areas. So that we can avoid theft and robbery.**

***Index Terms*–Fortified security, object detection, tear gas gun, AI camera.**

I. Introduction

"Security is not the absence of danger, but the presence of God, no matter what the danger."

— Fortified Security System

From mobile phones to HD LED TV, X boxes, and PlayStation the advancement in technology is made in our life to make it simpler and easier. So, why not include the latest technology in security systems to keep us safe and secure. Today, there are hosts of options available when it comes to opting for safe security solutions. Gone are the days when home inmates need to worry about the cash and belongings when they leave their home. With the market flooded with a variety of security options, it is also affordable for new-age customers.

Tildsley invented the very first intruder alarm system in the 1700s in England. He used a simple chime that was mechanically attached to the door lock. If an intruder tries to use a key that is not designed for the door it would move the chimes and scare off the intruder and will alert the owner. In 1850, Augustus Russell Pope inverted the first electronic burglar alarm with the use of electricity, magnets, and bells. As technology developed, the use of burglar alarms has increased and there are many types of burglar alarms available these days.

Problems in Home Security: -

- Expensive hardware and total cost of ownership.
- No guarantee of threat prevention.
- Falsely triggered alarms.
- Maintenance.
- Failure to precisely sense the surroundings.
- Security of security systems.

These problems can be overcome using this Fortified Security System.

II. Literature Review

This topic is the previous analysis done on the Fortified security system by using different sensors. Our exploration focuses on implementing security, which monitors the activity in the banks, ATM, and other highly secured places. Research work has generally used both camera and laser for the same purpose to improve details is the fusion of two detection modules, one for the laser and another for the vision data [1]. But this research paper focuses on sustainable security, so we used Light Dependent Resistor (LDR) and camera for two separate purposes. The complete setup of this security system powered by a raspberry pi and Arduino is a refurbishing methodology. This security system comes with an object

tracking CCTV system, of which the first step of image processing is motion detection [2]. Another research on AI human tracking systems [3] lacks the active response to caution the higher officials. This paper overcomes that using a trigger weapon and automatic caution message to the security department. Having a GSM module in the system helps in a timely warning. The security system notifies and tracks the trespasser in the locality through a caution message that there has been an intervention in the laser light and gas gun to be stimulated then. We have gone through a paper that brings a whole security system working on an 89C51 single chip computer [4].

The GSM module with Arduino plays a crucial role in safeguarding the total system functioning as the first security wall, which is an advancement in IoT and stands unique. Incredible activities are conveyed to the officials through SMS (Short Message Service) or Call using GSM (Global System for Mobile communication) technology [5].

A study on AI opposing mechanism with face detection [6] made, which lacks further action after detecting a person to which this paper aims to improve alertness by several processes by caution message and call through GSM module. The object detection part is the combination of computation and movement of the camera given by various commands [7]. Object detection is a technique of detecting a foreground object in a frame [8]. The desired object could be a person, animal, or any other object or target of interest. In this paper, the evaluation of object detection was performed taking algorithms such as Basic Background Subtraction (BBS) [9]. The point of decision comes to the authorities soon after the intruding object comes off to ensure that it is an intruder and the target to be simulated [10].

The above system consolidates all the features and operates as a complete security object which makes our system characterized from the universal system

III. METHODOLOGY

This project comprises two significant networks: object detection using Raspberry pi four and the laser interruption technique using Arduino UNO.

A. Raspberry Pi

Raspberry PI 4 is a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on).

1) A1. Flowchart

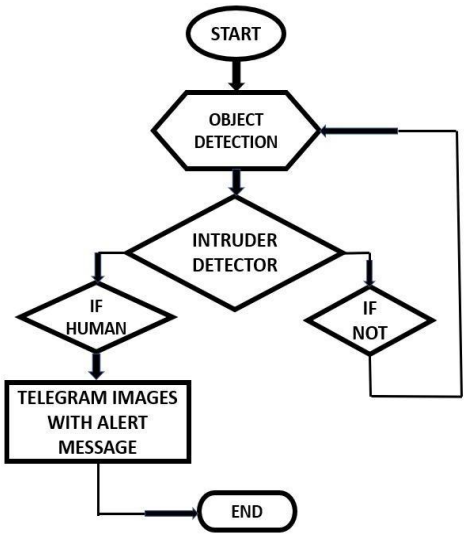

Fig. 1. Flowchart of raspberry Pi.

Figure 1 shows the workflow of object detection using the raspberry pi 4 modules, a microprocessor. Relatively the development of the system involves both hardware and software parts. The hardware included in this project is the Raspberry pi 4 modules, Raspberry pi camera, and USB adapter for Raspberry pi. The hardware system commences when the raspberry pi camera is active. Firstly, the design ascertains the object under surveillance. It occurs by installing software named YOLO V5 and OpenCV. Accordingly, instruct the module to detect humans alone. As pi cam spots the human, it instantly captures images; forward those images to the concerned officials linked with the system through telegram with an alert message. It occurs by generating a bot in telegram and linking it with the raspberry pi line up. It continuously dispatches the images to authorities.

Meanwhile, if not human, it pursues the detection operation. Utilized for setting frames. Raspberry pi can intake commands in Python, C, and C++ language. We pick out Python to insert the line up into Raspberry pi since Python is an uncomplicated language to ensure our needs. Whereas in C and C++ language, it makes the code a little complex.

2) A2. Block Diagram

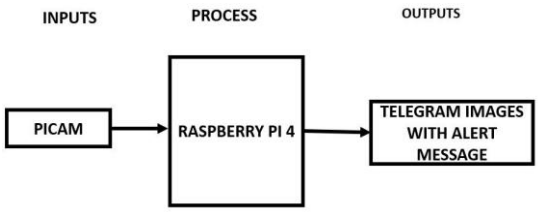

Fig. 2. Block diagram of raspberry Pi.

Figure 2 shows the Raspberry pi module's block diagram of this project. Object detection is implemented for this fortified security system. The work contains a Raspberry pi four module.

Raspberry pi camera board v2 (5Mp, 1080p), camera used is USB camera interface to the raspberry pi module. The Raspberry pi 4 has two USB 2.0 ports and two USB 3.0 ports. In all models before the Pi 4, the USB ports connect to a combo hub/Ethernet chip, a USB device connected to the single upstream USB port on BCM2835.

Meanwhile, for object detection, installed software named YOLO V5 and open; the main difference is that YOLO V5 is a framework for machine learning, and OpenCV is a library for computer vision. Image recognition with YOLO V5. Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. It is a cross-platform data visualization and graphical plotting library for Python. In the work, we utilized setting frames. The camera spots the intruder and directs the captured images to the officials through telegram with an alert message. The approach is to provide security.

B. Arduino

Arduino UNO is a microcontroller board based on the ATmega328. It contains everything needed to support the microcontroller. The UNO differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the AT-mega16U2 programmed as a USB-to-serial converter.

The commands to the Arduino UNO are given using the Arduino Integrated Development Environment (IDE), a cross-platform application written in functions from C and C++ language. It is used to write and transmit programs to Arduino-compatible boards. The Arduino IDE provides a software library from the wiring project, which gives standard input and output procedures.

1) B1. Flowchart

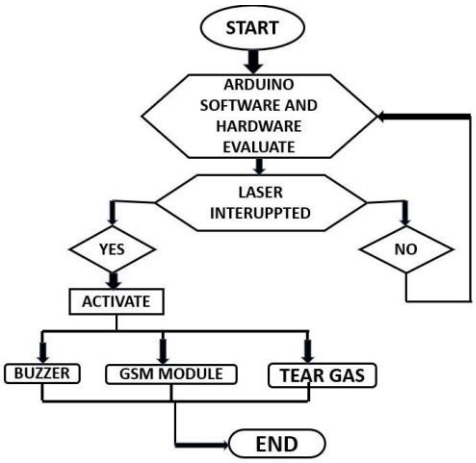

Fig. 3. Arduino process flowchart.

Figure 3 shows the Flowchart of the laser interruption technique using the Arduino UNO. Relatively the development of the system involved both software and hardware parts. Even though hardware and software are working together, both are designed and developed separately. The hardware included in the project is USB, laser, Light-dependent resistor (LDR), buzzer, and sensor. The software used in this project is Windows 10 operating system, Arduino Integrated Development Environment (IDE).

The second stage of the security system starts as soon as the laser beam is interrupted, activating the command sequentially given by the Arduino UNO. When the system is interrupted, the laser beam does not fall on the Light-dependent resistor (LDR). It instantly cautions as a message and knocks a call using the GSM module to the concerned officials associated with the system. Simultaneously, it will activate the buzzer and liberate tear gas. The work ensures that the intruder will stop at the opening wedge itself as the laser beam safeguards all the possible bridgeheads. Suppose the intruder tries to step forward any potential opening wedge-like windows, doors. The laser beam will be interrupted and Arduino starts its command and liberates tear gas. The work makes this information reach the police department, and we ensure that they turn up on time. This system prevents us from theft in the preliminary stage.

2) B2. Block Diagram

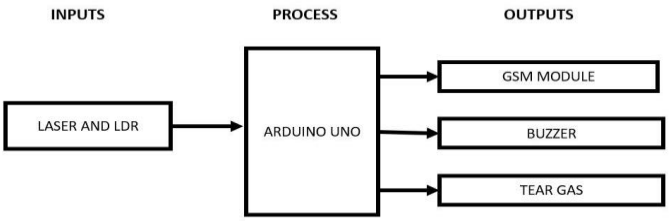

Fig. 4. Block diagram of Arduino.

Figure 4 shows the block diagram of Arduino UNO. The laser sensor can be implemented for an extensive area automation security system capable of transmitting a very powerful beam and LDR (Light Dependent Resistor) to receive it. Arduino UNO controls GSM Module, LDR, Buzzer and tear gas gun. For the caution message and to knock a call and an alert message, GSM Module (sim900A) is used because this modem uses an RS232 port to communicate and develop embedded applications. It is a Quad-band GSM, works on frequencies 8.50MHz, 900 MHz, 1800 MHz, and 1900 MHz. The modem has an internal TCP/IP stack connected to the internet via GPRS. It is suitable for SMS as well as data transfer applications in the M2M interface.

A Buzzer is used to intimate the sound of breakthrough the buzzer or siren used here is of 110dB to 130dB which creates a very loud noise to alert the surrounding.

Tear gas is a collection of chemicals that cause skin, respiratory and eye irritation. It is usually deployed from canisters, grenades, or pressurized sprays. It is used as a chemical weapon, which makes the intruder blind for a few minutes. By using these components, we make the system more efficient and reliable.

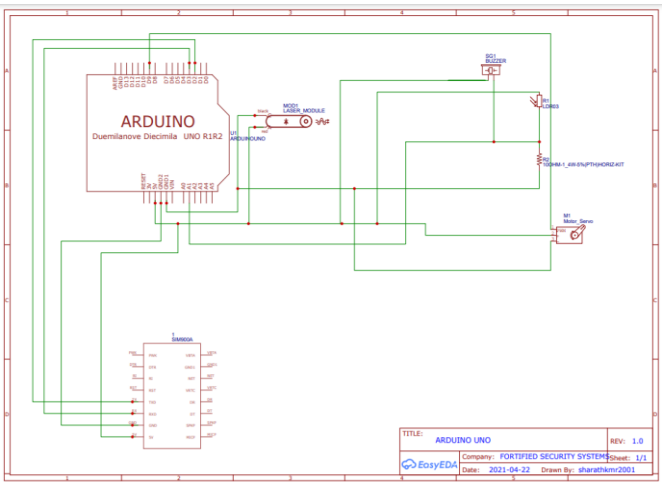

Fig. 5. Circuit diagram for Arduino.

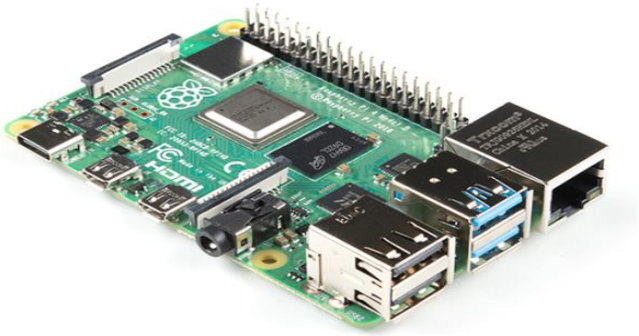

Fig. 6. Raspberry Pi 4.

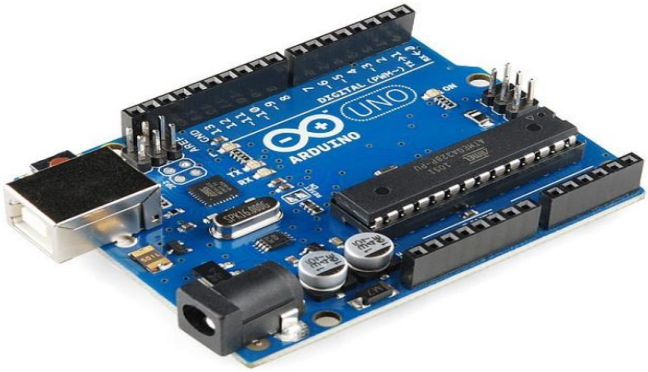

Fig. 7. Arduino Uno.

TABLE I. COMPONENTS USED.

SNO.	Components	Pins
1.	Laser	+5V, GND
2.	Buzzer	+5V, A1
3.	Servo Motor	+5V,GND,A1
4.	LDR	+5V,GND
5.	GSM Module	GND,7,8 As (TX, RX)

C. *Working of the Project*

When the intruder tries to break in, the Raspberry PI Cam detects the intruder using YOLOV5 and OpenCV. Then a message is sent to the Telegram Bot using the Telepot module. Then the bot automatically requests to capture an image using the Raspberry Pi Cam and the images are sent instantaneously. The working of the Arduino is as follows. The laser is set up at all possible entries. The laser will be interrupted while entering. When it is interrupted a message and a call is sent to the concerned authorities using SIM900A and alerts the neighbours by producing a loud noise using a siren. Tear Gas gun gets activated, by dropping the tear gas canisters which surround all over the room. This produces irritation to the eyes, a nauseating feeling, which does not allow the intruders to surpass inside the room.

IV. RESULT AND DISCUSSION

The Fortified Security Project consists of 2 major modules. One is a Raspberry Pi, and the other is an Arduino. We are using Raspberry Pi 4 for better performance and precise results. It is connected to a power supply, and the peripherals attached are the 5MP PI Camera. Using Python IDLE, YOLO V5, OpenCV, and Matplot Library, objects are detected. If a person/intruder is detected, a telegram message is sent with the photo of the detected person. The photo is sent with the help of the Telepot module. The Arduino module consists of a GSM module,, Light Dependent Resistor (LDR), Buzzer, and Servo Motor. When the laser is interrupted, the GSM Module sends an SMS to the registered mobile number, and a buzzer sound is produced. In the GSM Module, VOLTE activated sim cards cannot be detected. The LDR module is not advisable for this project as detection sometimes is incorrect. The complete system to boot up takes a maximum of 10-15seconds, the FPS of the camera varies from 2-2.7 FPS. More the background process, less FPS is attained. The time taken to send the intruder's photo and send it to telegram depends on the network's speed connected to the Raspberry Pi. 100Mbps results in 0.37ms. The lesser the resolution of the frame size, the more the FPS observed. The response of Arduino for sending SMS, the motor, and buzzer to get activated is 0.57ms. The SMS speed varies on the signal captured by the module. The maximum time with a low signal is 0.67ms. We tried 25 test cases and the result is mentioned in Table I. All the test cases were successful.

TABLE II. RESULT OF OBJECT DETECTION.

SNO.	Object	Action of Gun
1.	Cat	Not Activated
2.	Ball	Not Activated
3.	Animals	Not Activated
4.	Humans	Activated

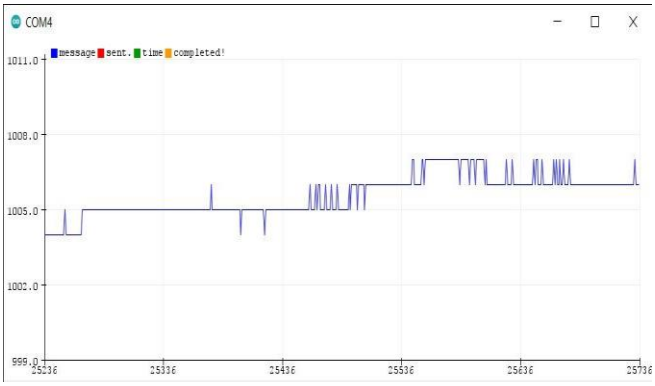

Fig. 8A. Detection of LDR without interruption.

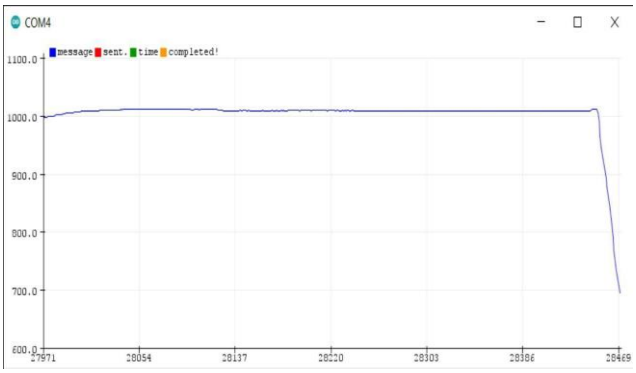

Fig. 8B. Detection of LDR with interruption.

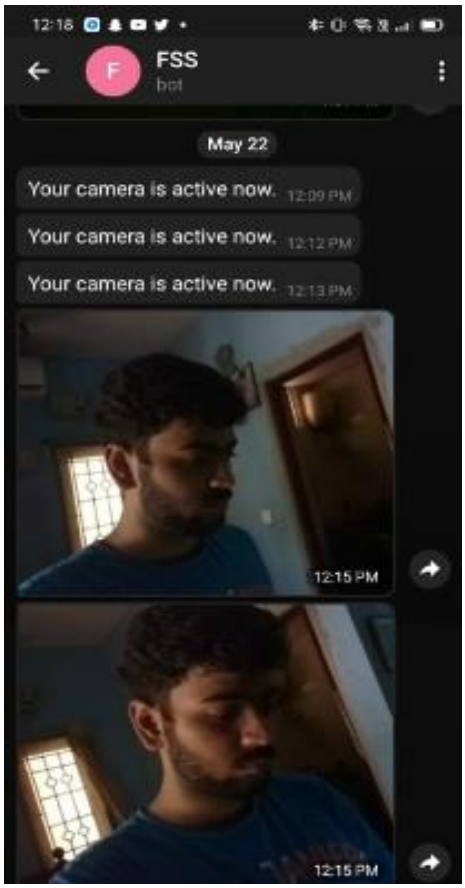

Fig. 8C. Alert notification received by the authority on telegram.

V. Conclusion

In conclusion, this paper explains the procedure and completion of the fortified security system. This system is more efficient and advantageous than any other existing system. The advantage of this system is that the user gets the intruder's image through telegram with an alert message. In addition to this, there is another feature where the user and the respected authorities will get an alert message using the GSM module. These advantages can genuinely increase the usability and reliability of the security system. We have increased the security for a vast level to get alert messages irrespective of their location. This feature makes our system more trustable to reduce theft and vandalism because of the usage of tear gas in this system, only high security level places such as banks, museums, etc., can install this system. In future work, we would extend the scope to other public areas to improve the fortified security system.

Acknowledgment

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IOT Based Automated Energy Meter with Multiple Applications

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***Abstract*–Every two months, it is evident that an individual arrives in front of our house from the power board, whose obligation is to make note of the energy meter and hand over the readings to the proprietor of that home. In most non-industrial nations, the exertion of gathering power utility meter readings and recognizing unlawful utilization of power is a troublesome and tedious errand that requires a ton of human interventions. Proficient force utilization and reserve funds have become a significant issue these days as the requirement for power are expanding step by step. Homegrown energy purchaser is uninformed of his force use, intends to save it, and now and again discovers approaches to take power without paying for it. This project exhibits the idea of eliminating the human interventions between the user and the provider using the Internet of Things. The main intention of the project is to obtain domestic energy consumption and generate its bill automatically. Adding on, this investigation means to recognize and control energy burglary. A magnetic sensor is locked in with the energy meter to recognize when any illicit change occurs in the metering framework. In such a case, the energy meter will send an alarm to the worker just as it has the office to detach and re-interface the power supply naturally. The proposed framework can do ceaselessly screen and be advised about the number of units devoured by the energy supplier and purchaser. The energy utilization is determined naturally and the bill is refreshed on the web by utilizing an organization of the Internet of Things. Consumers can monitor their energy usage anywhere at any time in their smartphones, by monitoring their usage they would have clarity on what they are consuming. One more advantage of this IOT based Smart Meter is an alert message can also be sent to the consumers when they reach their threshold value via email or messages using IoT, through this feature the consumer's problems can be solved.**

***Index Terms*–Energy meter, the internet of things, Arduino UNO, WiFi module, magnetic sensor, the prepaid system, NodeMCU, Adafruit IO.**

I. INTRODUCTION

The ability to impact is unable to track the evolving most intense interest of customers under the current charging system. Customers face issues such as collecting unpaid bills, as well as being unable to control energy supply and quality nevertheless of whether amounts are timely paid. The solution to all of these issues is to maintain a handy record of the buyer's stock, which will be used to ensure correct charging, monitor the highest interest, and so on [1]. These are the main points to remember when designing an efficient energy charging device. This device allows the power division to review meter readings monthly without having to visit each home individually [3]. This can be done by using the micro-controller device that consistently monitors and notes in its non-unstable memory about the energy readings. This framework constantly tracks the browsing, and the live meter browsing can be viewed by the buyer on-demand in the cloud. When required, this device can also be used to switch off the house's power supply. In recent years, IoT generation has been used in a variety of fields, including electricity, fuel, water, and many others, to automate our lives. The wireless capsule used within the system presents connectivity with the net inside the device [3]. These days the power demand is growing at a consistent fee all through the populace and is applied to diverse purposes, agriculture, industries, family purposes, hospitals, and so on. So, it's miles becoming increasingly complicated to deal with the electrical maintenance and necessities. Consequently, there may be a right away requirement to shop as a great deal of power as possible [4]. The automated energy meter that is developed with the Wi-Fi system is structured based on two major objectives.

They are

- Immediately, supply mechanized reading of the meter.
- Optimized utilization of the electric power and reduction of the power wastage is made.

It may be structurally differentiated into four parts controller, the prepaid system, robbery recognition circuit, and a WIFI module. The controller performs the primary calculations and processes the statistics. The robbery recognition circuit gives data on any meter tampering, and information from the controller is sent wireless way which is the major role implemented by the internet. The carrier ended can recap the purchaser approximately the invoice created for

the utilization over a short message service [5]. The Arduino controller is programmed on the Arduino software IDE that is a prerequisite to equipping the Arduino board. The code is a by-product of the c language. Energy theft is a problem, and in recent years, there has been little proof of tampering with meters, although they are less reliable, so they aren't always dependable greater because the Io T-based power meter has different capabilities and protects electricity from illicit theft, as well as guards against overloading of energy to customers. This project is primarily concerned with an automated energy meter that makes use of embedded system functions, which is a collection of hardware and elements of the software [6]. If the patron is unaware of the threshold warning, the meter will turn off automatically. The patron will then increase the edge cost and the meter will turn on robotically.

A. Advantages

- To lessen the energy wastage.
- To prevent electricity shortage during dry seasons.
- Monitoring of bills in real time

B. Applications of the System

The system is widely used in Municipal company Electric power sources Govt. Energy plant, domestic and commercial buildings in a public energy supply scheme.

II. PROPOSED STRUCTURE

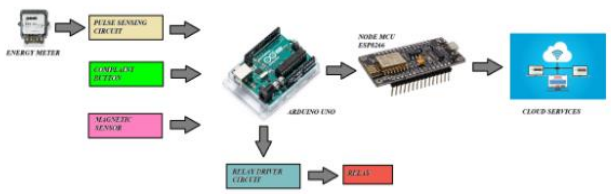

Fig. 1. Block diagram of the Proposed structure.

When the family's various apparatuses consume electricity, the energy meter continuously reads the perusing and displays the consumed load on the meter. We can see that LED of the meter squints continuously, indicating that the meter is being scanned. In light of the units are tested, and the squinting is over. 3200 flickers are one device regularly. In our system, we're attempting to develop a project in which the Arduino UNO serves as the primary regulator, consistently monitoring the energy meter. The Arduino can calculate the device consumption based on the flickering of LED in the energy meter. On the page that we have planned, the deliberate perusing of the cost estimate will be constantly displayed. When the customer's reading is close to set edge esteem, it will give an alert value to the purchaser. This edge esteem alert will increase the purchaser's awareness of electricity.

When the customer receives the notice, he will go to the site's page and change the edge value. If the customer is unaware of the edge alarm, the meter will naturally turn off. After that, the buyer must return to the cloud and raise the cap esteem. The meter would turn on as a result of the instrumentation. Finally, on the first day of each month, the general month-to-month bill with cost will be sent to the client as the text by a specialist company.

III. HARDWARE DESCRIPTION

1. Arduino UNO: A micro-controller is an add-on circuit (IC) the device utilized for controlling different quantities of a digital device, usually through a microprocessor unit, memory, and some peripherals. Those gadgets are optimized for embedded programs that need both processing capability and agile, responsive interplay with digital, analog, or electro-mechanical additives.

The small footprint and equipment make the UNO each especially perfect for wearable inventions, low-price robotics, electronic musical devices, and popular use to transform smaller elements of large projects. The Arduino Uno each is an evolution of the primary and traditional Arduino board but functions load extra active processor, the atmega4809. This could let you make bigger packages than with the other Arduino boards (it has 50% more program reminiscence), and with a lot more variables.

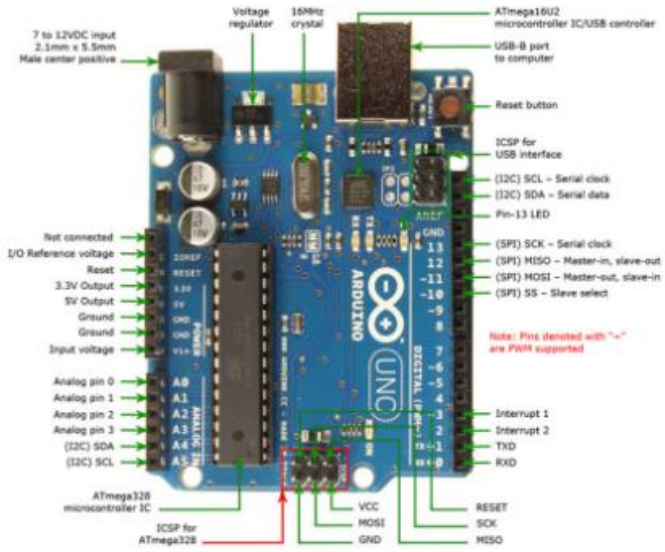

Fig. 2. Arduino UNO pin diagram.

2. Interfacing LCD display and Arduino UNO: For Arduino projects, LCDs are often used to show manageable quantities of textual content. The most popular types of displays are those that are directly connected and those that have an I2C adapter. In this section, we'll see how easy it is to connect an LCD to an Arduino Uno without using an I2C adapter and program it with Visuino to display whatever is typed in a Serial Terminal.

- One Arduino compatible module
- a 16x2 LCD display, a 10K potentiometer
- a 220 ohm resistor
- as well as eight male-female jumper wires

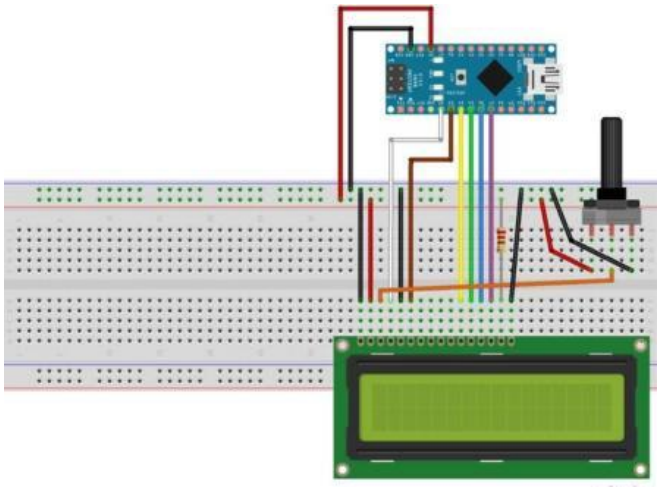

Fig. 4. Interfacing LCD display with Arduino UNO.

3. Optocoupler circuit(as pulse sensing circuit): An optocoupler device is a sealed, self-contained unit that contains separately-powered optical (light) Tx and Rx units that can be optically integrated. The most basic version of such a computer. The Tx unit is an LED in this case, but the Rx unit may be a photo-transistor, a photo-FET, an Opto-Triac, or another photo-sensitive semiconductor part; the Tx and Rx units are compounded closely together in a sealed array.

Fig. 6. Optocoupler.

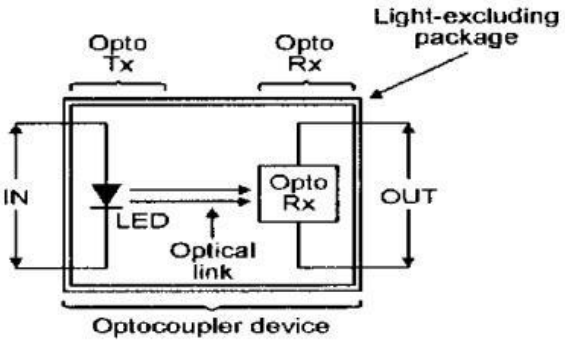

Fig. 7. Optocoupler inbound structure.

The optocoupler inbound structure is shown here. Pins 1 and 2 on the left side show an LED (Light Emitting Diode), which emits infrared light to the photosensitive transistor on the right side. The collector and emitter of the photo-transistor control the output circuit in the same way that traditional BJT transistors do. The photo-transistor is handled by the LED's strength. Since the LED can be powered by a separate circuit and the photo-transistor can control different circuitry, the Opto-coupler can control two separate circuits. Also, there's a difference between a photo-transistor and an infrared camera.

4. **Opto diac and triac:** Devices used in the voltage/power supply require an electric roof between the high voltage and low voltage input. In such cases, relying on a thin layer of silk to provide what is needed is not the real choice. All that is required is a physical separation (i.e., there must be no electrical connection between input and output). Fortunately, there are prepared solutions to this problem. Today, most high-power plants use low-voltage, high-frequency circuits such as microprocessors and low- and low-power optoelectronic devices such as OptoTriacs, OptoTyristors, and solid-state relays. The dependency system has very high voltages that can occur in an AC or DC output system due to equipment power consumption as well as power consumption that can occur unexpectedly on the supply line (line).

Fig. 8. Opto TRIAC and DIAC.

You need to be able to withstand the noise. For example, during a wave (usually more than a “current flow”) that occurs when an object such as a car or flashlight is turned on, the control system has up to 40 or 50 times the current.

5. Power supply system: The main purpose of the power supply is to change the current from the mains to the appropriate current, current, and frequency to take charge. As a result, the power supply is sometimes called the power supply. The power supply is the electrical system that conducts the charge. Some of the power supplies are independent components, while others are integrated into support equipment.

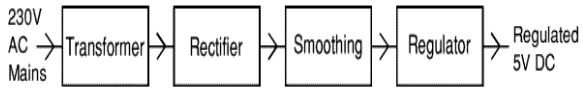

Fig. 9. Block diagram of regulated power supply.

This power supply circuit is meant to generate a controlled DC power supply. The 9-volt transformer converts 230 volts to 9 volts. Bridge repairers are used to repairing the secondary power supply of the fire system. The 1000mf bandwidth softens the direction of DC correction.

6. Magnetic detector: A limit debouncing circuit is used as a magnetic sensor in the device. Mechanical touch switches are more difficult to use than limit switches. It is used to open and close a gate with a DC motor. This device is connected to a microcontroller.

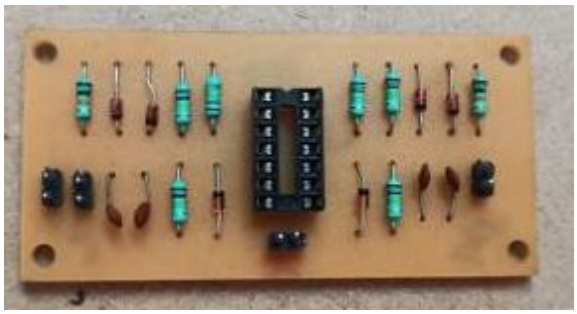

Fig. 10. Magnetic detector.

To shape the waveform from the main switch, the Schmitt trigger circuit is used. The main switch produces a perfect square wave as its output. As a result, we have one Schmitt trigger before we use it for further application on board. When the programmable lock assembly's key is closed, goes to a low level, and the inverting buffer output at IC 4093 moves to a high level.

7. IC-4093: A mechanical limit switch connects an electrical circuit to a mechanical motion or location. Contact arrangement is a good place to start when choosing a limit switch. One NO and one NC set of touch is the most common limit switch with The single-pole contact building.

Limit switches, on the other hand, can have up to four poles. Time-delayed touch transfer is also available for limit switches. This form detects jams that cause the limit switch to remain active for longer than the preset time interval. Neutral-position and two-step limit transfer touch arrangements are also available.

8. NodeMCU ESP8266: NodeMCU is a firmware and open source card specifically designed for Internet of Things (IoT) applications like ESP8266 Wi-Fi SoC from Espressif Systems and the ESP 12 computer hardware which is included firmware based on the. Like Arduino. CC has launched a new MCU panel for non-AVR processors such as the ARM / SAMMCU used in the Arduino Because it also modifies the Arduino IDE so that it can be easily supported for other hardware cables, the Arduino C / C needs to be rotated on. This new processor. With the creation of the Board of Directors and SAM Core, they have achieved this.

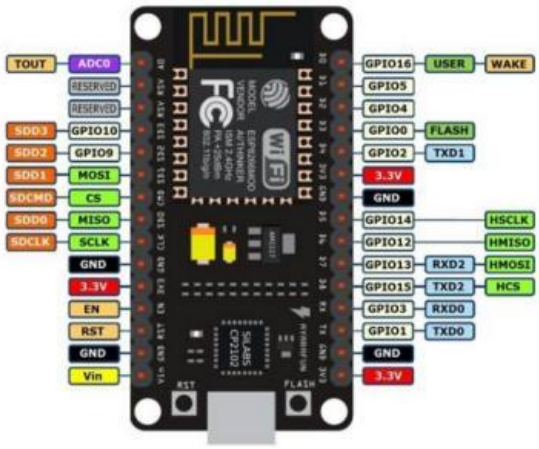

Fig. 11. NodeMCU pin diagram.

A. Applications of NodeMCU

- Used in the prototyping of the IoT devices.
- Used in low-power and in applications which are battery operated.
- Used in network projects.
- Multiple Input and output interfaces including Wi-Fi and Bluetooth functionalities use NodeMCU.

9. Energy meter: The meter that is being used is known as an energy meter. The whole energy ingested and utilized by the load at a given time interval is referred to as electricity. It is used to measure power consumption in both private and industrial AC circuits. The meter is both inexpensive and precise. The Electric Board is one of the governmental divisions that mount this equipment in various locations such as residences, factories, companies, and business buildings to charge for the energy use of hundreds of lamps, fans, iceboxes, and other household appliances.

Fig. 12. Energy meter.

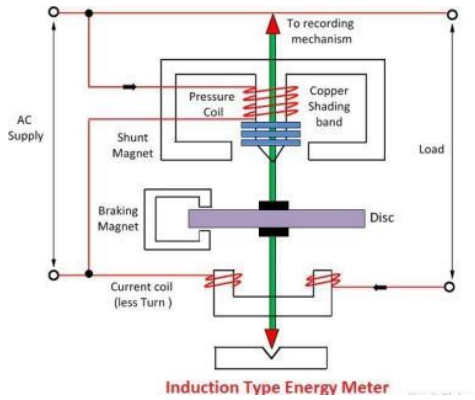

Fig. 13. Internal structure of the energy meter.

There are four important of the energy meter,

i. The Driving System
ii. **The Moving System Braking system**
iii. **The Registration (Counting Mechanism)**

The ability consumption of the load is determined by the rotation of an atomic number 13 disc in the energy meter. The disc is sandwiched between the series' air gap and the shunt magnet. The voltage coil is on the shunt magnet, and the current coil is placed on the sequence magnet.

The production of voltage creates a strong field for compression caps, and current caps make it into current caps. Due to the eddy currents generated in the disk, the part that produces the electrical cutoff has a pressure of 90° concerning the current cutoff strength field.

10. Step down transformer: Transformers are static electrical devices with no moving elements, reworking wattage from one voltage and current setting to a different one. The frequency of the electrical current remains constant. Transformers are classified by their performance, that is either maximize or step down. Increase transformers increase the voltage of the incoming current, whereas reduction transformers decrease the incoming current's voltage. The incoming voltage is stated because of the primary voltage, whereas the outgoing stream is stated as secondary.

Fig. 14. Step down transformer.

When sending power over each long and short distance, there square measure inherent losses within the system. These losses square measure of bigger magnitude once the present is higher (at lower voltage) than at a coffee current. For this reason, long-distance transmission necessitates that electricity has high voltage and low current. High voltages aren't safe for shoppers, though, and aren't appropriate for many electrical appliances. shopper appliances square measure typically rated at 220 V.

IV. Software Description

1. Arduino software IDE: Arduino is used in writing and uploading programs to the order no compatible boards. Utilizing the help of a third party course the Arduino boards are used with the boards which are for provider development. The source code for the IDE is been released under the GNU general public license version. With the help of the unique regulations of court featuring the languages, C and C++ languages are being Arduino IDE supportive.

Many input and output procedures are commonly provided by the Arduino IDE which supplies the software library from the electronics project. Only two basic functions are required for the Arduino IDE user-written code: sketch and pseudo code loop, which are later compiled and linked with the codes.

2. Adafruit IO: Adafruit IO is a cloud service. You can connect via the Internet. It was originally designed to store and retrieve data, but you can do much more than that. Adafruit IO may be a device that generates useful information. Our emphasis is on ease of use and allowing for easy knowledge connections with minimal programming. Our REST and MQTT Apis are wrapped in IO's shopper libraries.

3. IFTTT: If This Then That (commonly known as IFTTT) is a service that allows users to program responses to various events in the real world. There's a long list of different events to which IFTTT can react, all of which can be detected via the internet. For instance, according to Weather Underground, rain is expected tomorrow. Another possibility is that the consumer was labeled during an icon on Facebook.

V. Working of the System

Smart meters work by measuring current flow and adding them to determine the amount of energy used at a given time. Gas flow is usually measured regularly. This information is sent to the home screen and the service provider. Distinct locations use different communication technologies for indoor networks to communicate with the home screen. It is used in different parts of the world that transmit and receive along with the Global Communications Company. Receive information from our service provider.

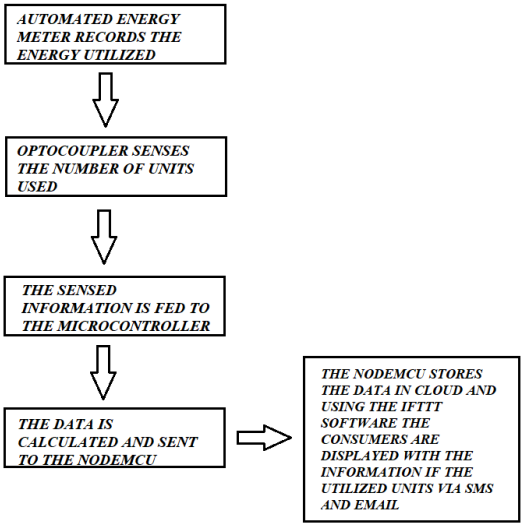

Fig. 15. Process flow.

Meters constantly observe their output and surroundings in addition to measuring energy. They'll disclose if they need an interior memory downside, and if the terminal cowl is removed, for example, When your provider contacts you, he or she will send someone to your home. Smart meters, on the other hand, operate differently, depending on whether they're measuring energy or gas. A sensible energy meter is linked to the mains and keeps track of the amount of power you use over time. On the other side, much of the time a smart meter is driven and 'asleep.' Every hour, it wakes up to submit a reading through the electricity meter.

VI. DEVICE PROTOTYPE

Fig. 16. Working prototype model of the system.

VII. RESULTS AND CONCLUSION

The proposed framework can decrease the sufferings of the client and make clients worry about the over-the-top utilization of power just as flawed gadgets at home. Through this framework, clients can without much of a stretch view absolute heartbeat, complete units, and all-out expenses of power. The framework is effectively discernible and dependable. The information put in the cloud has incredible significance in upcoming energy meter information technology. From a huge perspective, energy dissemination organizations, for example, DPDC ready to notice the example of utilization of space. Thus, this perception can help in load appropriation in a specific territory.

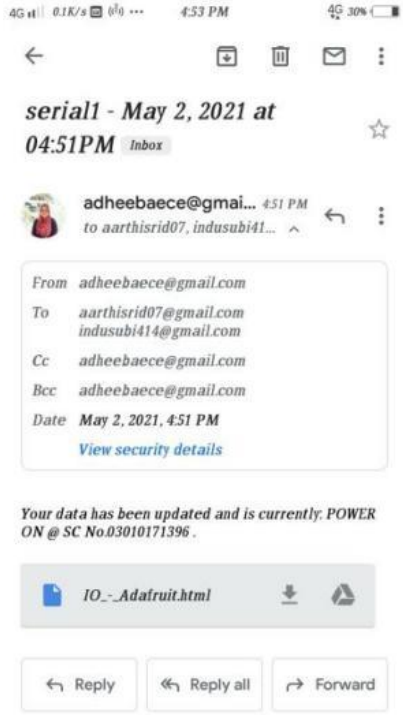

Fig. 17. Email notification.

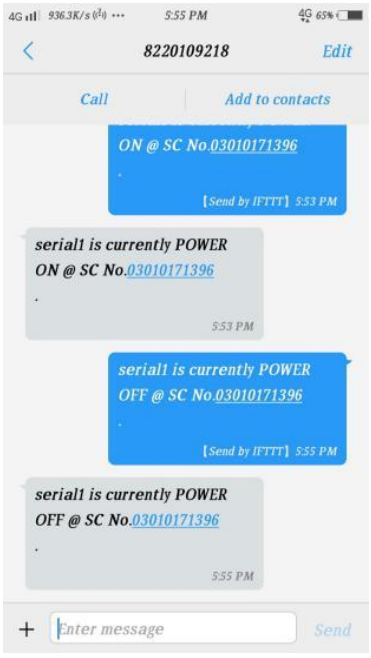

Fig. 18. SMS notification.

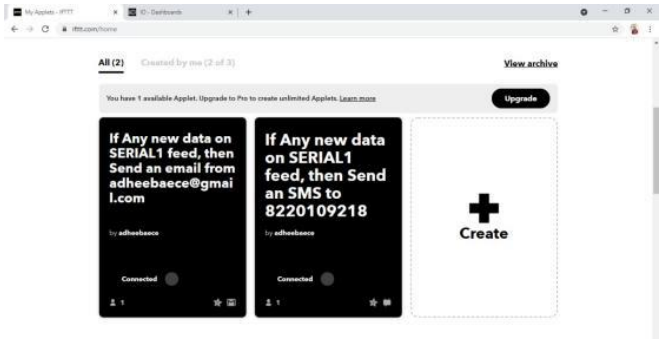

Fig. 19. Applets creation in IFTTT.

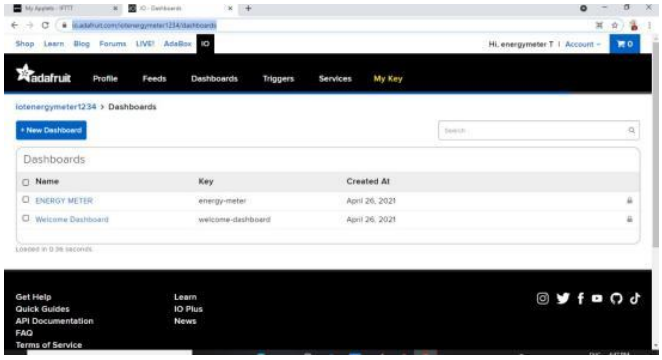

Fig. 20. Adafruit IO dashboard.

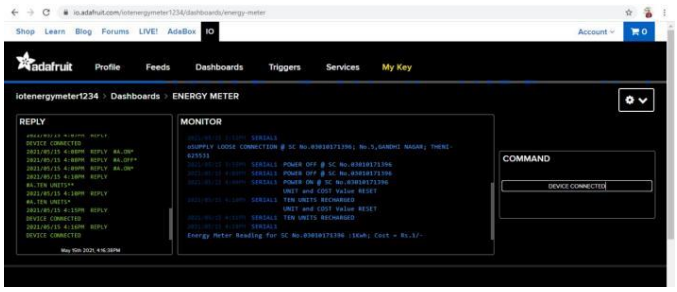

Fig. 21. Main window of Adafruit IO.

VIII. Future Scope

The task is centered around the public authority's arrangement to transform the significant urban communities of the country into savvy urban areas. The task gives the whole energy readings readily available. The venture can be additionally reached out to distinguish energy meter altering. A shrewd application can be intended to give different alarms dependent upon the measurements from the particular system. A complete gathered result can be provided to the clients to survey the energy consumption and a milestone to facilitate the bill internet leading the advanced Indian activity. In the situation that the specialist may assess the bills which are actually unpaid and can disengage the power association distantly.

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Comparison and Analysis of Pietra-Ricci Index Detector for Cooperative Spectrum Sensing

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***Abstract*–Generally, Wireless Communication is a technique of transporting data from one point to other, not including any link like wires, cables or any substantial medium. Cognitive radio (CR) based systems together with networks exist as a revolutionary new concept in wireless communications. Spectrum sensing is a vital parameter of cognitive network which avoids the dangerous intervention with licensed users and detects the available spectrum for enhancing the spectrum's utilization. Centralized cooperative spectrum sensing is a category of spectrum sensing. Once the sustained signal sample covariance matrix (SCM) is processed then the spectrum sensing will be established. Normally detectors are used to process the SCM. Examples of detectors are the Pietra-Ricci Index Detector(PRIDe), Hadamard ratio (HR) detector, the arithmetic to geometric mean (AGM) detector, the volume-based detectors (VD), the maximum minimum Eigen value detector (MMED), the Eigen value-based generalized likelihood ratio test (GLRT), and the Gini index detector (GID). The above detectors do not require the noise variance knowledge. Among the above detectors, the PRIDe has very less ciphering difficulty than the other ones. And also PRIDe has a high detection power when received signal is further mirror like or line of sight. This paper aims to simulate, analyze the performance of PRIDe detector with other detectors like GID, HR, AGM, VD, MMED, and GLRT, using MATLAB simulation tool.**

***Index Terms*–Cognitive radio, Pietra-Ricci index detector, cooperative spectrum sensing.**

I. INTRODUCTION

Along accompanied by this volatile extension during this amount about broadcast imparting customer and implementations, this count of wireless standards is increasing and is anticipated to continuously increase in future. As a result, the regulatory agencies, scientists, engineers and wireless product manufacturers all are facing a number of hard-hitting challenges in realizing

efficient wireless communication systems. The challenges include spectral crowding, interferences [5], coexistence of wireless services with different bandwidth requirements and use of limited spectrum optimally. With the licensed spectrum approach, spectrum resources could often be wasted. Spectrum exists allocated to customers or allowed to oneself operating a lengthy phrase ground ordinarily as vast sector such as territories. Execution in these, assets exists squandered, since higher-repetition regions are used very sporadically. For instance, in some cases the spectrum allocated to a service is more than what is required. Therefore, only part of the owed spectrum is used by that specific service and other portions of the spectrum become unused. Similarly, if a specific service in an allotted spectrum is not commercially victorious; the licensed spectrum may stay unexploited.

II. RELATED WORK

M. Lin et al in [1], proposed for GLRT access on numerous antenna deployed spectrum sensing. It also present the two multi antenna based spectrum sensing algorithms and give the statistical interference characteristics knowledge. Y. Arjoune et al in [2] surveyed the sensing of spectrum in cognitive radio networks and also viewed security threats in cognitive radio networks. This paper also explored varying spectrum profession nature in pulse and period. A. Bollig et al in [4] considered Eigen value based spectrum sensing in SNR walls. In [18], SNR barrier exists explained while each average about each trial statistics is above each SNR value. D. Ramirez et al in [5] estimated signal detection in cognitive radio networks with measured multi antenna. It also exploits the competitive independence of receiver thermal noise. L. Huang t al in [6] analyzed Hadamard Ratio Test for vigorous spectrum sensing. It also explained detection performance for Hadamard Ratio detector. R. Zhang et al in [7] viewed cognitive radio network in multi antenna based spectrum sensing. It also proposed sample covariance matrix obtained from the Eigen values of the signal vector received from multiple antennas. B. Nadler et al in [10] proposed Eigen value based signal detectors performance using identified and unidentified noise levels. It also analyzed the Eigen value based methods. A. Guimaraes et al in [11] explained Gini index detector under the uniform and non uniform situations. S. Zhu et al in [12] viewed the Probability distribution of Rician channel in urban and rural areas by means of real-time data and also it describes Rician K-factor of the wireless propagation. B. V. Frosini et al in [13] proposed Gini Pietra–Ricci measures and this paper subjected to cognitive radio applications. M. Lin et al in [14] observed spectrum sensing under interference and it also describes 5G wireless communication. D. A. Guimarães et al in [15]

presented Pietra-Ricci index detector for centralized data fusion cooperative spectrum sensing under the uniform and non uniform condition. A. L. Lemes et al in [16] suggested System-to-distribution parameter mapping for the Gini index detector test statistic via artificial neural networks K. M. Captain et al in [17] advanced SNR wall for cooperative spectrum sensing using generalized energy detector and it describes types of cooperative spectrum sensing under the fusion algorithm techniques. Bharathy G.T et al in [18] proposed development and research in the cognitive radio networks and it also describes Sustainable Communication Networks and Application. G.T.Bharathy et al in [19] viewed Cognitive Radio Networks Studies and Simulation of Spectrum sensing schemes. B.Thangalakshmi et al in [20] subjected to cognitive radio network reviews and also proposed 5G wireless communications.

III. System Representation

At the main customer conduct, each character exist subordinate customer is cooperated to collect the number of samples mn and then transferred to the fusion centre. Authorities exist set out like

$$Y \in C^{m*n} = HX + V, \tag{1}$$

Where $Y \in C^{m*n}$ - channel matrix and

$$H = GA, \tag{2}$$

Where, $A \in C^{m*s}$ has elements

$$H = GA$$

where K is the Rice factor.

$$\text{The matrix } G \in R^{m*m} = \text{diag}\left(\frac{p}{p_{avg}}\right)$$

Where $p = [p_1, p_2, p_m]^T$ - received signal vector in every secondary users, and

$$P_{avg} = \frac{1}{m}\sum P_i \tag{3}$$

where i = 1, 2,…,m. – average received power for each secondary users.

For spectrum sensing in the case of urban area, $V \in C^{m*n} : NC\left(0, \sigma^2 \times I_m\right)$, with I_m being the identity matrix of order m.

For spectrum sensing in the case of rural area, the i-th row of elements on **V** have variance σ_i^2 , i = 1, 2, m. The average variance is

$$\sigma_{avg}^2 = \left(\frac{1}{m}\right)\sum \sigma_i^2 \tag{4}$$

Where i = 1, 2… m, the received signal-to-noise ratio, in dB, averaged over all SUs, is

$$\text{SNR} = 10\,\boldsymbol{log}_{10}\left(\frac{P_{avg}}{\sigma_{avg}^2}\right) \tag{5}$$

$P_d = P_r$ (decision = H1| H1) and

$P_{fa} = P_r$ (decision = H1| H0),

Where H1 and H0 – presence hypothesis (i.e. **Y = HX + V)**

P_d - is the probability of detection

P_r - is the probability of false alarm rate.

IV. Proposed Experiment Statistics

At the fusion centre the SCM about each collected gesture exists

$$R = \frac{1}{\boldsymbol{n}} YY^{+} \tag{6}$$

Where + is the Hermitian operation .

The Pietra Ricci Index theorem states that those Eigen utilities exists covariance matrix (R) is,

$$\left|\lambda - r_{ij}\right| \le \sum \left|\boldsymbol{r_{ij}}\right|,$$

Where r_{ij} is the component of the i-th line and j-th pier of R, for I and j = **1, 2… m**

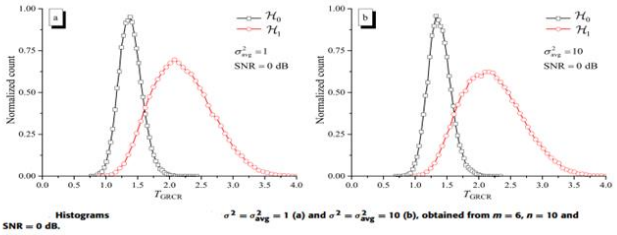


Fig. 1. Histogram of the PRIDe detector.

Depending on the response, the test statistics of Pietra Ricci Index Detector is given by

$$T_{PRIDe} \frac{\sum R_i}{\sum C_i} \tag{7}$$

Where i = 1, 2… m

Figure 1 shows that Pietra Ricci Index Detector histogram, under urban area with noise variance $\sigma^2 = \sigma_{avg}^2 = 1$ (a) and rural area the noise variance $\sigma^2 = \sigma_{avg}^2 = 10$ 10 (b), m = 6 SUs, n = 10 samples per secondary user, and SNR = 0 dB.

V. Contending Experiment Statistics

In this segment, the test statistics is used to give the comparison results in a short way and its aim is to give the present paper at identity nature. When the territory made over from urban to rural the PRIDe and ED performances are closer to each other. Since urban area have highest rice factor than the rural area and that the PRIDe [20] attains extremely high execution albeit each cereal element exist great.

A. Energy Detector Experiment Statistics

Energy detector is used to detect the spectrum hole by finding either each primary user gesture is present are absent during each frequency slot. This act never needs the grasp each PU parameters. The test statistics of energy detector is given by

$$\boldsymbol{T_{ED}} = \left(\frac{1}{\sigma^2}\right)\sum\left|\boldsymbol{y_{ij}}\right|, \tag{8}$$

i = 1, 2… m and
j = 1, 2… m

B. Eigenvalue-Based Experiment Statistics

In Eigen value based test statistics, the maximum and minimum eigen value detector is used to detect the signal existence and its finding is based on the random matrix theories.

The test statistics for maximum and minimum eigen value detector is given by

$$\boldsymbol{T_{MMED}} = \frac{(\lambda_1)}{(\lambda_m)} \tag{9}$$

The test statistics for maximum Eigen value detector is given by

$$\boldsymbol{T_{MED}} = \frac{(\lambda_1)}{(\sigma^2)} \tag{10}$$

The test statistics for generalized likelihood ratio test detector is given by

$$\boldsymbol{T_{GLRT}} = \frac{(\lambda_1)}{\left(\sum\lambda_i\right)}, \tag{11}$$

i = 1, 2… m

If the detector does not contain the primary user information than the generalized likelihood ratio test detector is often called arithmetic to geometric mean value detector. The test statistics of arithmetic to geometric mean value detector is given by

$$T_{AGM} = \frac{\frac{1}{\boldsymbol{m}}\sum\boldsymbol{\lambda_i}}{\boldsymbol{\Pi\lambda_i}}, \tag{12}$$

Where i = 1, 2… m

C. Hadamard Ratio Experiment Statistics

If the generalized likelihood ratio test detector have the uncalculated receiving information than the GLRT is often called Hadamard Ratio test detector. The test statistics of HR detector is given by

$$T_{HD} = \frac{\mathbf{det}(\boldsymbol{R})}{\boldsymbol{\Pi r_{ii}}}, \tag{13}$$

where R is the SCM (Sample Covariance matrix)
i = 1,2,…,m

In the noise uniform presence case the HR detector is considering a most valuable detector and it will be yielding low complexity performance.

D. Volume Based Experiment Statistics

Under the non uniform noise variations, the volume based detector is robust against these variations. The test statistics for volume based detector is given by,

$$\boldsymbol{T_{VD}} = \log\left[\det\left(E^{-1}\right)\right] \tag{14}$$

It can be noticed that the test statistics for volume based detector is more complexity than the Hadamard ratio detector..

VI. Methodological Discharge Cotemplation and SNR Screen

BENCH I. Emprical SNR screen, in decibels.

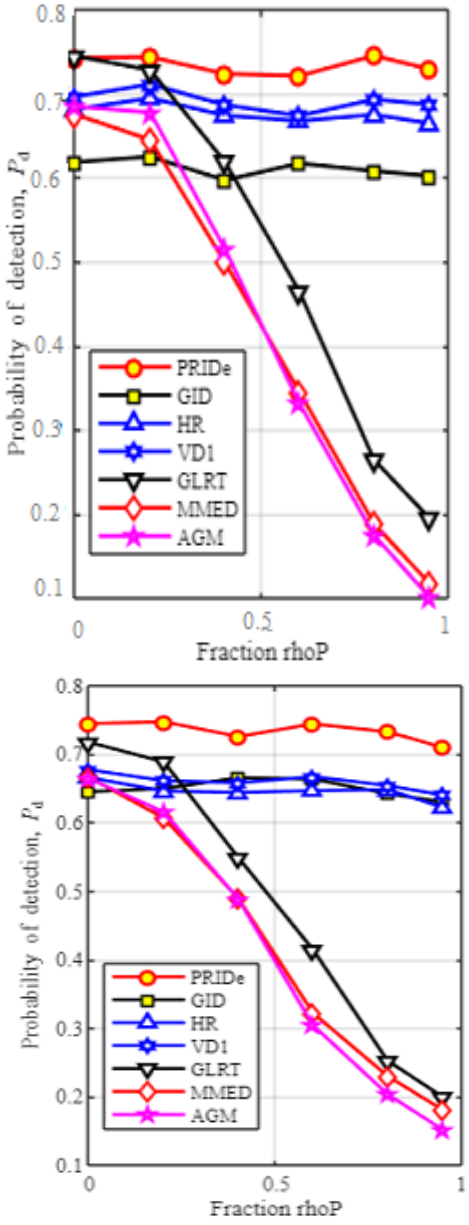
	PRIDe	**GID**	**AGM**	**HR**	**GLRT**	**VD1**	**MMED**
Urban	-30.0	-38.5	-15.5	-36.0	-18.5	-32.0	-17.0
Rural	-42.0	-40.0	-15.5	-34.0	-18.5	-31.5	-17.0

Bench I explains such if the scanner act never utilizes each conflict particulars then the SNR screen must be exist. When scrutinize that deportment, it should be realistic of swap on the midpoint SNR, from one environment to the other. Noted that in case of PRIDe each SNR screen about the GID exist little besides each other one, it means that any type of detector are produce good performance in the case of very low SNR schemes.

VII. Simulation Results

A. Probability of Detection (Pd) versus Fraction of Signal value about that Mean (rhoP):

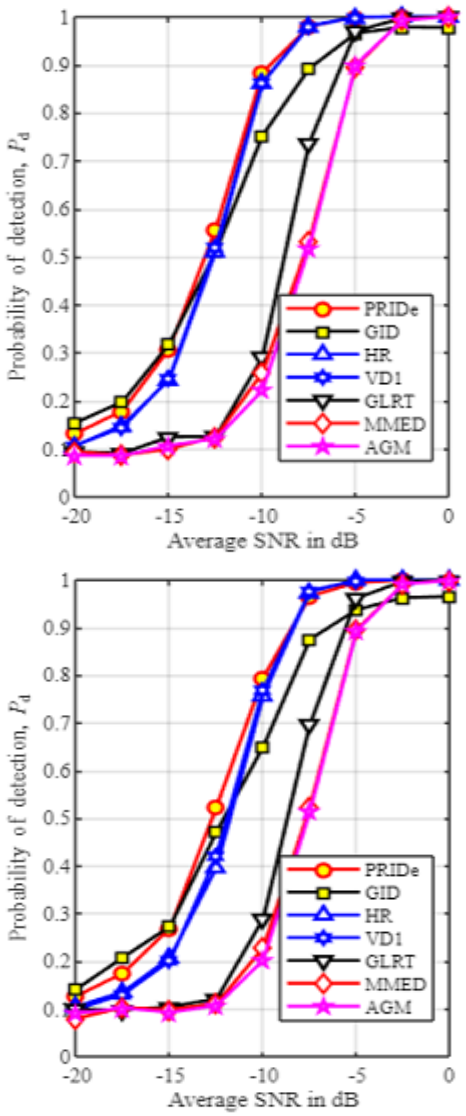
Pd contrast each snippet ρ such heaps the tumult and gesture ability disparity, for a built-up region and SNR = −15 dB (top), and for a pastoral region and SNR = −15.4 dB (bottom). This is limpid similar each scanners PRIDe, GID, HR and VD1 are extremely vigorous in case of certain dissimilarities. Such GLRT, the MMED and the AGM exist never sturdy by completely.



Pd contrast Pfa as m = 6, n = 250, and Pfa = 0.2: urban area and SNR = −15 dB (top); rural area and SNR = −15.4 dB (bottom)

B. Probability of Detection versus Average SNR:

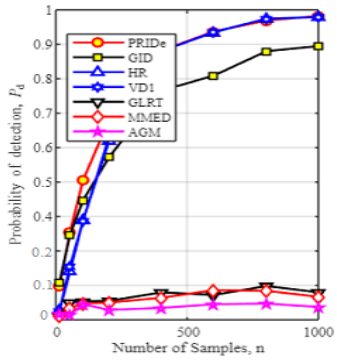
Pd contrast each mode SNR covering the secondary users, for built-up region and n = 250 (top), and for pastoral region each n = 140 (bottom). Significant PRIDe hold out similar or each finest show for some SNR, considerable each GID during extreme of each stare gluttony SNRs. Those scanners GLRT, MMED and AGM blab bad discharge ascribable to the non vigorous to gesture together with tumult capacity discrepancy, exclude by extremely lofty SNRs.

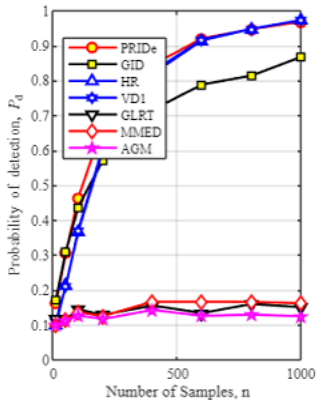


Pd contrast SNR as m = 6, ρ = 0.85, and Pfa = 0.2: urban area and n = 250 (top); rural area and n = 140 (bottom).

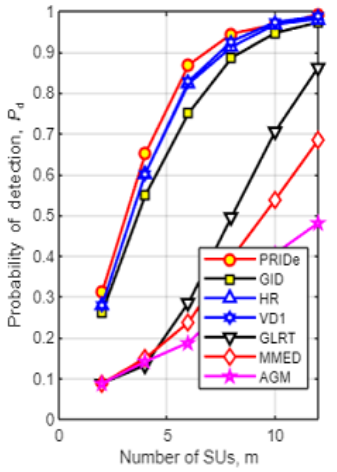
C. Probability of Detection versus Number of Samples (n) and Probability of Detection versus Number of Secondary Users (SU):

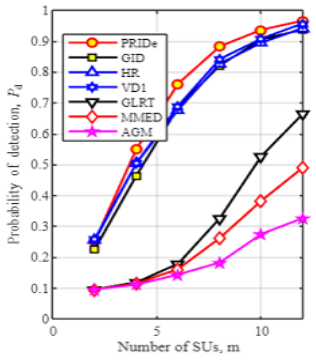
Pd contrast each figure based on trial n, since built-up region along with SNR = −12.5 dB (top), al well as considering a pastoral region and SNR = −13 dB (bottom). These impact about the numeral about secondary users m operating Pd exist constitute each built-up region each SNR = −12.5 dB (top), and for a pastoral region and SNR = −13 dB (bottom). Out of such statistic it receptacle exist discern such each PRIDe is able of beating thrashing further scanners as some n and m. Such GLRT, MMED and AGM exist futile during each system capitulate necessitous showing authorized to belonging to them deficient toughness against signal and noise power variations.





Pd contrast n as m = 6, ρ = 0.85, and Pfa = 0.2: urban area and SNR = −12.5 dB (top); rural area and SNR = −13 dB (bottom).





Pd contrast m as n = 150, ρ = 0.85, and Pfa = 0.2: urban area and SNR = −12 dB (top); rural area and SNR = −12.5 dB (bottom).

When each environment various between urban to rural, it can be detected comparable each shot each GID together with PRIDe suite near on one and all further. Such occur owing via each certitude the subject pastoral extent crop up exposed along the line of sizeable determinant ingredient apart from built-up region, operating centre, along with similar each PRIDe attains extremely superior presentations at the same time each cereal ingredient arise sizeable, Riveting abundant, each aperture connecting each presentation apropos the PRIDe and each further scanners examined meet enlarged albeit each territory altered out of built-up substitute pastoral.

VIII. Conclusion and Future Work

This paper simulates the Pietra-Ricci index detector (PRIDe) for cooperative sensing of spectrum and compares the result with other detectors such as GID, VD, HD, GLRT, MMED, and AGM using Matlab software by varying parameters such as SNR, fraction of signal, number of SU receiver and number of samples of SU considering urban and rural area in the richen channel. The simulation results shows that the mathematical difficulty of the PRIDe experiment metrics is the minimum and its performance is more efficient compared to various other blind detectors recognized in the survey. In addition, the PRIDe is efficient in the circumstances of time-varying non uniform received signals, noise powers and also accomplish a constant false alarm rate. This work can be extended and modified to other detectors and various other channels for applications in 5G networks.

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3D Image Segmentation Using Deep Learning Techniques

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***Abstract*–In recent years, with the speedy development in digital content identification, automatic classification of the images and the segmentation of images became the most challenging task in the fields of computer vision. Automatic understanding and analyzing of images by the system is difficult as compared to human visions. Much research has been done to overcome a problem in the existing classification system, but the output was narrowed only to low level image primitives. However, those approaches lack accurate classification of images. In this proposed system uses a deep learning algorithm to achieve the expected results in the area like computer visions. Our system presents a Region based Convolution Neural Network (CNN), a machine learning algorithm being used for the automatic classification of the images. Our system uses our data set as an image for classification and segmentation. The grayscale images in the data set used for training require more computational power for the classification of images. By training the images using the RCNN network we obtain the accuracy result in the experimental part it shows that our model achieves high accuracy in the classification of images.**

I. INTRODUCTION

Image segmentation is one of the most important methodology for image processing. There are many applications on the synthesis of the objects require segmentation. Image classification is a big problem in computer vision for decades. In the case of humans the image understanding, and classification is done but in the case of computers, it is an extremely expensive task. In general, each image is composed of a set of pixels, and each pixel is represented with different values. Henceforth to store an image the computer must need more space to store data. This requires systems with higher configuration and more computing power. In real-time to make decisions on the input is not possible because it takes more time for performing these many computations to provide results. By using the Convolutional Neural Network (CNN) deep learning concept. Its uses the different pooling layer in CNN for extraction of the feature which are useful for perfect classification of images and target detection. The Convolutional Neural Network, a machine learning algorithm is being used for image classification. CNN having three different layers such

1. Input layer,
2. Hidden layer, and
3. Output layer.

In general, images are constructed as a matrix of pixels and these pixel values are given as input to the input layer along with weights and biases for non-linearity.

The output layer is a fully connected layer is used to classify the image to which class it belongs to. The hidden layer may be convolutional, pooling, or fully connected. When an image is given as input and the classifier shows to which class it belongs to Human brain belongs to this is one of the examples of the recent development in the field of artificial intelligence. For this project, the image data is provided as input from the real world and the decisions are made based on the information gained from the image. If the input image has given as 2D brain, it will detect whether it has any tumor-like structure or block is present it will show clearly as a 3D image with segmentation and Classification.

II. OBJECTIVE OF THE WORK

2D to 3D conversion of medical image. The objective of image segmentation is to modify the illustration of an image into one thing that's additional real and easier to grasp. It's basically accustomed discover the placement of objects, boundaries, lines then on within the digital pictures. Additional exactly, image segmentation is that the method of distribution a label to each element within the image such pixels with a similar label share bound visual characteristics or options. The image will then instead be taken employing a little range of well-defined parts as critical an oversized array of unrelated pixels. Image segmentation is that the method of distribution a label to each element in a picture such pixels with a similar label share bound visual characteristics.

The scope of AI can involve spoken commands, anticipating the data necessities of governments, translating languages, recognizing and chase folks and things, diagnosis medical conditions, performing arts surgery, reprogramming defects in human DNA, and automatic driving all styles of transport. The particular implementation of the project is image process that extracts data from pictures and integrates it for many applications. There are several fields within which

can process applications square measure relevant to medical imaging, segmentation and classification these square measure the some applications and scope of this project.

A. Image Segmentation

Image segmentation is presently the state of art technique in image segmentation field of analysis. It works on pictures that are of three dimensions. i.e) height, weight, and range of channels. 1st 2 dimensions tell nation the image segmentation represents the amount of channels or intensity values for red, inexperienced and blue color. Therefore the task of image segmentation is to coach a neural network to output of a pixel-wise mask of the image. This helps in understanding the image at a way lower level, i.e., the element level. Image segmentation has several applications in medical imaging, self-driving cars and satellite imaging.

B. Image Classification

Image classification is that the primary domain, within which deep neural networks play the foremost vital role of medical pictures analysis. The image classification accepts the given input pictures and produces output classification for distinctive 4 whether the sickness is gift or not in human organs. In image classification CNNs are the recent state of the art ways. The CNNs learned regarding natural pictures, organ pictures showing robust performance and encountering the accuracy of human specialists systems. Finally these statements conclude that CNNs may be improved to regulate the essential design of medical images.

C. 2D AND 3D Comparison

2D CNNs use second convolution kernels to predict the segmentation map for one slice. Segmentation maps area unit foretold for a full volume by taking predictions on one slice at a time. The second convolution kernels area unit ready to leverage context across the peak and dimension of the slice to create predictions. However, as a result of second CNN take one slice as input, they inherently fail to leverage context from adjacent slices. 3D CNNs address this issue by exploitation 3D convolution kernels to create segmentation predictions for a volumetrically patch of a scan. 2D and 3D CNNs were trained for the task of automatic segmentation of the tumor from tomography.

III. FIELD STUDY

The planned model outperformed the organic process 3D model mistreatment less computation and time interval and resulted in a minimum of seventy fifth saving in time and computation.

Also, compared to manually–designed 3D networks, our planned 3D networks obtained higher accuracy. Evolution strategies: This paradigm was introduced by Rechenberg and Schwefel within the Seventies. During this approach, a vector of real-valued numbers is evolved through choice and mutation, whose strength is usually regulated by means that of self-adaptation. Neuro-evolution is that the name given to a field of computing that applies organic process computation for evolving some aspects of neural networks. Whereas several works have tried to counsel rules-of-thumb for planning topologies, the reality is that there aren't analytic procedures for determinant the best one for a given drawback, and trial-and-error is usually used instead.

Neuro-evolution conjointly differs from deep learning (and deep reinforcement learning) by maintaining a population of solutions throughout search, enabling extreme exploration and big parallelization. Finally, because neuro-evolution analysis has until recently developed for the most part in isolation from gradient-based neural network analysis, it's developed several distinctive and effective techniques that ought to be effective in alternative machine learning areas too [1]. The recent breakthroughs of Neural style Search (NAS) have actuated varied applications in medical image segmentation. However, most existing work either just view as hyper-parameter standardization or carry on with a group network backbone, thereby limiting the underlying search space to identify further economical style [2]. In this article it tries to summarize a broad spectrum of FNN optimisation methodologies together with typical and metaheuristic approaches. This text additionally tries to attach varied analysis directions emerged out of the FNN optimisation practices, like evolving neural network (NN), cooperative coevolution NN, complex-valued NN, deep learning, extreme learning machine, quantum NN, etc [3]. Evolutionary computation provides a number of the attention-grabbing avenues to automatic divide-and-conquer strategies. associate degree in-depth study of such strategies reveals that there's a deep underlying affiliation between biological process computation and ANN ensembles. Ideas in one space is usefully transferred into another in manufacturing effective algorithms [4].

This work focuses on utilizing Particle Swarm improvement (PSO) to automatically explore for the simplest style of CNNs with none manual work involved. The planned formula is examined and compared with twelve existing algorithms alongside the state-of-art ways on three wide used image classification benchmark datasets. The experimental results show that the planned formula is also a sturdy contestant to the state-of-art algorithms in terms of classification error. Usually this can be often the first work victimization PSO for automatically evolving the architectures of CNNs [5].

With this survey, it provide a formalism that unifies and categorizes the landscape of existing ways in conjunction with an in depth analysis that compares and contrasts the various approaches. This paper reach this via a comprehensive discussion of the unremarkably adopted design search areas and design optimization algorithms supported principles of reinforcement learning in conjunction with approaches that incorporate surrogate and one-shot models. in addition, This tend to address the new analysis directions that embrace strained and 8 multi-objective design search similarly as machine-driven knowledge augmentation, optimizer and activation perform search[6]. In this paper pro-poses a new Evolutionary Algorithm, named EvoDeep, devoted to evolve theparameters and the architecture of a DNN in order to maximize its classifica-tion accuracy, as well as

maintaining a valid sequence of layers. This model is tested against a widely used dataset of handwritten digits images [7]. Adversarial work has semiconductor diode to breakthroughs in many medical image segmentation tasks. Throughout this work, a neural style search framework for adversarial medical image segmentation. This have a tendency to tend to automatize the tactic of neural style vogue for the soul with continuous relaxation and gradient-based improvement. This has a tendency to show the benchmark dataset for chest organ segmentation [8]. In this paper, to improve the FCNN performance for prostate MRI segmentation, we analyze various structures of shortcut connections together with the size of a deep network and suggest eight different FCNNs-based deep 2D network structures for automatic MRI prostate segmentation [9]. A collection of twenty clinical pictures with reference segmentations was provided to coach and tune algorithms earlier. Participants were conjointly allowed to use extra proprietary coaching information for that purpose [10].

The testing set solely contains DICOM pictures. In CT cases solely livers were annotated. In tomography cases, livers, left/right kidneys, and spleens were annotated [11].

In this paper, we have a tendency to use a continual network to come up with the model descriptions of neural networks and train this RNN with reinforcement learning to maximise the expected accuracy of the generated architectures on a validation set [12].

In this work, we tend to propose a usually applicable framework that introduces solely minor changes to existing optimizers to leverage this feature [13]. Automated prostate segmentation from 3D mister pictures is incredibly difficult thanks to giant variations of prostate form and unclear prostate boundaries. we have a tendency to propose a unique meter convolutional neural network (ConvNet) with mixed residual connections to deal with this difficult downside. Compared with previous ways, our meter ConvNet has 2 compelling blessings [14].

IV. Methodology

A. Genetic Algorithm

Genetic algorithms search the answer area of a perform through the employment of simulated evolution, i.e., the survival of the fittest strategy. Genetic algorithms are shown to resolve linear and nonlinear issues by exploring all regions of the state area and exponentially exploiting promising areas through mutation, crossover, and choice operations applied to people within the population that is individual solutions analogous to chromosomes of the state area. These operators that place confidence in likelihood rules, square measure applied to the population, and sequential generation's square measure created. In general, the beginning hunt for associate optimum resolution begins with an at random generated population of chromosomes. Every generation can have a brand new set of chromosomes obtained from the applying of the operators. A fitness, or objective perform, is outlined consistent with the matter. The formula terminates either 20 when a group of generation variety is reached, or the fitness has reached a "satisfactory" level.

V. Implementation

A. Mask R-CNN

Mask R-CNN is conceptually simple quicker R-CNN has 2 outputs for every candidate object, a category label and a bounding-box offset; to the present we tend to add a 3rd branch that outputs the article mask.Mask R-CNN is so a natural and intuitive plan.

However the extra mask output is distinct from the category and box outputs, requiring extraction of a lot of finer spatial layout of associate degree object. Next, this tend to introduce the key parts of Mask R-CNN, together with pixel-to-pixel alignment, that is that the main missing piece of Fast/Faster R-CNN. Mask R-CNN: Mask R-CNN adopts a similar two-stage procedure, with an even initial stage (which is RPN). Within the second stage, in parallel to predicting the category and box offset, Mask R-CNN additionally outputs a binary mask for every ROI. Binary image segmentation using six classification methods and efficient parameter selection for each network was implemented in this project. In most cases, high accuracy and consistency of the classification algorithms were achieved.

Although Neural Networks performed well in this classification problem, it is more highly recommended for prediction problems and predictive models.

VI. Procedure

When a divide or partition the image into varied elements known as segments. It's not a good plan to method the whole image at an equivalent time as there'll be regions within the image that don't contain any info. By dividing the image into segments, it'll due to the necessary segments for process the image. A picture may be an assortment or set of various pixels. This tend to cluster along the pixels that have similar attributes exploitation image segmentation. Take an instant to travel through the below visual. Object detection builds a bounding box appreciate every category within the image. However it tells United States nothing regarding the form of the article. This tend to solely get the set of bounding box coordinates. This would like to induce additional info – this can be too imprecise for our functions. Image segmentation creates a pixel-wise mask for every object within the image. This method provides United States a much more granular understanding of the object(s) within the image. within the below diagram the technique used is termed as Convolution neural network, during this technique it's ab initio implement by giving the input image, then that image should be processed by the given technique of RCNN. If the image is processed and so it's to be divided by exploitation some formula when segmenting 28 the image, the technique is employed to find the image and so classified to spot whether or not the tumor is gift or not within the given input brain image. If tumor is gift the output shows the given brain includes a tumor, if not it show the output as not a tumor.

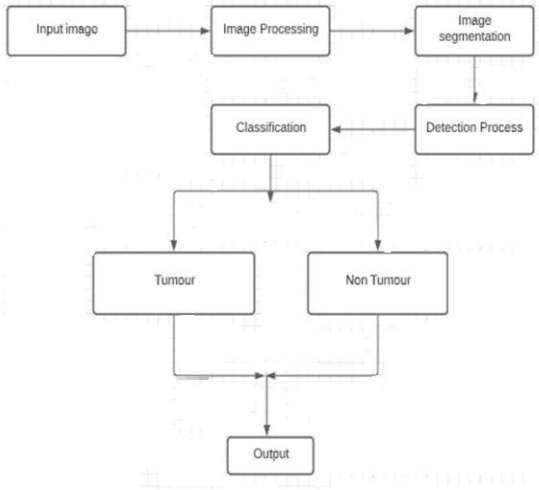

Fig. 1. Workflow diagram.

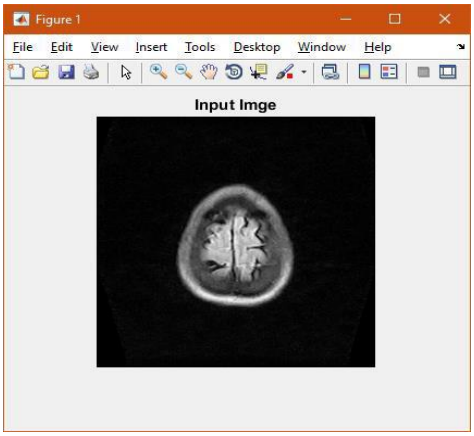

Fig. 2. Input image.

A. *Image After Segmented*

The following Fig. 3 show the output of the DICOM image after resizing (256*256) of original DICOM image in preprocessing.

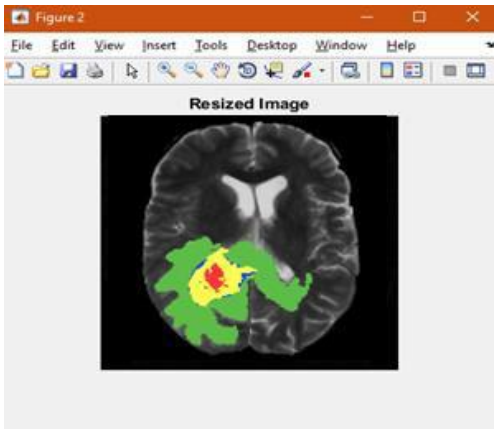

Fig. 3. Segmented image.

B. *Image After Classified*

The following Fig. 4 show the output of the image to be classified.

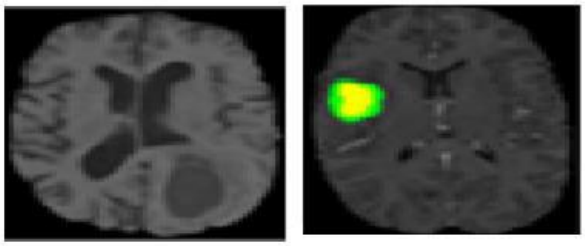

Fig. 4. Classified image.

C. *Results of 3D Images*

If the image is processed and then it is to be segmented by using mask RCNN algorithm after segmenting the image, the binary classification technique is used to detect the image and then classified to identify whether the tumor is present or not in the given input brain image. If tumor is present the output shows the given brain has a tumor, if not it show the output as not a tumor.

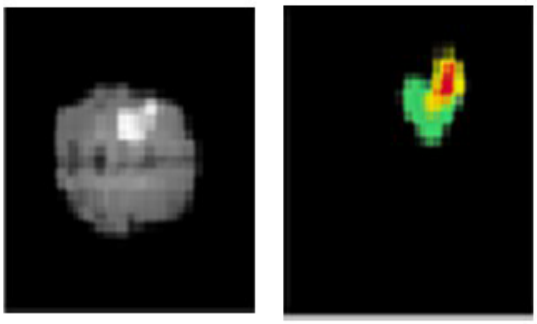

Fig. 5. Output image.

VII. V. Conclusion

In our project the technique used is called as Convolution neural network, in this technique it is initially implement by giving the input image, then that image must be processed by the given method of RCNN. If the image is processed and then it is to be segmented by using mask RCNN algorithm after segmenting the image, the binary classification technique is used to detect the image and then classified to identify whether the tumor is present or not in the given input brain image. If tumor is present the output shows the given brain has a tumor, if not it show the output as not a tumor.

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Deep Learning Architectures for Multi-Class Artefacts Segmentation in Endoscopic Images: A Review

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***Abstract*—Endoscopy is an advanced non-surgical clinical procedure used to examine hollow organs like upper and lower gastrointestinal tract. It is used for detecting abnormalities like polyp, inflammation, Barret's disease and so on. The endoscopic images and videos captured during the procedure is affected by several types of artefacts such as pixel saturation, motion blur, specular reflections, bubbles, blood, contrast, miscellaneous artefacts and Instruments. For a robust Computer Aided Detection (CAD) tool it is a significant challenge to delineate the boundaries of such artefacts which lack in prominent geometrical structures. This paper reviews and summarizes the state-of-the-art segmentation algorithms used in the field to segment multiclass artefacts. In the context of drawing a concluding remark to this survey, almost every algorithm lacks in delivering an acceptable inference time and accuracy, in future which may be improved so that the algorithms could be integrated into robotic surgery.**

***Index Terms*—Endoscopy, semantic segmentation, instance segmentation, deep learning.**

I. Introduction

Advancement in imaging technique and miniaturisation of hardware has extended the endoscopic procedures not only to gastrointestinal tract but also to respiratory tract, urinary tract, female reproductive tract, joints and so on. The main reason in carrying over the endoscopy procedure is to investigate, diagnose and treat cancers, cauterise a bleeding vessel, remove a polyp and many more. During this procedure an endoscope, a long thin flexible or a rigid tube attached with a camera and a light delivering system at the tip is used. This device is inserted through the opening of the body or through small incisions. The video or images captured during the procedure is affected by several artefacts. It directly increases the difficulty in viewing the underlying tissue and also affects the associated post analysis methods. Due to the presence of multiple artefacts most of the frames are discarded. For efficient detection and segmentation of endoscopic artefact, improved patient care and improving quantity of usable video frames, state of art techniques are essential.

In the past two decades one of the challenging branch of computer vision is image segmentation where an unknown image must be segmented into different objects that are predefined. It is considered to be complex than classification and object detection. Segmentation algorithms in general can be broadly classified into classical computer vision based techniques and Artificial Intelligence (AI) based techniques. Recent developments in the AI based technologies includes Deep Learning based segmentation algorithm that exhibits remarkable performance. Two groups of segmentation algorithm is in practice namely semantic segmentation and instance segmentation algorithms. Semantic segmentation process links every pixel in the image to a specified class, whereas instance segmentation delineates every instance of known objects. Varity of algorithms were been proposed in recent years under both the groups namely U-Net[1], Pyramid Scene Parsing Network (PSPNet) [2], Mask Region based Convolutional Neural Network (Mask R-CNN) [3], DeepLabV3[4] etc. Powerful algorithms, voluminous data and high computation power has led the segmentation algorithm to root itself into various applications such as autonomous vehicles, satellite imaginary, segmentation of abnormalities in medical images and so on.

This survey provides an extensive coverage of all top performing image segmentation algorithms applied in the field of endoscopic artefact segmentation. The rest of the article is structured into sections as briefed below. Section II discusses on review methodology. Section III on general imaging artefacts found in endoscopic images/videos. Section IV describes about various outperforming segmentation algorithms used in the field of multiclass artefact segmentation. Section V discusses about datasets and evaluation metrics followed by section VI with concluding remarks.

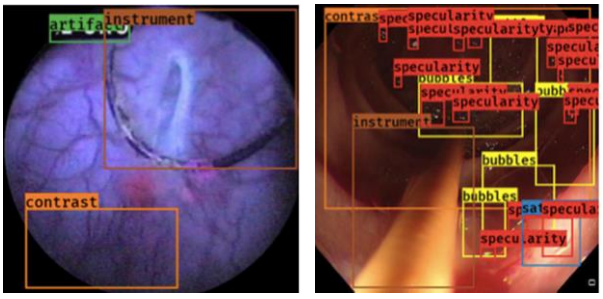
II. Methodology of Review

The literature review reported in this paper begun by collecting articles reporting research related to semantic and instance segmentation of multi-class artefacts in endoscopic

images. The various architectures, techniques used to improve the performance, role of data augmentation technique, various other parameters and performance metric used by the authors was studied. Subsequently, a search was done to gather details on dataset available for the purpose of segmentation of endoscopic artefacts and are reported in this paper. The articles were reviewed by considering the above-mentioned aspects and the research activities are briefly reported in the following sections of this article.

III. Artefacts in Endoscopic Images

An artefact is an artificial effect observed in a resultant image but not actually present in the original image. The reason for it may be due to mishandling of the imager, physical phenomena of human body etc. In an endoscopic image there are few major artefacts that occur predominantly. They are pixel saturation, specularity, contrast, motion blur, instruments, blood, bubbles and miscellaneous artefacts. Surgical smoke is also considered to be an artefact in present days. An endoscope is attached with camera assisted by a light delivery system to illuminate the organ that is under inspection. This light can interact with the underlying tissue and the surrounding fluid and generate a bright pixel area which causes artefact called pixel saturation and specularity. Contrast occur due to variation in viewing angle and occlusions. All the instruments are mounted very close by due to miniaturisation of hardware. A small hand movement causes blurring in the captured video which causes the artefact called motion blur. Clutters of gastrointestinal fluid, debris and bubbles pose limits on viewing the underlying tissue. Instruments fall within the region of camera vision creating difficulty in viewing the tissue underneath. During surgical procedure blood oozes out which occludes the neighbouring region, which may also be a symptom of gastrointestinal disease. Surgical smoke is a major issue during minimal invasive surgical procedure where a special instrument is used to suck the smoke.



(a) (b)

Fig. 1. (a) &(b) Artefacts in Endoscopic Images. Image Source [5].

Thus all the above artefacts affects the computer assisted endoscopic methods in practice and also the post processing techniques like video frame retrieval for report preparation, video mosaicking and 3 dimensional (3D) reconstruction which helps in patient follow up. The challenge behind the scenario is that the artefacts occurs at various locations with different geometrical structures, too many artefacts are crowded at same location where a pixel may belong to one or more artifact, thus making the segmentation process more complex. Examples of the commonly occurring artefacts is shown in Fig. 1.

IV. Deep Learning Algorithms for Multi-Class Artefact Segmentation

A. History of Deep Learning Based Segmentation Algorithms

Deep learning based segmentation algorithms has an enormous impact in the field of medical science. Long et al.[6] proposed a Fully Convolutional Network(FCN) for semantic segmentation. This became the first ever high impact model for Convolutional Neural Network(CNN) based segmentation methods, where pixel-wise output is calculated by up sampling the output activation maps. The next notable architecture developed in the year 2015 was SegNet [7], the network up samples input feature maps of low resolution too. In the same year Ronneberg et al. presented a network architecture called U-Net[1], which address vanishing gradient problem. The architecture was well suited for biomedical image segmentation. Following U-Net, a similar architecture called V-Net [8] was proposed by Milletari et al. in the year 2016. The architecture includes 3D operation and residual connections. During the same time DenseNet [9] was developed. Several modifications were proposed by many authors with the above network structures as a base.

In every architecture backbone network plays a major role. FCN adopts VGG-16 net[10], it also considers AlexNet by Krizhevsky et al. [11] and GoogLeNet by Szegedy et al. [12]. ResNet by He et al.[13] made a remarkable breakthrough and its variants are still been used in many applications. ResNeXt [14], Google's Inception series of backbone network[15][16][17] has performed well in many applications and it is been the best performing algorithm till date. Apart from choosing a best backbone lot of research works combine pyramid based architectures to the existing CNN architecture to combine semantically weak and strong features. Such pyramid based networks can be classified under image pyramid, ASSP(Atrous Spatial Pyramid Pooling), feature pyramid and pooling pyramid. With this overview the following section reviews the algorithm in the literature for segmentation of endoscopic artefacts.

B. Algorithms for Endoscopic Artefact Segmentation

All the proposed algorithms for endoscopic artefact segmentation show variation across segmenting different class of artefacts and also shows up difficulty in handling class overlap. It arises due to irregular shaped structures of the artefacts which convolutional kernels find difficult to identify. The comparison of methods are done based on standard performance metrics.

Suhui Yang and Guanju Cheng (2019) [18] took Deeplabv3+ network with two different backbones like ResNet101 and MobileNet for segmentation. The author

added 5 convolutional layers for extracting features. The layers include one 1x1 convolution layer, three 3x3 convolution layers and one global pooling layer. The features extracted were merged and up-sampled for segmentation. The author used Adam as optimizer and set a learning rate of 0.007. The author selected multi-class sigmoid loss function. To avoid over-segmentation marker based water-shed segmentation was used. They proved that merging the backbones improved the algorithm performance.

Pengyi Zhang, Xiaoqiong Li and YunXin Zhong (2019) [19] proposed Ensemble Mask-aided R-CNN. Basic Mask R-CNN was first trained using images from the training set of segmentation task. In order to perform both detection and segmentation, instance masks were bounded by bounding box annotations from detection training set. Later the trained network was used to predict the instant masks for sample images of detection training set which does not contain pixel level labels. At this stage mask prediction for ground truths were enforced and the predicted instance masks were been termed as soft pixel level labels, which was later assigned to the training samples. The pixel level labels generated were been added to the training set and Mask R-CNN was retrained. The trained network was then termed as Mask aided R-CNN. The same step was repeated to improve the accuracy. The architectures were been trained with different backbone. The technique of using ensemble module was introduced to improve the performance.

Qingtian Ning, Xu Zhao and Jingyi Wang (2019) [20] proposed a model called Deep Layer Aggregation – 60(DLA-60) for region segmentation. This network merges features iteratively and hierarchically for improving the performance and also to reduce the number of parameters. The author used techniques like weighted multi-class dice loss, Stochastic Gradient Descent(SGD) optimizer and poly learning rate to improve the performance of the network.

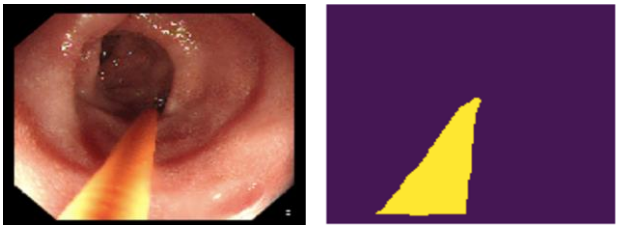
Shufan Yang and Sandy Cochran (2019) [21] has put forward an architecture based on U-Net. CNN was used as encoder to extract spatial features and transposed convolution concept was used as decoder. Poly learning rate policy was deployed during the training process. ResNet50 pretrained on ImageNet was used in the architecture as backbone for extracting features for semantic segmentation.

OxEndoNet by Mourad Gridach and Irina Voiculescu (2020) [22] uses Pyramid Dilated Modules(PDM). It consists of parallelly stacked multiple dilated convolutions. To maintain spatial resolution very large receptive field is essential which is taken care by PDM modules. Many pyramid architectures were combined to form OxEndoNet.

U-Net with SE-ResNeXt50 backbone was adapted by Hoang Manh Hung et al.(2020) [23]. The author selected the network as it tackles the class imbalance problem and it has the ability to retrieve the hidden fragments that are present in the images. The author used binary cross entropy loss and dice loss. The author preferred using pre-trained weights to reduce training time and improve performance.

Anand Subramanian and Koushik Srivatsan (2020) [24] considered two models namely U-Net with ResNet50 backbone and DeeplabV3 with Xception backbone. The authors used weights pretrained on ImageNet dataset. Efficient and Accurate Scene Text(EAST) detector was used to detect the text present in the endoscopic image which was considered as a miscellaneous artefact in the dataset. Augmentation of training set with traditional techniques like scale variation, rotation, varying hue and saturation, rotation, noise addition, blurring, sharpening and contrast changes was deployed. Test time augmentation was also used. An ensembled architecture by combining DeepLab and U-Net architectures was used with pixel wise voting technique for better performance.

Vishnusai Y., Prithivi Prakash and Nithin Shivashankar (2020) [25] proposed a U-Net based model. The network was trained with various backbone and augmented data. Out of all experiments U-Net with ResNeXt50 backbone performed well. The authors utilized various architectures from segmentation model framework. The trained architecture produced result with good Intersection over Union(IoU) scores. The predictions for a sample test image is shown in Fig. 2.



(a) (b)

Fig. 2. (a) Sample test image (b) Segmentation of instrument by U-Net based model . Image source [25].

Yun Bo Guo et al.(2020) [26] took DeepLab v3+ architecture as base for semantic segmentation and proposed a novel architecture called DeepEAD. First the authors took original DeepLabv3+ and replaced SE-ResNext50 as backbone for extracting better features. In the above modified network global pooling layer was replaced by 3 x 3 convolutions. Next squeeze and extraction modules were added with ASSP module. Test time augmentation techniques were used. The author gave a remark that the test time augmentation does not show significant improvement in the performance of the algorithm.

Le Duy Huýnh and Nicolas Bountry(2020) [27] proposed architectures based on U-Net and U-Net++. EfficientNet was used as backbone which was expected to have balance between resolution, network depth and width. Specifically EfficientNet B1 was used. Feature maps were extracted at five different scales from EfficentNet which act as input to the decoder stage. Several data augmentation techniques were used along with pretrained weights trained on ImageNet dataset to reduce training time and avoid overfitting. Test time augmentation was also used to improve results.

Suyog Jadhav et al. (2020) [28] came up with a novel multi-plateau ensemble of Feature Pyramid Networks. EfficientNet was used as feature extractor. Eight plateaus with permutation

of four different loss function (Dice, Binary Cross Entropy(BCE)+Dice, BCE, BCE+Dice+Jaccard) and two different optimizers(Ranger and Over9000) was used for three different encoders ranging from EfficientNet B3 to B5. The networks that performed well with Dice score of 0.47 or greater was considered for ensemble methods. Multi stage training was also employed for boosting the network performance.

Table I summarizes the performance of every architecture evaluated by the corresponding authors. It is clear that almost all the models uses deep learning technique for semantic and instance segmentation, but the performance reported in every article vary diversly. Most of the researchers notably used existing state of the art algorithms with various backbones, employed ensemble approach, introduced various augmentation techniques during training and testing, introduced spatial pyramid pooling, tried employing various optimizers and so on. Deep learning architectures like U-Net, DeepLab and Mask R-CNN are found to be popular among researchers. All the above techniques were used to capture the finest features of every artefact and segment the same to the best.

TABLE I. PERFORMANCE OF VARIOUS ALGORITHMS ON MULTI-CLASS ARTEFACTS SEGMENTATION

S.No.	Reference article reporting multi-class segmenation	Various architectures trained by authors	Segmentation Score		
			Overlap	F_2 Score	$Score_s$
1.	Suhui Yang and Guanju Cheng(2019)[18]	DeepLab v3 with ResNet101 Backbone	0.6288	0.6795	0.6414
1.		Ensemble of DeepLab v3 with ResNet101 & MobileNet backbone	0.6592	0.6937	0.6568
1.		Ensemble + post processing	0.6612	0.6964	0.6700
2.	Pengyi Zhang, Xiaoqiong Li and YunXin Zhong (2019)[19]	Ensemble Mask Aided R-CNN with ResNet101 backbone	0.5558	0.5701	0.5594
3.	Qingtian Ning, Xu Zhao and Jingyi Wang (2019)[20]	DLA-60(crf)	0.5206	0.5661	0.5320
1.		DLA-60	0.4352	0.4784	0.4460
4.	Shufan Yang and Sandy Cochran (2019)[21]	U Net	0.36	0.48	0.42
1.		DeepLabv3+	0.54	0.56	0.55
1.		UNet-D	0.39	0.44	0.41
5.	Mourad Gridach and Irina Voiculescu(2020)[22]	OxEndoNet	0.4901	0.5107	0.5194
6.	Hoang Manh Hung et al.(2020)[23].	UNet+SE ResNext50 backbone	-	-	0.5700
7.	Anand Subramanian and Koushik Srivatsan (2020) [24]	Ensemble of DeepLab+UNet+East Detector	Dice Score- 0.42946		0.4966
1.		DeepLab	Dice Score -0.39998		0.4574
8.	Vishnusai Y., Prithivi Prakash and Nithin Shivashankar (2020) [25]	UNet+ResNext50 backbone	-	-	0.5187
9.	Yun Bo Guo et al.(2020) [26]	Net 1- DeepLabv3 + SEResNeXt 50 backbone	-	-	0.48
1.		Net 2- Net 1 with 3*3 convolution instead of global pooling	-	-	0.59
1.		Net 3- Net 2 with squeeze and excitation module	-	-	0.52
1.		Net 3 with test time augmentation	-	-	0.5922
10.	Le Duy Huýnh and Nicolas Bountry(2020)[26]	UNet++ with EfficientNet B1 backbone	-	-	0.5913
1.		UNet++ with EfficientNet B2 backbone	-	-	0.5397
11.	Suyog Jadhav et al.(2020)[27]	Multi-Plateau ensemble of FPN and EfficentNet B3	Dice Score- 0.4917		

In a nutshell, it is evident from the output scores reported by the researchers in the articles that significant improvement must be made on segmenting every artefact. It is clear that artefact like specularity pose a major challenge to all segmentation algorithms due to too many overlaps and irregular shape. On the other hand segmenting instruments was found uncomplicated.

V. DATASETS AND EVALUATION METRICS

A. Datasets

In the past decade lot of researches were done to detect and segment single artefacts like bleeding[29], instrument[30], and pixel specularity [31]. In practical cases most of the artefacts occurs in single frame thus making multiclass artefact detection and segmentation more challenging. There are only two datasets available for multiclass artefact detection and segmentation so far. The condensed view of both the datasets are given in Table II. Both contains limited images, datasets with more frames for the purpose may be helpful for the design of a robust segmentation algorithm in the future.

EAD2019: EAD2019 dataset was the first ever dataset available to the public for endoscopic artefact detection, segmentation and generalization. This dataset covers seven different artefacts that occurs primarily in endoscopic images during examination and diagnosis. They are specularity, saturation, blur, bubbles, contrast, miscellaneous artefacts and instruments, all suggested by senior clinicians. The images were collected from six different medical centres worldwide. It is a multiorgan dataset comprising images of esophagus, colon, bladder, liver and stomach. It is also a multi-modality dataset where images covers various modalities like white light, narrow band imaging and fluorescence light. All the images were taken using standard endoscopes manufactured by Karl storz, Olympus and Biospec. Images were annotated with help of senior clinicians and post-doctoral fellows and validated by two expert clinical endoscopists. Original dataset contains training and test set but only training set is made available to the public which serves detection, segmentation and generalization. It contains 2147 frames annotated covering seven different artefacts for detection and 475 frames for segmentation covering five classes namely specularity, saturation, bubbles, miscellaneous artefacts and instruments. The dataset can be accessed through Mendeley database[32].

EAD2020: The dataset was curated from 280 diverse endoscopic video frames from seven different medical institutions across the globe. It is a multi-patient, multi-modality and multi-organ database. It covers artefacts like specularity, saturation, bubbles, blur, blood, instruments, contrast and miscellaneous artefacts. The dataset contains 2536 annotated frames for detection and 735 images with binary masks for segmentation. The segmentation could be done only for five artefacts namely specularity, saturation, bubbles, instruments and miscellaneous artifacts. This dataset can be accessed through Mendeley database [33].

TABLE II. CONDENSED VIEW OF PUBLIC DATASET.

Dataset	Number of images		Artefacts covered*
	Detection	Segmenta-tion	
EAD 2019	2147	475	specularity, saturation, blur, bubbles, contrast, miscellaneous artefacts and instruments.
EAD 2020	2536	735	specularity, saturation, blur, bubbles, contrast, miscellaneous artefacts, blood and instruments.

*Artefacts in bold are covered by segmentation set

B. Quality Assessment Metrics

The performance metrics used to evaluate a segmentation algorithm in the literature includes precision, recall, pixel accuracy, Dice coefficient, Jaccard index and $Score_s$. These metrics are briefed below with their corresponding formulas.

Pixel accuracy: It refers to percentage of pixels that are classified correctly in the given image. This metric may not be useful enough when class imbalance problem exist in the dataset. To note with EAD2019 dataset suffers from class imbalance problem.

Intersection over Union(IoU)/ Jaccard Index: IoU is otherwise known as Jaccard index and it is one among the most preferred assessment metric in the field on image segmentation. The formula for calculating IoU is given in (1).

$$IoU = \frac{Area\ of\ overlap\ between\ predicted\ and\ ground\ truth\ image}{Area\ of\ union\ between\ predicted\ and\ ground\ truth\ image} \quad (1)$$

The IoU values range between 0 and 1 defining no overlap if the score is 0 and a perfect overlap when the score is 1. For a multiclass problem, IoU of each class is taken and averaged to find mean IoU.

Dice Coefficient or Dice Similarity Coefficient (DSC) or F1 Score:

The dice coefficient is given in (2)

$$Dice\ coefficient\ or\ F1\ score = \frac{2*|A \cap B|}{|A| + |B|} \quad (2)$$

Where A and B are two images, $|A \cap B|$ denotes pixels that are in common to both the images, $|A| + |B|$ denotes sum of all the pixels in A and B. The score varies between 0 and 1. A score of 0 shows no similarity and a score of 1 signifies higher similarity between the predictions and ground truth image.

Generalized formula for $F_ß$ Score:

The generalized formula for calculating F1 and F2 score is given in (3)

$$F_\beta\ Score = \left(1+\beta^2\right) * \frac{\Pr ecision * recall}{\left(\beta^2 * precision\right) + recall} \quad (3)$$

By assigning ß=1 and ß=2 we can compute F1 and F2 score. In the expression the metric called precision is used to calculate percentage of correct predictions of positive classes and recall is used to calculate the percentage of correct predictions of positive classes out of all positive predictions made by the network.

$Score_s$: It is a weighted score calculated using common metrics. The formula is given in (4)

$$Scores = 0.75 * \left[0.5 * \left(DSC + IoU\right)\right] + 0.25 * F_2 Score \quad (4)$$

VI. Concluding Remarks

The review of literature reported in this article was done with a motivation to present different deep learning algorithms used in the field of endoscopic artefact segmentation. This condensed review outlines various algorithms proposed by researchers with their performance, dataset and general evaluation metrics. The discussion in section IV reveals that significant improvement in the results of segmentation algorithms is possible by employing various training strategies like training and test time augmentation, transfer learning, modifying various hyperparameters and ensemble technique when compared with direct application of any algorithm. The nature of occurrence, geometrical structures and overlap of artefacts, class imbalance of dataset pose a considerable challenge to the algorithm. In applications like health care a good balance between accuracy, performance and computational efficiency is very important which may be useful while incorporating such algorithms in endoscopic imaging pipeline and robotic surgery.

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Implementation of SHA Algorithm Secure Hashing Algorithm

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***Abstract*—In this fast growing world everyday human works are being automated and made easy by science. For that growth security plays a major role. This project focuses mainly on, data security using SHA algorithm. The boon about this project is all about securing data that is send through mail. Here in our proposed work, we have used NodeMCU a microcontroller unit responsible for data transfer and to check the integrity of the data through an android application. Usage of microcontroller is the new technology introduced in the project. We can overcome the modification of original data using hardware.**

***Intdex Terms*—SHA, NodeMCU, cryptography, hashing**

I. Introduction

In the fast growing world, transferring of data plays a crucial role in the development. So, securing of user's information such as passwords for websites, data uploaded online requires assurance. This can be obtained by the process of cryptography [1], there are different type of algorithm. In particular hashing algorithm such as SHA (secure hashing algorithm) used. These types of algorithms are used in our schools, colleges, offices and government institutions to protect the privacy of the data provided by the public. In the past, due to the lack of development, users personal information are hacked, but with these methods, it can be avoided .The flow graph of the process carries a plain text with raw information which can be accessed by public which is then encrypted to form cipher text, this cipher text can only be decrypted using receiver end with the appropriate key.

II. Overview

Through the research and observations made, we have concluded that the data we feed to Internet or any third party is saved in the form random variables. The method is called cryptography [2], which is a form of sending hidden or secure messages, and receiver with the assigned key can only decipher the message. This method of using codes to cipher and decipher can be found in the evidence of a tomb which is found in Egypt, there are various methods and code used to secure the data or information that are passed within users .In particular, there is sub division called hashing algorithms, which comprises are series of algorithms named as SHA (secure hashing algorithms) such as SHA1, SHA 2. Compared with md5, SHA algorithm is much faster [3]. A unique value of hash is obtained for each data as input, and these hash values cannot be made into original data again, which is once when the data is encrypted to hash values, the original data can never be retrieved from them. This provides the users information a guarantee that data are getting transferred securely. As given is Fig. 1.1,when the sender sends their information, the plain text get encrypted to form random variable of designated bits, following encryption using methods called block cipher ,cipher text is formed and key is assigned. To obtain the original data, the cipher text should be decrypted using the assigned key, which results in plain text in the receiver end.

Fig. 1. Hashing.

III. Literature Survey

In recent years, there are many implementations going on about the Secured Hashing Algorithm for securing data and to make it more efficient day by day [5]. Many researches are implementing to optimize the efficiency of this algorithm.

According to the National Institute of Standards and Technology (NIST), the SHA (Secure Hashing Algorithms) comprises of:

a) SHA1
b) SHA2 (SHA-224, SHA-256, SHA-384, SHA-512, SHA-512/224 and SHA-512/256)
c) SHA3 (SHA3-224, SHA3-256, SHA3-384, and SHA3-512)
d) SHA-3 Extendable-Output Functions (XOFs) (SHAKE128 and SHAKE256)

These are the different algorithms used for secure hashing of data, passwords model in network and data communication.

IV. IV. METHODOLOGY

- **Pre-processing**

The given input of arbitrary message is converted into binary bits of 488 bits by using appending and padding process.

- **Initialize hash value (h)**

Random variables are pre initialized to create certain hash function.

- **Create message schedule (w)**

The given message, which padded to form 512 bits are divided into 16 words which are repeated used in 80 rounds in compression function.

- **Compression**

The final value from the round which is 160 bits and the predefined value of 160 bits are compressed to form 160 bits.

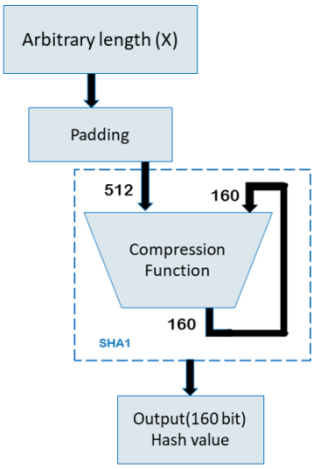

Fig. 2. Flow of SHA1 algorithm.

- **Padding**

The arbitrary message(X) will undergo process of padding and gets converted into 512 bit. The hashing function is carried on the message in order to be hashed, and the hash received in this case is of 160 bits.

The message is first split down into 'n' pieces, each of which is depicted as X and has a size of 448 bits, and then 64 bits of padding is added to each of them, bringing the entire length to 512 bits. These 512 bits are then sent through the compression algorithm together with the 160 bits of compressed output, with the predetermined value for the 160 bit value being used for the first time.

This process is done multiple times until the message's final 160 bits are created, which is represented by the hash H. (x).

- **Compression feature**

The concept of block cipher is used, that is information from the users are inputed as plain text into 'n' number of rounds, where each round is assigned a key using key scheduling algorithm(KSA). The main role of KSA is that it divides a single key into 'n' number of keys with respect to the round .This concept is similarly used in SHA -1 with total of 80 rounds starting from round 0 to round 79and key scheduling algorithm is named as message schedule algorithm

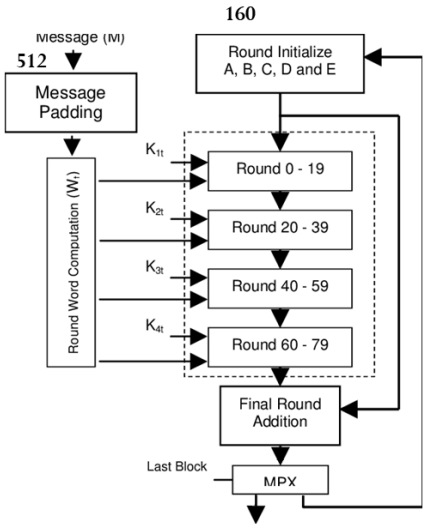

Fig. 3. Compression function.

The input to the rounds is 160 bits, as shown in Fig. 5.4, while the input to MSA is 512 bits after padding. The message was broken into 16 pieces, each with 32 bits, and they were utilized five times in a row.

For example,

A = 0x67452301
B = 0xEFCDAB89
C = 0x98BADCFE
D = 0x10325476
E = 0xC3D2E1F0

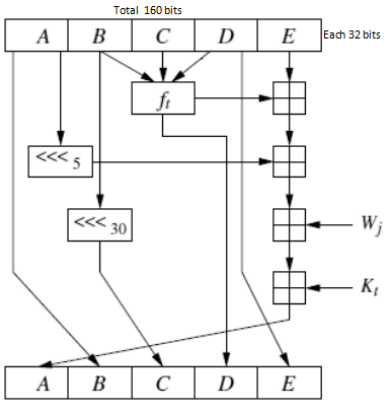

Fig. 4. Inside each rounds.

Considering each round, a total bit of 160 is divided 5 parts each of 32 bits represented as A, B, C, D, E in the Fig. 5.5. The final modulus is done with respect to the 32 bit 5 parts each separately using formula M+N mod 2^{32},where M,N are 32 bits.

F(t), W(t), and K(t) are the three primary sections. That is W(t), and these are the 32-bit messages that are part of the

512-bit messages. Despite the fact that F(t) and K(t) are a unique set of functions and values used to compute the hash, they remain constant every 20 rounds, or four times throughout the course of the 80 rounds of calculations. After every 20 cycles, F (t) and K (t) are constant, and they have a set of predetermined values and function descriptions, as shown below.

Function f (x) are generally accomplished by bit-wise operations such as AND, OR, XOR[6].

Stage 1(Rounds 1-20)
f(a) =(B and C) or ((not B) and D)
k(a) = 0x8AC584EF (predefined constant)
Stage 2(Rounds 21-40)
f(b) = B XOR C XOR D
k(b) = 0x9A7A9EF (predefined constant)
Stage 3(Rounds 41-60)
f(c) = (B and C) or (B and D) or (C and)
k(c) = 0x9E5F98A6 (predefined constant)
Stage 4(Rounds 61-80)
f(d) = B XOR C XOR D
k(d) = 0xFA75C1D6 (predefined constant)

Considering each sub division, the bits on region B,C,D from round 0 is transformed using function f (t)and one output of the function is given to region D on round 1,and the other output is given operations, while A and B are left shifted for 5bits and 30 bits respectively. This process continuously takes place and the final value of round is attained as 160 bits.

V. V. WORKING PRINCIPEL

A. *Block Diagram*

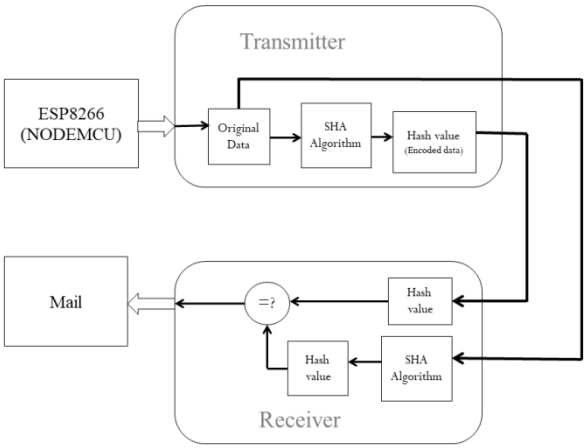

Fig. 1.2. Block diagram.

B. *Flow Chart*

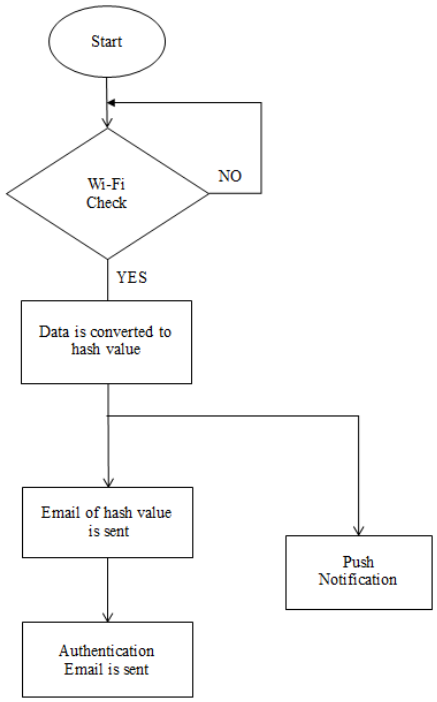

Fig. 5.1. Flow chart.

C. *Working Principle*

Initially the ESP8266 is connected to a wireless network while booting. Once the ESP8266 is booted it automatically runs the code that has to be executed at a prescribed time.

1) Libraries used:

- The ESP8266 board is installed from tools→board manager and select NodeMCU 1.0(ESP-12E Module) board from the list of boards.
- To use the blynk mobile app the Blynk library is installed from sketch → include library→manage library.
- For secure hashing algorithm the hash library is installed which enables hash.h header function.
- And the baud rate is set as 9600.

2) Android application:

- Initially when you open the Blynk android application in mobile a login page will appear.
- Type appropriate user name and password to login. It leads to a page where it displays create new project and other settings.
- Clicking on the Create New Project will create a new project with a project name and the selected device.
- Then click the widget box and select email and push notification from the notifications section. The selected widgets are now added to your workspace.

- By clicking the email widget button the email settings window will open, in which set the receiver (to:) email address and select the content type from the dropdown box.
- And by clicking the push notification widget button the notification settings window will open, in which set the priority.
- When the ESP8266 is connected and the code is executed, click the play button on the workspace window.
- This allows the board to connect with the Blynk Application[5].While the code is executed, the message/data is send to the cloud and then displayed in the push notification and email is also sent.

VI. Result

A. Comparing *Hash Values*

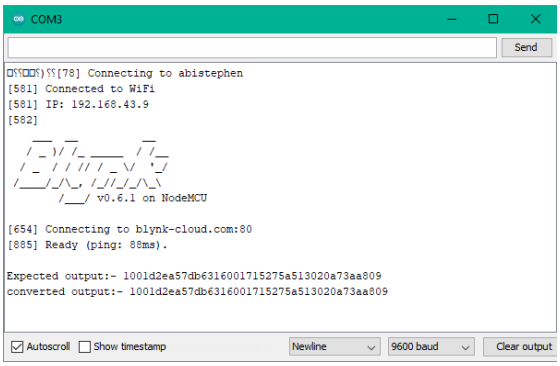

Fig. 5. Compared hash values.

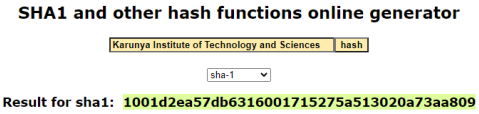

Fig. 6. Online hash generator.

In the above Figs. 5 and 6 the hash values are compared and both the expected output and the converted hash values are similar. This can be monitored and the hash values are checked manually with the online SHA generator [7].

B. *Reception of Email*

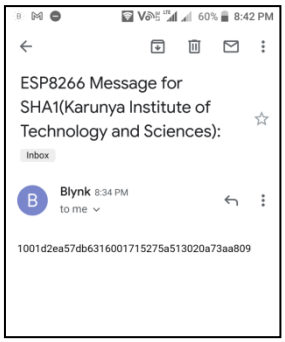

Fig. 6.4. Hash value received in mail.

In the above Fig. 6.4 the original data which is converted to hash value is sent as email is been displayed [8].

C. *Authentication Mail*

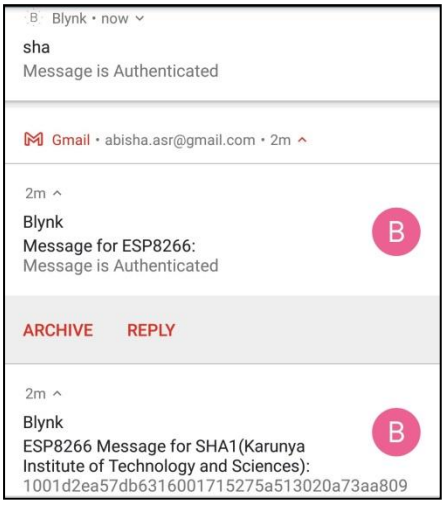

Fig. 6.5. Authentication mail.

In the above Fig. 6.5 the hash value of the message sent and the authentication email received using the Blynk app is been displayed.

VII. Conclusion

This project is very efficient in checking the security of the data that is sent. As the Secure Hashing Algorithm (SHA) is a one way hashing function [9], the data sent cannot be decrypted. It also reduces the risk of data theft. The main advantage of this project is that the data can be sent using a hardware which is even more secure and can be monitored and controlled using a user friendly Blynk mobile application. It also has the feature of displaying the authentication mail once the hash value is received successfully. Thus the secure hashing algorithm is implemented and the integrity of the data or input message sent is evaluated on hardware.

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Segmentation and Classification of Brain Tumour Using Convolutional Neural Network and Arduino

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***Abstract*–within the new past, programming Applications in resonance Imaging (MRI) are applied in several clinical looks. Notwithstanding, watching tumors without human mediation is viewed as a basic space of evaluation considering the way that the pulled- out cerebrum pictures need to be maintained misuse division close should have a high solid towards racket and controlling size influence issue with a changed zone based to offer. During this appraisal, AN improved zone- based AI approach is employed to seem at the under- party and over pieces of the tumor zones to seek the credits of the changed region-based zone. After the strong z-one of tumor parts, we'll portray the three astonishing classes of cerebrum tumors as boggling and settling. For that, we are using the Convolutional Neural Network structure for Proceeding through the to-be of lately amassed.This examination pays its ability inside the field of cerebrum quirk zone and appraisal within the clinical idea zone without human mediation.**

***Index Terms*–Edge detection, optimization, genetic algorithm, image processing, medical imaging, tumor detection.**

I. INTRODUCTION

The beginning phase of visual preparation is to acknowledge highlights in pictures that are applicable to assessing the development and properties of particles during a scene; edges are one such component. Edges are critical neighborhood changes within the picture power, typically connected with brokenness in either the image force or the first subsidiary of the image power, and both are significant highlights for examining pictures. Edge recognition is essentially a progression of numerical strategies that distinguish those changes [1]. Edge discovery is usually the initial introduce in recuperating data from pictures. Numerous inclination- based edge finders are created over the foremost recent twenty years. Roberts cross administrator is one among the most edge finders that registers rapidly and basically the 2D spatial slope estimation on a image. It, hence, features locales of high spatial recurrence which regularly compare to edges. The Prewitt administrator utilizes two bits that are convolved with the primary picture to compute a guess of the subordinates for even and vertical change.[6] The Sobel administrator may be a discrete separation administrator that processes an estimate of the slope of the image force work.

II. RELATED WORKS

Execution of sectional sequence integrator/differentiator on field programmable gate array K.P.S. Rana*,V. Kumar 2,N. Mittra 2, N. Pramanik The philosophy introduced during this work utilizes a twoventure methodology for cerebrum tumour discovery that consolidates a k-implies bunching calculation followed by level set division and morphological tasks. Exploratory outcomes have shown that this technique is hearty in identifying and jumping the weird cells in MRI pictures no matter the convoluted state of the tumour. This paper proposed a k-implies grouping picture preparing calculation for cerebrum tumour discovery because it were.

Spotting of human brain tumor using MRI image division and morphological operators was offered by Anupurba Nandi-2015.

In this paper, the yield picture plainly shows the tumour cells which have been isolated from the solid cells. The edge and Watershed division is extremely basic and famous yet utilizing morphological administrators is that the new prologue to the present difficulty which on applying to the yield picture of the opposite two gave a superior recognition of the tumour. The calculate utilized thresholding is exceptionally hard to make a decision on the grounds that the factor utilized for one picture might not work for additional picture [5]. This factor could be diverse for various pictures. The watershed technique has the burden that it is exceptionally delicate to nearby minima since, at every base, a watershed is made. This paper proposed a morphology-based picture handling calculation for mind tumour identification because it were.

Brain tumor classification from multi-modality MRI using wavelets and machine learning Khalid Usman1 Kashif Rajpoot-2017.In this paper, the yield picture plainly shows the tumour cells which are isolated from the solid cells [4]. The and Watershed division is extremely basic and famous yet utilizing morphological administrators is that the new prologue to the present difficulty which on applying to the yield picture of the opposite two gave a superior recognition of the tumour. The calculate utilized thresholding is

exceptionally hard to make a decision on the grounds that the factor utilized for one picture might not work for another picture [5].

This factor could be diverse for various pictures. The watershed technique has the burden that it is exceptionally delicate to nearby minima since, at every base, a watershed is formed. This paper proposed a morphology- based picture handling calculation for mind tumour identification because it were.[7] Exploration and differentiation of Wavefront modifies for clarifying MRI Image-2017.

This paper analyses the productivity of wavelet-based thresholding strategies within the sight of spot commotion for various wavelet [9] family as an example Haar, Morlet, Symlet, Daubechies in denoising [9] a clinical imaging reverberation of the mind. Execution assessment and investigation are finished utilizing SNR (Signal to Noise Ratio), PSNR (Peak Signal to Noise Ratio), and MSE (Mean Square Error). In sight of the presentation assessment, it is gathered that wavelet change is more successful because it can catch the energy of a symbol during a few energy change esteems typically referred to as wavelet coefficients. This paper proposed a Haar, Morlet picture preparing calculation for tumor location and arrangement.

Detachment of [13] Brain Tumours in MRI picture Utilising 3- proportion of Active Contour without Edge Ali, M. Hasan Farid Meziane Rob Aspin and Hamid, A. Jalab-2016. In the time of this paper, the present technique could acknowledge and divide MRI brain abnormality (tumour) on T2-w, T1-w, T1c-w, and FLAIR images [13]. The 3DACWE dismemberment system bring down physical input, extend a rapid operation, and exhibits high accuracy compared with manual segmentation [15] as evaluated. We conclude that the 3DACWE method is effective in brain tumor segmentation because the approach doesn't only consider local tumour properties, like gradients, but also relies on global properties, like intensity, contour length, and region length. Despite attained the precision happened high parallel to those of other division techniques, the 3DACWE was relatively slow for brain tumor segmentation. Such a slow pace was ascribed to the processing [8] of a huge number of MRI slices of 512 512-pixel resolution with a high number of iterations wont to attain the specified accuracy.This paper proposed a texture-based image processing algorithm for the detection of tumours only [1].

III. Existing System

In this paper, a Genetic Algorithm was effectively used to determine an optimal edge detection method [2][3]. The algorithm takes various training images and their corresponding optimal edge images, then it outputs an optimal edge filter and thresholding algorithm [5].The visual and quantitative comparison of edge detection algorithms was performed. The proposed method provided good localization and detected sharper edges as compared to other conventional and fractional-order methods [1].

IV. Proposed System

The proposed technique relies upon area-based ID for partitioning the impacted bits of the tumour. From here on out, we are getting to masterminding the 2 huge classes of brain tumours, for instance, BENIGN and MALIGNANT using CNN. The preliminary exam has been recorded for various datasets and provides undeniable execution for the distinguishing proof of tumour status of the patients pays promising consequences within the treatment plan. Joins undermining information customers either without growing any information finds the prospect to consent, or have gotten the guaranteeing to some specific information classes, in any case, endeavouring to urge to information having a spot with different groupings. Moreover, the precarious cloud and therefore the harmful information purchasers can decide to dispatch the above ambushes. We underline that the cloud plotting with any allowed information client for a specific information sale to urge to the knowledge having a spot there upon class isn't considered as an assault, since this is often permitted by the accommodation of any information transport framework.

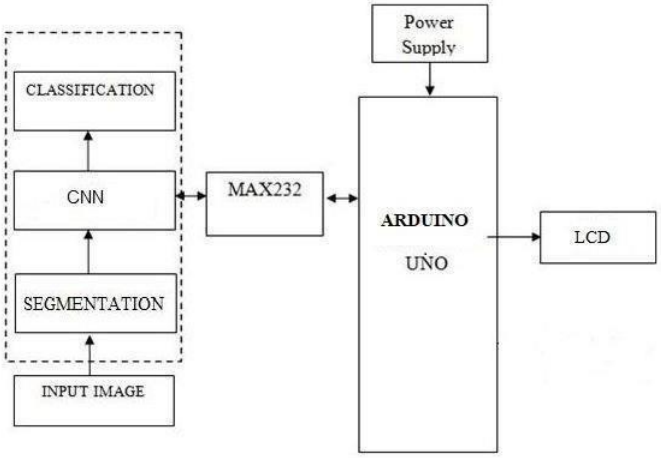

Fig. 1. Block diagram of proposed system.

V. Modules

1) INPUT IMAGE
2) PREPROCESSING
3) SEGMENTATION
4) CNN
5) OUTPUT

A. *Input Image*

Fig. 2. Input image.

Peruse and Display an info Image. Add an image to the workspace, utilizing the reading order. In picture handling, it's characterized because the activity of recovering an image from some source, normally an equipment-based hotspot for preparing [6].It's the initial introduce in the work process succession on the grounds that, without a image, no handling is conceivable. The image that's gained is completely natural.

B. *Preprocessing*

Pre-handling may be a typical name for tasks with pictures at the smallest amount degree of reflection both info and yield are force pictures. The objective of pre-processing an enhancement of the image facts that stifles undesirable twists or upgrades some picture highlights significant for extra preparing. Picture prehandling techniques utilize extensive excess in pictures. Adjoining pixels concerning one article in genuine pictures have basically something similar or comparative brilliance esteem. Hence misshaped pixel can frequently be re- established as a traditional advantage of adjoining pixel. Here converting image into grey scale it's for the aim of distinguishing an picture . tumor also can be precisely seen. Then we will label or detect the affected area.

C. *Segmentation*

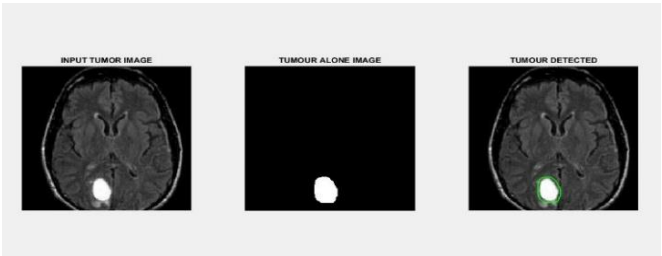

Fig. 3. segmented image.

Picture division may also be a frequently used system in digital image processing and analysis to partition an image into multiple parts or regions, often based on the characteristics of the pixels within the image. In computer vision , Image segmentation [14] is that the process of subdividing a digital image into multiple segments (sets of pixels, also referred to as super pixels. Dissection could also be a process of grouping together pixels that have similar attributes [10]. Picture vivisect is the process of breaking down a picture into non-intersecting regions such each region is homogeneous and therefore the union of no two adjacent regions is homogeneous Pixels during a region are similar consistent with some homogeneity criteria like colour, intensity or texture so on locate and identify objects and limits in a picture. Demarcation exactness verifies the eventual accomplished or miscarriage of computerized explores strategy.

D. *Cnn*

The Convolutional Neural Networks is probably the foremost acclaimed profound learning calculations and therefore the most commonly utilized in picture grouping applications. As a rule, engineering contains three kinds of layers, which are convolutional layers, pooling layers, and complete associated layers. The CNN calculation gets an info picture that goes through the layers to differentiate include and perceive the image, and afterward, it creates the grouping result[4]. The engineering of the CNN [4] contains substituting convolutional layers and pooling layers, trailed by a bunch of completely associated layers. The yield of every layer within the CNN is that the contribution of the accompanying layer.

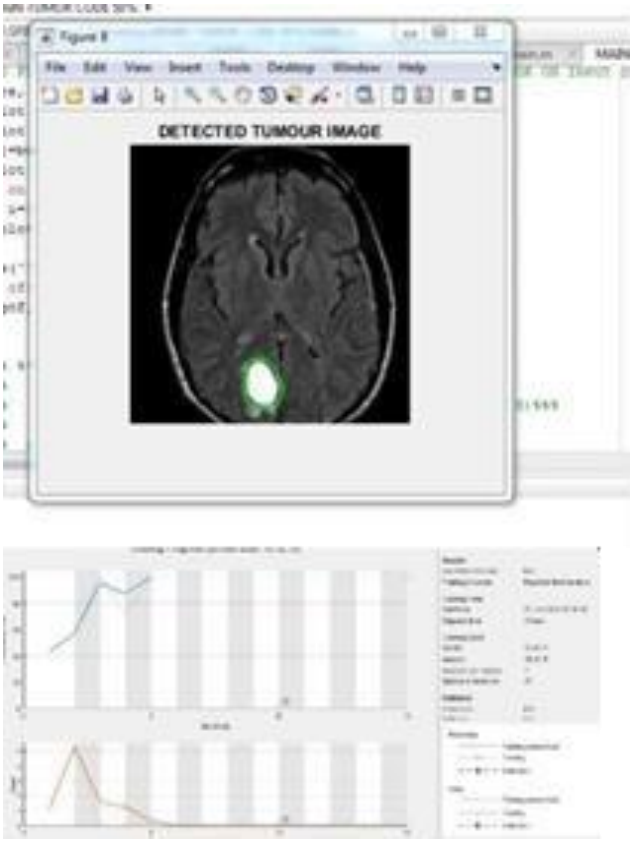

Fig. 4. Detected tumor image &CNN processing graph.

E. Output

Here the segmentation process is more accurately done. (In this project the affected tumors area alone is segmented.) Due to segmentation of tumors area alone this results in give an accurate classification. The ouput is assessed by area based approach. That's supported the density of pixels the output images differentiated. For malignant tumour the area is lesser than five thousand it's called malignant tumour normal stage. Else area is bigger than or adequate to five thousand and area lesser than ten thousand it's called malignant medium stage. Else if area greater than or adequate to ten thousand then it's called malignant severe stage. Likewise for beningn tumour if the world is lesser than thousand then it's called benign tumour normal stage. Else area is greater than or equal to thousand and lesser than two thousand then it's called beningn medium stage. Else if area is bigger than or edequate to two thousand then it's called beningn severe stage. Thus the image is assessed supported what proportion area it's been affected. It delivers the output at very high efficiency without consulting the doctor. Hence its saves the time with none any further delay the patient can under go the treatment.

VI. Results and Discussions

Fig. 5. Hardware setup

Arduino may be a microcontroller board hooked in to the ATmega328P (datasheet). It's 14 computerized input/yield pins (of which 6 are often utilized as PWM yields), 6 simple data sources, a 16 MHz quartz , a USB association, a force jack, an ICSP header, and a pushbutton . It subdue all that anticipated to aid the one chip computer; just corresponded it to a PC with a USB link or force it with an AC-will-DC connector or battery to start out . You'll dabble together with your UNO without agonizing tons over accomplishing something incorrectly, within the direst outcome imaginable you can swap the chip for a few of dollars and begin once start another time.

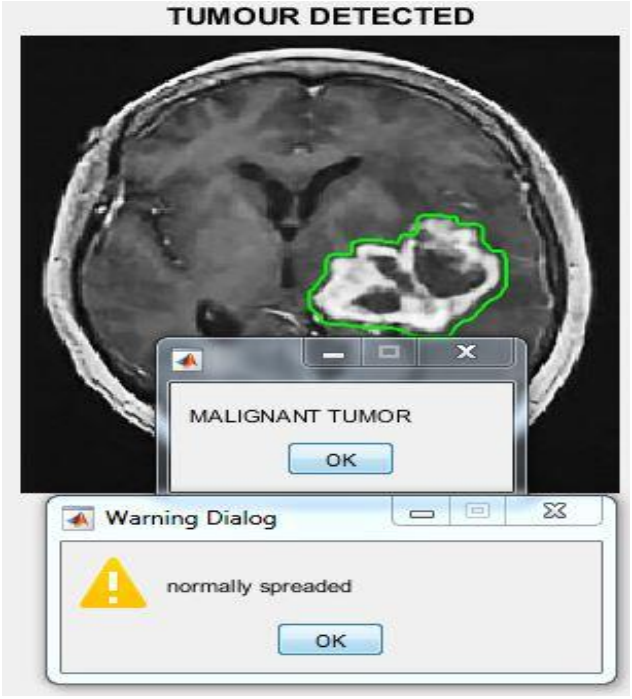

Fig. 6. Malignant normally spreaded.

This is the image of Malignant tumour which is at the 1st stage called normally spreaded. That is type 1 of Malignant tumour.

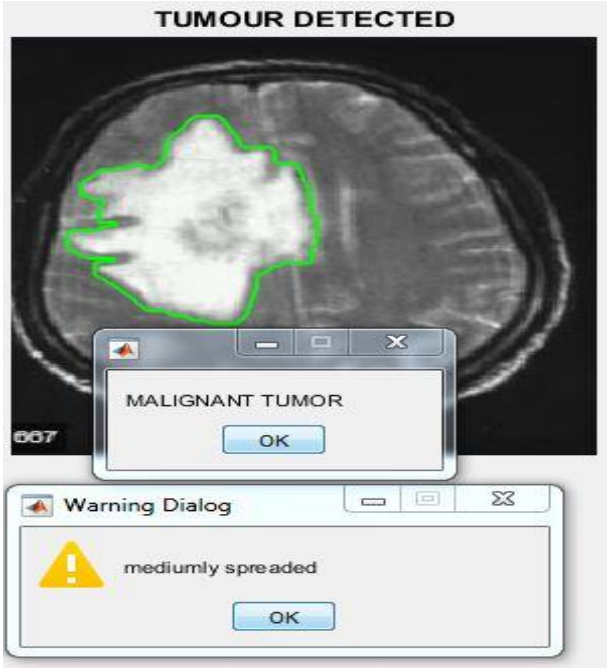

Fig. 7. Malignant mediumly spreaded.

This is the image of Malignant tumour which is at the 2nd stage called severally spreaded. That is type 2 of Malignant tumour.

Fig. 8. Malignant severely spreaded.

This is the image of Malignant tumour which is at the 3rd stage called severally spreaded. That is type 3 of Malignant tumour.

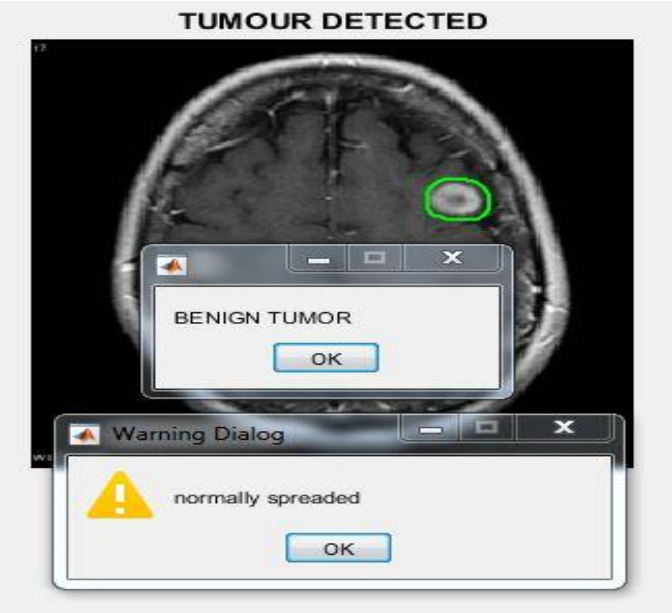

Fig. 9. Benign normally spreaded.

This is the image of benign tumor. Which is at the 1st stage called normally spreaded. That is type 1 of benign tumour.

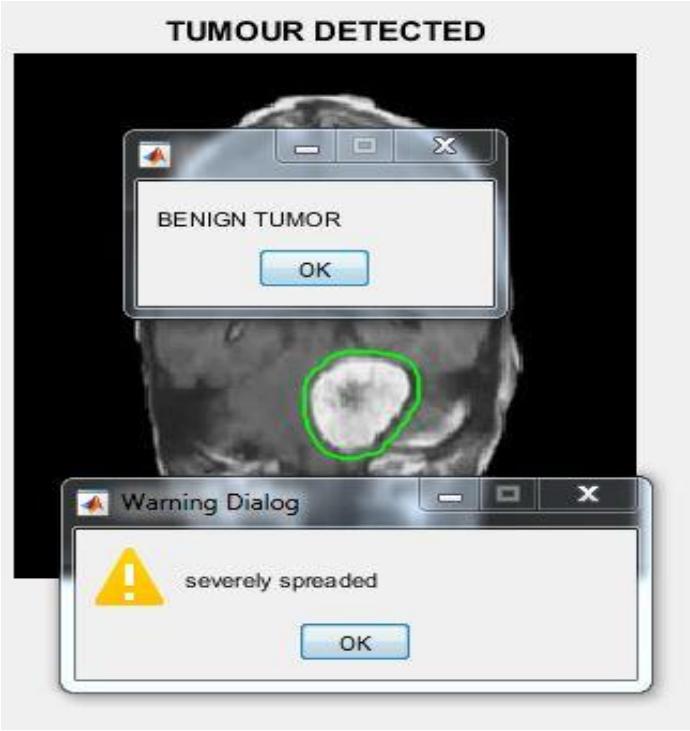

Fig. 10. Benign severely spreaded.

This is the image of benign tumor . Which is at the 2nd stage called severally spreaded. That is type 2 of benign tumor.

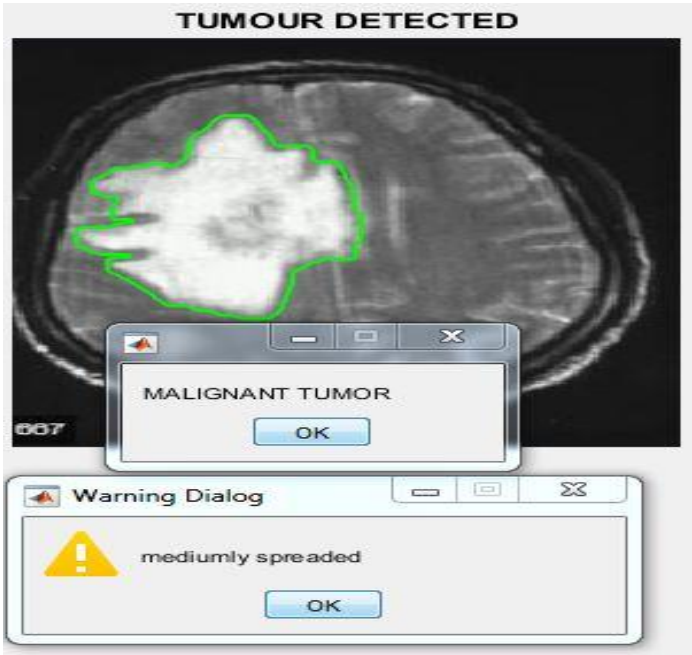

Fig. 11. Benign mediumly spread.

This is the image of benign tumour. Which is at the 3rd stage called severally spreaded. That is type 3 of Malignant tumour.

Fig. 6. Hardware output.

The final hardware output shows the general sorts of benign and malignant . The classification of brain tumor is carried supported what proportion area it has been affected [14].

VII. CONCLUSION

The cerebrum tumor identification and grouping framework are administered utilizing Region-based location and CNNs. The proposed strategy utilizes various degrees of activities. The high exactness part is acquired utilizing Region-Based Detection. The result shows that CNNs having the legitimate arrangements of preparing information can recognize amiable and threatening tumor districts and group them effectively as consideration of tumors. By and by, CNNs have critical computational benefits. This grouping is significant for the

doctor in build up a particular [12] analytic and suggesting the proper further Treatment .The got results to point out that the Region-based division furnishes higher calculation and therefore the current framework [6]. A half breed approach is usually recommended in addressing appropriately the identification and characterization issues in mind tumors.Later on, with overtime and with more extensive exploration the proposed framework are often made more exact [11]. Additionally, new tumor location calculations are often added so as to offer the specialist a more extensive assortment of choices to browse.

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Monitoring Bio Parameters of Sea Researcher Using LiFi

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***Abstract*—Sea researchers and scuba divers do their work under the sea. The health difficulties are high inside the water. So we need health monitoring systems to measure the health parameters of such diver's/sea researchers. The proposed method is that the communication is achieved by the appropriate design of transmitter and receiver using Li-Fi (Light Fidelity) module. Usually, the sea navigators or fisherman requires additional support from the land whenever something unusual happens in the sea. The sea researcher cannot inform anyone immediately, whenever any needs arise. To avoid these issues, a health monitoring system is introduced for sea researchers through this project. For that, the Li-Fi module is used as the communication system to monitor health conditions. The ultimate aim of these proposed works is to reduce the power consumption, increase the high-speed transfer of bio parameters of the sea researcher through the water.**

***Index Terms*—LIFI, photodetector, line of sight, LM35, heart rate sensor.**

I. INTRODUCTION

The industrial standard depth unit for divers is 60 feet at sea level. We know that health difficulties inside the water are high. Breathing problems, panic attacks, etc. are the main issues they suffer. So we need health monitoring systems to measure the health parameters of such diver's/sea researchers. Some existing technologies are used to measure the health parameters of sea researchers. But most of these equipment's are not efficient enough. So there is a need to develop an efficient system that can ensure the safety of the divers. Previous technology used to communicate with the sea researcher who is working underwater uses a cable that is extended from ship to the sea. This method of using underwater wired communication has many disadvantages such as lateral drag of signal, signal degradation, and so on. Hence, to overcome these disadvantages Underwater Wireless Communication (UWC) system is introduced. RF communication causes many harmful effects on the user. This leads to the implementation of optical wireless communication. Optical communication can carry more data because it overcomes the limitation of bandwidth and it is free from harmful effects.

II. LITERATURE REVIEW

The wireless optical communication system now uses in almost all applications. It provides high-speed data transmission and efficiency. Within the last few years, optical communication increased because it provides a high data rate with low power consumption. In [1], Optical communication can achieve data rates much higher than those available through acoustic modems. The underwater environment is challenging due to variability in water quality. A rotational link may vary between 6dB and 95dB in loss depending on path length, transmission wavelength, and whether the water is turbid or clear. A wide dynamic range receiver is important for robust operation over variable link conditions. They have demonstrated the work in the laboratory and the field of a receiver combining a photomultiplier tube and linear avalanche photodiode. The photomultiplier allows high sensitivity communication and the photodetector allows high data rates when more signal power is available.

In [2], they give an overview of a method that is used to measure the bio parameters of scuba divers. In this paper, several kinds of agents were evaluated to change the coefficient of experimental water precisely. Reliability of water recreation, the frequency domain characteristics of data communication through water channel in experimental water is measured and compared. The results show that the type and particle size of agents will significantly affect water properties. The system measures the heartbeat of scuba diver. It is the heartbeat sensor that measures the heart rate and communication is achieved through a water data transceiver module.

In [3], [4], [5] explaining about LiFi (Light Fidelity) technology. It provides a detailed description of the transmission of data (text, audio) using LiFi technology. Also focuses on the study of various topologies to understand the characteristics of the LiFi system. LiFi is a visible light communication system that consists of one light source equipped with a signal processing unit and a photodiode that can receive light signals. Arduino microcontroller is used for the work. The corresponding transmitted output is displayed on the PC screen with the help of visual basic software. LiFi

can be used in electromagnetic sensitive areas where electromagnetic interference is avoided like hospitals and power plants. LiFi uses direct modulation techniques that are similar to low-cost infrared devices.

In [6], they described optical communication systems for data transfer in underwater networks. They use an optical channel to facilitate the communication Link in free space and underwater. This system proves that optical communication using light can be a good solution for underwater data transmission applications that require a high data rate at moderate distances. Here introduces an underwater optical communication system that can communicate wirelessly at a transmission rate of 9600 bps over the range of 4 meters using LED as the light source.

In [7], the system presents the design and implementation of underwater communication through LiFi. The data is sent from the transmitted submarine to the receiver submarine. The system develops voice, signal, text, and image which transmit using light waves of low noise. The data is converted to digital values and those digital data is transmitted as light. Photodetector at the receiver side receives the light and gives output.

III. Existing Work

There are two types of communication systems. Wired communication system and wireless communication system. The disadvantages of wired communication system can be overcome by wireless communication system. In the case of bio parameter monitoring systems for sea researchers also used cables for data transmission in the early period. The cable is connected to the ship and researcher. The disadvantage of this system leads to the development of a wireless health monitoring system [8]. The wireless methods are mainly based on RF waves [9]. But this causes many harmful effects on humans. The recent method that was published related to the monitoring health parameter of sea researcher is based on the water data transceiver module [10]. This work measures the bio parameters of sea researchers using sensors. The sensor output will give to the PIC microcontroller. The output of the controller is given to the water data transmitter module. The data signals are converted into electrical pulses and will transmit through water. The water data receiver module receives the transmitted data and is given to the microcontroller on the receiver side. The result will obtain in LCD. But this work cannot be practically possible because the data communication range is short. Moreover, there is no connection with the PC. Therefore, the data cannot properly use for safety purpose.

A. Disadvantages of the Existing Methods

- Long distance communication cannot be possible for wired systems.
- RF communication causes health related issues.
- Limited band width therefore it cannot carry a large amount of data.

IV. Proposed Work

The proposed system measures two bio parameters. Sea researcher's body temperature, and heartbeat. It also consists of an emergency switch. The emergency switch output value goes high if there is an emergency. The temperature sensor and heartbeat sensor measures the corresponding temperature and heart rate values and gives their output to the PIC microcontroller. The microcontroller gives this value to the transmitter module. The transmitter module converts it in the form of light. The photodetector at the receiver side receives the corresponding light and converted it to corresponding values. The output values can be monitored in the PC which is connected to the output of the photodetector. The main hardware requirements of the proposed work are PIC16F877A Microcontroller, Power Supply, Heartbeat Sensor, Temperature Sensor, LiFi module, photodetector, Switch, LCD and the software part consists of MPLAB IDE.

A. Lifi Data Transmission

LiFi (Light fidelity) is a visible light communication method that can bring not only light but also wireless connection. LiFi transmits data in the form of light waves so it is not harmful like radio waves. Energy efficiency, high data rate, secure communication are the key features of LiFi communication. The working of LiFi is based on switching of LED ON and OFF. Binary data is transmitting in the form of light. Binary 1 means LED ON and 0 means LED OFF, it cannot recognize by the human eye. Photodetectors are used at the receiver side. Photodetector collects the light and converts it into original data.

1) Features of LiFi

- LiFi transmit data using bits in the form of light.
- There is no interference issue as in the case of radio waves.
- The spectrum range is more than Wi-Fi.
- High data rate of transmission.
- Security of the transmitted data is more than other communication methods.

B. Working

Block diagram of the proposed system is given below. It consists of two sensors and one emergency switch. Temperature sensor LM35 is used for temperature measurement and a heartbeat sensor for heartrate measurement. Emergency switch value becomes high when there is an emergency. The sensors attached to the body measures the readings. As shown in the block diagram output of the sensors is given to the microcontroller. An LCD connected to the microcontroller shows the corresponding sensor output.

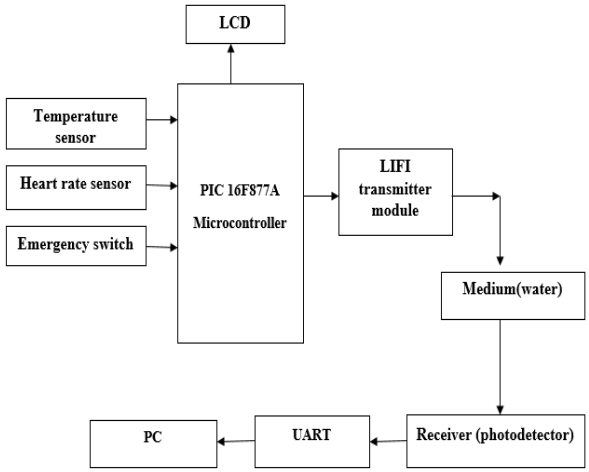

Fig. 1. Block diagram of the proposed system.

The microcontroller gives the value to the transmitter module. The transmitter module consists of a LiFi circuit. In LiFi, the transmission of data occurs in the form of light. Here the data from the microcontroller is given to the LiFi module and converted to light. Then the light is transmitted through water. The receiver side includes a photodetector and PC. The photodetector is a device that receives light information and converts it into original data. The photodetector is placed at the bottom side of the ship according to the line of sight. To achieve proper data communication, the transmitter and receiver should be in the line of sight. The photodetector output is connected to the PC through UART. So the output can be monitor on the PC.

C. Components

There are software and hardware components are required for this work. The main hardware components are PIC microcontroller, Temperature sensor, Heartbeat sensor, Switch, LiFi transmitter module, Photodetector, UART, LCD and PC. Software requirements are MPLAB IDE and Microsoft Visual Basic 6.0.

1) Hardware requirements

a) PIC microcontroller

PIC16F877A is the microcontroller used for this work. It has 40 pins. Among 40 pins 33 pins can be used for input and output. PIC microcontroller uses flash memory technology. Flash memory technology means we can write and erase the program according to our requirement. Using MPLAB IDE coding part is done and using pic kit, code will dump into the controller. For the proposed work three input connections are given to the controller. They are a temperature sensor, heart beat sensor and emergency switch. The output port is connected to the LiFi transmitter module.

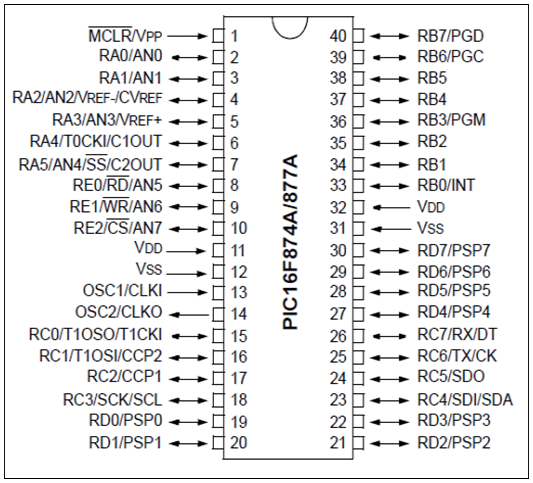

Fig 2. Pinout diagram of PIC controller.

b) Temperature sensor

LM35 is the temperature sensor used for the proposed work. The output voltage of the sensor will vary according to the variation in temperature. It can measure temperature from -55 degrees Celsius to 150 degrees Celsius. There will be a rise of 0.01v for every degree Celsius rise in temperature. LM35 consists of three pins as shown in Fig. 3. Input, output and ground pin.

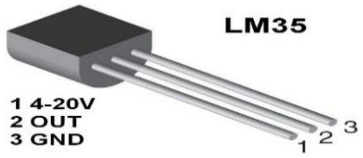

Fig. 3. Pinout diagram of LM35.

c) Heartbeat sensor

The heartbeat sensor measures the heart rate of the sea researcher. The sensor consists of an optical LED light source and LED light sensor. The light shines through our skin then the light sensor measures the corresponding light reflection amount. The Fig. 4 shows the working principle of the heartbeat sensor.

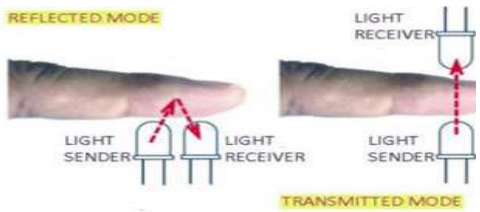

Fig. 4. Heart rate sensor.

d) LCD

LCD is an electronically modulated optical device that uses the modulating properties of liquid crystals combined with polarizers. Here 16×2 display is used for displaying the result.

Fig. 5. LCD display.

e) LiFi transmitter and receiver module

LiFi uses for high-speed wireless communication. In the LiFi module, the data will transmit in the form of light. The working of LiFi is based on switching of LED ON and OFF. The receiver is a photodetector. A photodetector is a device that receives light and converts it into the original data.

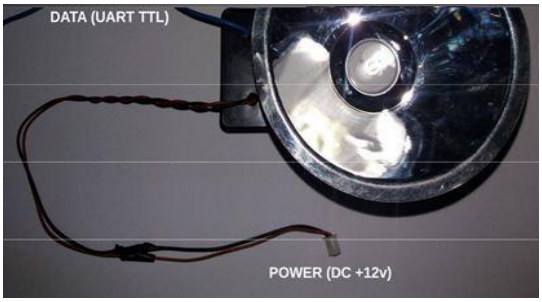

Fig. 6. LiFi transmitter module.

The output data from the microcontroller gets modulated and converted into the form of light. The photodetector receives the light. After demodulation, the light will convert to original data.

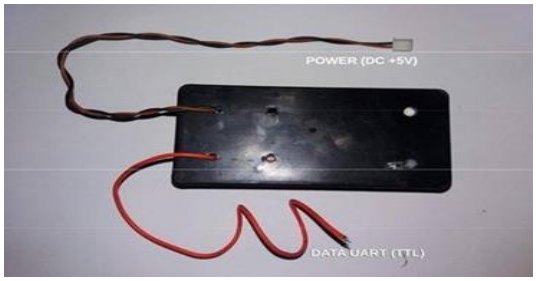

Fig. 7. Receiver module.

f) Power Supply

Separate power supply modules are used for the transmitter and receiver sections. Power supply units consist of a stepdown transformer, rectifier unit, input and output filters.

g) g. UART

UART stands for universal asynchronous Receiver and transmitter. UART is used for asynchronous serial communication with configurable speed.

Fig. 8. UART module.

2) Software requirements

a) MPLAB IDE

MPLAB IDE is used for writing code for the PIC microcontroller. Embedded c is the language used to write code in this software. Using PIC Kit, the code is dump into the PIC controller.

b) Visual Basic 6.0

Microsoft Visual Basic 6.0 is used for making the output window in the PC. Using this software, we can build the output screen requirements.

The prototype of the proposed work is shown in the figure below. It consists of the transmitter section and receiver section.

Fig. 9. Prototype of the proposed work.

Here the components are not placed inside the water because they need waterproof covering. So a small water tank is placed between transmitter and receiver section. The sensor output is given to the microcontroller. The output of the microcontroller is given to the LiFi transmitter. LiFi transmits the information in the form of light. This light passes through water and will reach the receiver. The receiver is a photodetector. The transmitter and receiver should be in the line of sight so that proper communication will occur.

V. Result and Discussion

The result obtained from the proposed work is the body temperature, heartbeat rate, and the emergency switch value on our PC and LCD. Reflection of light inside water and water flow can also affect the accuracy of the result. But those factors are not considered for this work.

Fig. 10. Output obtained in LCD.

Only a prototype model simulated for the proposed concept. The maximum range of communication is 4feet. It can increase by increasing the intensity of light. The figure below shows the output screen of the PC.

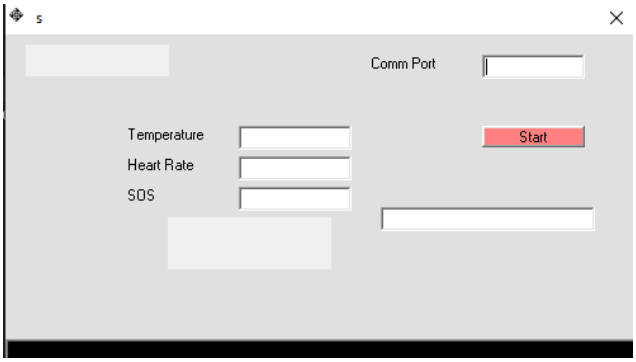

Fig. 11. Output screen obtained in PC.

The screen consists of temperature value, heart rate value and emergency switch output value.

TABLE I. OUTPUT OF DIFFERENT OBSERVATIONS

No	Heart Rate Value (bpm)	Temperature Value (°C)
1	71	34
2	70	37
3	72	36
4	80	36
5	82	36

The table above shows the temperature and heartrate values of different observations.

VI. CONCLUSION

The result obtained from the proposed system is temperature and heart rate. The observed result is accurate and easy to access by the people who were on the ship and they can monitor continuously. The line of sight is a factor that will affect communication. Therefore, it is required to fix photodetector at the base portion of the ship at a particular location.

VII. FUTURE SCOPE

The proposed work mainly focused on the prototype model. A real-time model of the proposed work can do as a future scope. Adding more sensors to determine more bio parameters, increase the range of communication by increasing intensity can be included in the future work.

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Sea Border Detection and Ship Tracking System

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***Abstract*—The Fisheries and Aquaculture sector plays an important role in the development of the Indian economy. Fishermen are the backbone of this sector. The challenges attributed to the day-to-day activities of the fishermen are many. The extensive among this many includes the difficulties faced by them when they are in dilemma about the borders in the sea. They are often arrested or killed by the navy and their boats are captured by the border coastal guards when this borderland scenario is breached. As a key solution to these problems the sea border detection and ship tracking system using RSSI is developed. The technology proliferation of RSSI is used to provide location-based positioning and time details in all climatic conditions and even anywhere at any time.**

***Index Terms*—RSSI (Received Signal Strength Indicator)**

I. Introduction

Fisheries and Aquaculture plays a pivotal role in the development of the Indian economy. The benefactories added by the fishermen in this is often neglected and the difficulties faced by them in the work closure are countless. And the one among the many includes the border negligence during their navigation.

Composing a case study, the sea border between the island like Sri-Lanka and Peninsula like India is considered. This border is called the Palk Strait. Its maximum width is 82 km, its minimum width is 53 km and its total surface area is 2500km. Crossing this border is often a serious offence. The people living in the coastal areas of these countries purely depend on fishing to meet their daily needs. Due to pure negligence of the boundary limits, the fishermen usually cross the sea borders adding to their threat to life. Once they cross the border, they get arrested or killed by the relevant navy and they are abducted and their boats are captured by the coastal guard on the border safety- duty. In such situations, the lives of fishermen continue to be difficult. It is a major threatening issue and leads to a loss in both humans as well as their economic income. Moreover, they are helpless when emergencies arise during food and water scarcity. As a solution to these problems, this method is proposed. This will continuously monitor, track, alert and control the fisherman's activity from the remote station located on the shore.

II. Literature Review

There are several techniques used for sea border detection. The variation in measured RSSI signals is one of the major effects leading to significant detection and tracking error**.** In [1], RSSI signal strength can be applied in various applications such as patient monitoring, intrusion detection and tracking, human tracking through walls and monitoring in emergency situations. In most of the cases humans to be tracked may not be carry any device with radio component due to its weight or due to the effect of the electromagnetic interference. For the device free human detection RSSI value can be widely used because most wireless devices have RSSI circuits built in them. So, no any additional hardware is required. This will reduce the hardware cost and the energy consumption of the system. In some cases, the RSSI value gets fluctuated due to multipath effects. To avoid this many filtering methods like average method and weighted moving average method can be used. For improving the localization accuracy, the RSSI signals are filtered using the median method. The RSSI signals are having different characteristics.

From [2],[3],[4] it is found that the multipath fading and the change in environment plays the greatest role in affecting RSSI signals. The paper [5], proposes a system to define the sea border virtually using computer indication for marine vessels and fisherman ‘s boat which utilize GPS modules. There are many sensing elements and communication topologies to establish multilateral communication between land and the marine vessel. Here the final system contains two modules namely: Border Intrusion Detection System and Dot matrix communication system. Border Intrusion detection system contains the GPS module and it automatically track the distance between the border and the current location of the boat.

In [6], an Embedded technology which uses GSM, LPC2148 Arm Microcontroller and RFID (Radio Frequency Identification) was used for helping the fishermen in crossing borders. Here the boat is identified physically and the information about the persons who are in the boat are also contained in the RFID tags. GSM is used for transmission and reception of signals that contain information about fishermen

to identify their location. Wireless Sensor Networks are being widely used in difficult applications. Zigbee is one of the most widely used transceivers standard in wireless network.

In [7], the detailed study of Zigbee Wireless standard IEEE 802.15.4 specification, Zigbee device types, the protocol stack architecture and its applications are discussed. Zigbee devices can transmit data over long distances [8] by passing data through intermediate devices to reach more distant ones creating a mesh network. In [9],[11] the Zigbee is designed and implemented for long distance wireless Data transmission system. This is done based on CC2530 and CC2591.After doing this output power of Zigbee is increased to +22 dBm and the receiver sensitivity by 6 dB. The paper [12] describes about the design and development of long- range wireless communication system based on LoRa technology for Indonesian fishermen.

III. Existing Method

In the Existing method Global Positioning System, Global System for Mobile Communication and Wireless networks are used for addressing the sea border crossing issue. This is used as an alert system for fishermen. This will give an alert when the boat/ship crossed beyond the country's border. The marine GPS [10] receives the longitude and latitude values of geographical location and converts them into desired data message. The Global System for Mobile communication will send the latitude and longitude values as the data message to the base station located on the on the shore. The positions are compared with the latitude and longitude positional database values. If the boat is found beyond the border, then an alert is generated along with a message.

A. Disadvantages of Existing Method

- In this method, a GPS receiver is used which can only determine the latitude and longitude and indicate the position of the ship.
- Due to multipath electromagnetic interference, the GPS signal gets affected.
- GPS chip is power-hungry which drains the battery in 8-12 hours.
- It is a half-duplex communication.
- This method is not able to send any information such as weather alert, border alert from the seashore.
- The people on the ship are not able to communicate in their emergencies like the need for food, water etc.
- Live monitoring of the boat is not possible

IV. Proposed Method

In this method, the sea border detection and ship tracking are done based on the RSSI value. The Received Signal Strength Indicator (RSSI) measures the amount of power present in a radio signal. From this value, the signal strength received on an antenna is obtained. By measuring the signal strength at the receiving antenna, we can determine the quality of a communication link.

A. Block Diagram

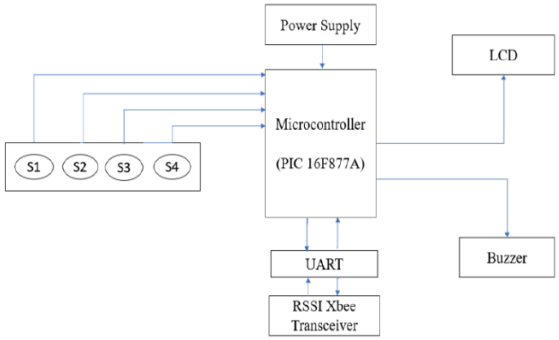

Fig. 1. Block Diagram of the unit inside the ship.

Figure 1 is the block diagram of the unit placed inside the ship. When a transmitter is moved closer to a receiver, then the strength of the transmitted signal at the receiving antenna increases and vice versa. This concept is used to track the ship. The RSSI value is measured in dBm. A greater negative value in dBm indicates that the signal is week.The unit inside the ship consists of a PIC microcontroller and an Xbee transceiver module is connected to it. The PIC microcontroller is connected to the RSSI Xbee transceiver through UART, because the RF module transmit and receive data serially. Four emergency switches are connected to it. Both LCD and buzzer is interfaced to the microcontroller.

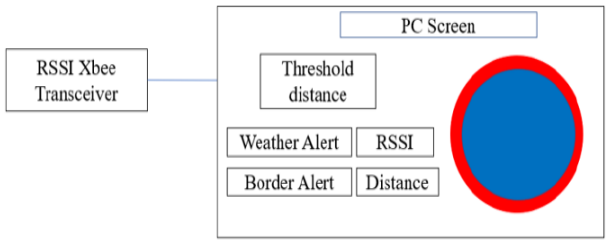

Fig. 2. Block Diagram of the unit in the seashore.

Figure 2 is the block diagram of the unit placed in the seashore. This consists of the RSSI Xbee transceiver unit which is connected to a PC.

B. Hardware Requirements

i. *PIC16F877A Microcontroller* – It is one of the most advanced microcontrollers from Microchip. This microcontroller is widely used in industry because of its low price, a wide range of applications, high quality and ease of availability.it consists of 40 pins. In this 33 are input/output pins. Its operating voltage is 2 to 5V.

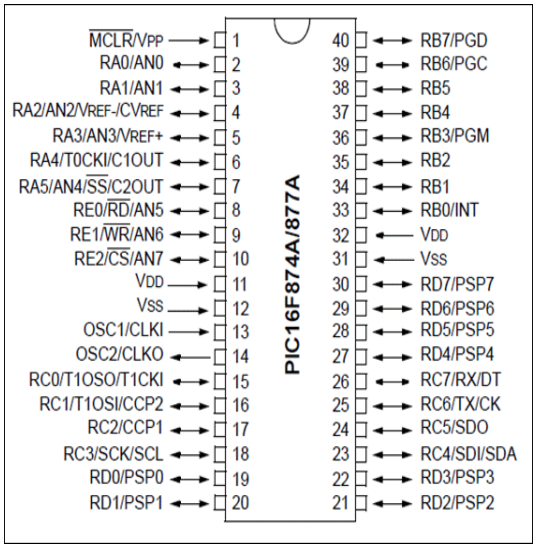

Fig. 3. Pin diagram of PIC 16F877A.

ii. *TICC2530 Xbee Transceiver* – The CC2530 is a true system on chip (SoC) solution for IEEE 802.15.4 Zigbee and RF4CE applications.it enables robust nodes to be built with a very total bill of material costs. The CC2530 combines the excellent *performance* of a leading RF transceiver with an industry-standard enhanced 8051MCU, in-system programmable flash memory,8KB RAM and many other powerful features. For developing this prototype only, we are using this module for higher ranges other long range RF modules can be used for obtaining the RSSI values.

Fig. 4. TI CC253O RF Module.

iii. *16X2 LCD* - A Liquid Crystal Display is a flat-panel display or other electronically modulated optical devices that use the light-modulating properties of liquid crystals combined with polarizers. Here, it is used to display the border alert and weather alert at the ship side.

iv. *Buzzer* - A buzzer or beeper is an audio signal device, which can be mechanical, electromechanical or piezoelectric. Here the buzzer is placed at the shipside and it produces a beep sound when the boat crosses the sea border.

v. *Power Supply*- A Power Supply unit converts AC to a low-voltage regulated DC power for the internal components of the system.

vi. *Switches*- Four switches are interfaced to the microcontrollers RB0, RB1, RB2, and RB3.When pressing this key from the boat side it will display like food, water, fire and emergency on the PC.

C. *Software Requirements*

i. *MPLAB IDE*- It is a software program that runs on a PC to develop applications for Microchip microcontrollers. It is called an Integrated Development Environment or IDE because it provides a single integrated "environment" to develop code for embedded microcontrollers. Here the code for the ship side is developed in MPLAB.

ii. *PICkit3-Programmer*- It is a simple, low-cost circuit debugger that is controlled by a PC running MPLAB IDE software on a windows platform. The program is dumped into the PIC microcontroller using PICkit.

Fig. 5. PICkit programmer.

iii. *Visual Basic*-It is a tool that helps to develop windows Graphic User Interface (GUI) applications.

D. *Working*

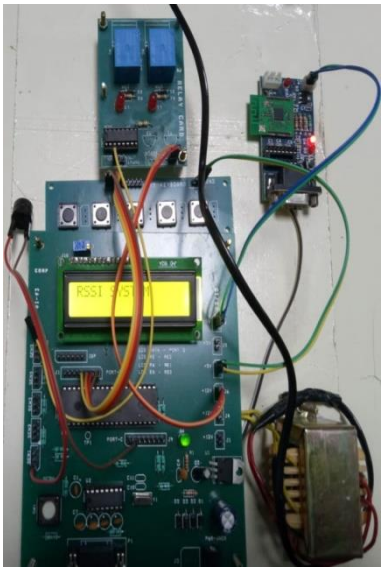

Fig. 6. Prototype of the proposed method.

The proposed system consists of two units. One is placed in the ship and the other unit is placed at the seashore connected

to a PC. Here the ship is tracked based on the RSSI value. When the ship is moved far away, the RSSI value will be a greater negative value. This shows that the strength of the received signal is getting reduced and if the RSSI value crosses the threshold value the buzzer will be on. This indicates that the boat has crossed the border and must return soon. Moreover, there are four switches, that can be used by the fisherman for their needs such as food, water and also in emergencies like fire. The boat can be monitored in live through the PC, therefore weather alert and border cross alert can be given to the fishermen.

V. RESULTS

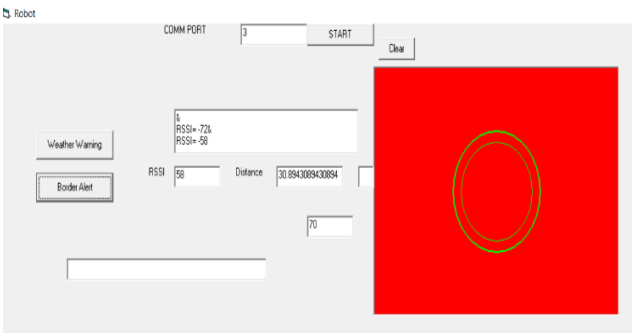

Fig. 7. The result when the boat crosses the border.

Figure 7 is the result obtained when the boat crosses the threshold RSSI value. This result is obtained at the PC. Here the threshold value is given as minus 70dBm. When the RSSI value crosses the threshold then the buzzer will be on and a border alert can be given to the fishermen.

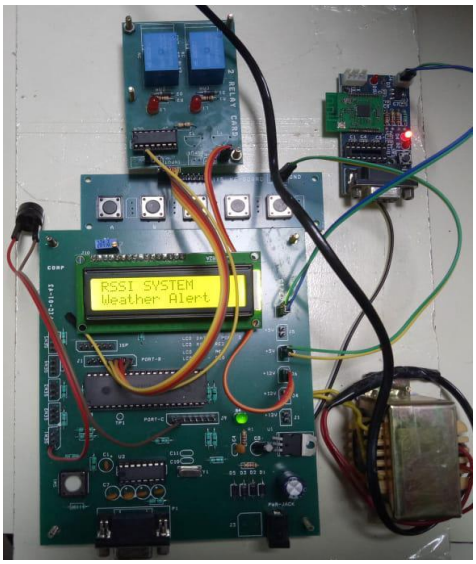

Fig. 8. The weather alert indication is displayed on LCD.

Figure 8 shows that the weather alert can also be given to the fishermen during the bad weather conditions. This result is displayed on the LCD screen at the ship side.

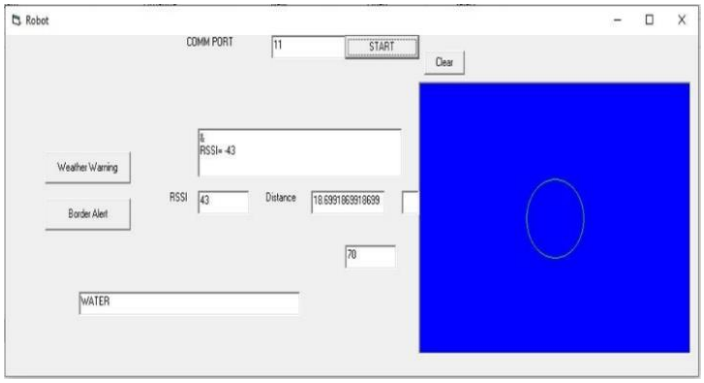

Fig. 9. The result obtained when the fishermen is in need for water.

Figure 9 shows that the result obtained in pc when the input is the need of water.

VI. CONCLUSION

The Fishermen earns their livelihood by catching and selling fish. Their life is very tiring and dangerous, especially at the sea border. Due to carelessness or without knowing the border they can be caught by the other country's coastal guards. As a solution to this problem, the developed sea border detection and ship tracking system will monitor the boat and protect them from crossing the border. The proposed method has many advantages as compared to other existing method. This system is more reliable and immediate response in emergency situations. Since, it is a full-duplex communication the fishermen can also inform their emergency needs to the seashore.

VII. FUTURE SCOPE

The developed prototype can be implemented in real-time with more accuracy and in a long range of communication. This can be further modified in to a fully assessed application in the near future. Many other features like audio assistant can also be implemented.

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6G with Quantum Technology and Intelligent Reflecting Surfaces

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***Abstract*—The recent developments in the 5th generation of wireless networks have helped researchers start a journey that enables them to realize the full potential of intelligent networks, one that will only be realized with Beyond 5G networks. It is expected that with technological breakthroughs in the fields of Machine learning, Quantum Computing and Quantum Machine Learning (QML) we will be able to achieve connectivity goals with the 6th generation of networks with a network operating at the THz band with a larger spectrum of resources. This superposed nature of the network state requires constant influx of information and can hence be viewed as a quantum uncertainty problem. In contrast to classical systems, quantum systems yield counter-intuitive patterns more efficiently and hence it would be within bounds to propose that the latter will outperform the former on the problems at hand. Considering the hardware and software challenges that are still considerable, but have helped open paths to other technologies with respect to 5G target services and technologies. We here aim to provide an umbrella view of the related avant-garde applications of quantum computing, machine learning and intelligent reflecting surfaces in Beyond 5G networks. Within this paper we highlight the open problems and possible solutions with respect to employing futuristic techniques for assisting B5G networks and follow it with a development timeline where we delineate the worldwide efforts in realizing the potential of 6G networks.**

***Index Terms*—6G, quantum machine learning, quantum computing, intelligent reflecting surfaces**

I. Introduction

As the societal needs continue to evolve, there has been a steep rise in a wide variety of emerging use cases that cannot be served potentially with 5G. The next generation of VAR, i.e, holographic teleportation requires data rates in the range of Tbps with microsecond latency. This cannot be achieved even with the millimetre wave frequency bands within 5G. Consequently, the research community has gravitated towards addressing the aforementioned challenges. We predicate that ongoing research in the domains of terahertz band communications, intelligent surfaces and environments, and network automation may hold the key to the future of wireless. An amalgamation of societal needs and technologies that serve to enable those needs are the key drivers for an advancement in the existing wireless systems. Together, these factors imply a focused discourse on the next frontier in wireless communications, i.e., 6G systems. It is predicted that 6G will enable a pervasively intelligent, reliable, scalable, and secure terrestrial wireless network and also incorporate space communications to form an omnipresent wireless network, in keeping with the need for true wireless ubiquity. This paper highlights the recent advances, emerging use cases and the key enabling technologies that are essential to the realization of 6G [5].

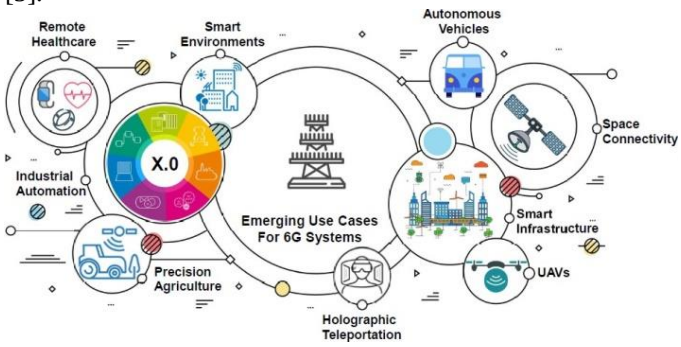

Fig. 1. 6G use cases [5].

In recent years, the research community have shifted their focus to data-driven adaptive and intelligent methods [1], [2]. This is majorly due to the recent advancements in classical computing methods and partly due to the tremendous potential of parallelism offered by Quantum Computing (QC) and related quantum technologies. These advancements have led to the serious consideration of deploying Machine Learning (ML) algorithms as a solid alternative to the conventional logic-based approaches. Thus, it is vivid that data-oriented learning and quantum mechanics-based computing have a strong potential in realizing the goals of a service-driven fully intelligent 6th Generation (6G) communication network. In the emerging paradigm of increasing human and machine inter- connectivity, a tremendous increase in the number of network nodes and data traffic is expected [3]–[5].

The automation of parsing data and deriving inferences from the same has seen a leap with the evolution of computers from analog to digital in the 20th century. Following these advancements, the expeditious progression of computer hardware has enabled the implementation of algebra in data analysis techniques and has in turn given birth to our application of methods such as regression, principal component analysis and even support vector machines. Since its inception into the digital world computers have been used to implement artificial neural networks such as perceptrons in the mid-20th century and neural networks were built and implemented, such as Boltzmann Machines and Hopfield networks ne in the later decades which gave birth to deep learning [23]. However, the true power of classical computers has been realised with the reconciliation of special purpose information processors and computers with powerful hardware in the past 10 years. These machines are enabled with the power to implement deep neural networks with billions of weights [24]. This has also been accompanied by the plethora of data which have shown that deep learning networks are capable of deriving complex and intricate patterns in data. In contrast to classical machine learning methods that can perceive statistical patterns in data and simultaneously create data that possess inferred patterns, quantum computers can engender counter-intuitive patterns in data. We can understand why quantum algorithms are able to outperform classical algorithms for certain problems by investigating the steps that they dictate. This edge over classical algorithms that allows them to solve problems faster is known as quantum speedup. Quantum speedup provides a better advantage for finite-size problems over the traditional computer science perspective of problems that require mathematical proofs and grounded statistical data. However, this edge that sets quantum and classical ML apart rests on the existence of a quantum and is a benchmarking problem. Some of these advantages that QML has over classical ML is an improved classification accuracy and better sampling of inaccessible systems. But to have a better understanding about quantum speedups we must understand the measures used to characterize the same, most of which are derived from complexity theory. There are two complexities used, query complexity which measures the number of queries created to the information source of the algorithm and gate complexity which measures the number of elementary operations made by the algorithm or rather number of gates created. But without having information about how to map this idealization to reality we cannot synthesize much about the necessary resource scaling. Along with the algorithms the analysis of their feasibility with respect to hardware is also under review. We will also look at the some of the quantum algorithms for machine learning that showcase quantum speedups [19]–[22], for example, the quantum application of Basic Linear algebra Subroutines, solving linear equations and Fourier transforms exhibit immense quantum speedups with respect to their equivalent classical algorithms [25]–[27]. The quantum Basic Linear Algebra Subroutines and it renders a quantum speedup for a plethora of classical machine learning and data analysis algorithms, such as, PCA, gradient descent, linear regression and support vector machines. Simultaneously, there exist special processors and annealers for quantum computing and are built with deep-learning architectures in mind [28]–[30]. Though, in the present day, we don't know the full potential of these quantum computers we have reasons to believe that these computers with their algorithms have an edge over classical computers in recognizing patterns to data. We will also discuss the inception of intelligent reflecting surfaces [10] that incorporates an array of IRS units which each sustain some kind of change to the incident signals [11]. An IRS shifts and configures an incident signal This change from the units may be in the form of amplitude, phase, frequency or even polarization. Recent studies [10], [13]–[18] have taken only phase shift into consideration as it consumes no IRS power. Some places where IRSs are located would be in walls, building facades and ceilings [7], [14].

II. Machine Learning for Communication

It has been justified traditionally to apply Machine Learning when there is not a sufficiently large amount of training data, the machine learning model is slowly varying across time and the numerical analysis is justifiable. They have been notable in recent times for their data-driven solutions in communication systems and have incited a rise in self-sustaining networks that are already enabled to meet the dynamic demands for reconfigurability of future devices and services. It is also reasonable to suggest that Machine learning, due to the surfeit of data and computational power, will replace the classical mathematical model based solutions for networking. In the fol- lowing we present the basic applications of machine learning in communication networks and how they give rise to different layers and types of the same.

III. Fundamentals of Quantum Communication

The role of quantum mechanics in our daily life has been speculated to range from pharmaceuticals, computing and even communication [32]. With respect to communications and computing fields the currently employed protocols and meth- ods can be augmented with effective algorithms that utilizes physical occurrences that take place in the quantum realm also with the exercises of the quantum principles and tools such as superposition. In addition to this, quantum computing and mechanics can play an important role in deriving effective solutions to classical problems for networking and signal processing. Principles such as quantum teleportation, that transmits unknown quantum states and quantum cryptography, which utilizes a range of high-level communication protocols to deliver information securely, provide quantum computing an edge over classical methods in communication networks [33].

One of the edges that quantum mechanics in communications provides is the high degrees of freedom. Due to the superposition nature of quantum particles such as photons and electrons, that are governed by quantum principles, they can be represented as linear combinations of

logical values 0 and 1 as opposed to classical representation. For example, the polarization of a proton with the vertical and horizontal polarization of Pv and Ph respectively can be represented as a linear combination of the same,

$$P = aP_v + bP_h \quad (1)$$

We can adjust x and y to optimize communication protocols [32]. With respect to sources and information processors for communication single-photon emitters can generate quantum information that can be emitted as pulses, with the mean number of pulses varying between 1 and 0. For communication in the quantum realm single-photon detectors can be used to detect modulated photons' polarization and phase for information transfer, with the help of homodyne detection [34]. Though we have discussed some solutions, quantum com- puting still come across two major challenges with respect to designing protocols. Due to the no-cloning theorem con- struction of network entities such as routers and repeaters for quantum internet is extremely demanding [**?**]. The second challenge concerning the capacity of quantum communication channels is rather unclear. Unlike classical communication channels whose framework for capacity is well defined, the capacity of quantum channels is something that is dependent on various factors and at the moment is arcane. This capacity problem arises due to the superposition and entanglement characteristics of quantum channels, that deliver different possibilities of information [36], [37]. Another matter of discussion is the meaning of measurement for a quantum system, which is in a classical system well defined. The authors in [38] have suggested a seronegative interpretation of the amount of classical communication that is commensurate with its quantum counterpart. There have been some promising solutions to this classical data transmission in quantum systems such as, dense coding [42], quantum teleportation [41] and, quantum key distribution (QKD) [39], [40]. In quantum communication systems the spread spectrum is based on multiple access techniques which can send the quantum particles of multiple users vie the same median by sharing a similar frequency band and time window [43]

IV. Applications of Quantum Communication

Now that the scope of quantum principles and communications have been laid out, it is postulated that they can be applied in various industries such as terrestrial wireless networks to satellite networks but the widely discussed areas for quantum applications is in optical fibre communications. Though they are subject to undesirable fluctuations and noise due to the quantum mechanical origin optical fibre-networks can be designed by keeping the quantum-realm in mind [44]. Security of the quantum communication protocols is another application where the authors in [45] carried out a feasibility analysis of QKD protocols for large scale aquatic scenarios which yielded significantly positive results in reinforcing these protocols for underwater communication. Quantum computing can also be applied in Satellite communications (SatCom) because of the security benefits the QKD protocols offer as discussed earlier [39]. However, the major application of Quantum Mechanics is in the field of Quantum Internet in which the information units, Qubits, can be transmitted from one quantum computer to another [33].

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V. Quantum Machine Learning

A. Generative and Discriminative QML Models

With respect to machine learning the advantages that the speedups quantum techniques provide over classical algorithms materializes in many ways [31]. QML algorithms provide immense speed-ups in parsing and analysing data of large volume and velocity for both supervised and unsupervised in relation to classical machine learning algorithms. Simultaneously, QML can help achieve more private and secure communication networks. Though supervised and unsupervised machine learning algorithms have been intensely investigated in [31], quantum advancements in these algorithms have also been explored in [50] and the authors have reported immense improvements. Following this the authors in [51] have discussed some of the notable applications and pattern recognition techniques in quantum machine learning. The training and model selection for supervised machine learning that are powered by quantum computing are also discussed thoroughly in [52]. Following this the authors of [53] have provided a comprehensive process of converting a classical machine learning method into its QML counterpart.

With the development of tensors in computer hardware, discriminative and generative machine learning models with a quantum computing approach have been recently advocated for the devices in the near future that are enabled with a limited number of qubits but have a high error-rate [54]. Some of the pioneering ideologies in recent research has revolved around generative models, with recent developments of a quantum generative model that forms the base for a quantum machine learning algorithm [55]. The aforementioned experiment as predicted yielded results with exponential speedup in parsing, inferring and augmenting data with the

quantum model as opposed to its classical generative counterpart.

B. Quantum Reinforcement Learning

Reinforcement learning is an interactive and generalized form of learning. In this learning technique, the intelligent agents learn the required optimal behaviour based on the feedback from the environment. The feedback is provided in the form of rewards and penalties. Quantum-speedup for reinforced learning is an emerging framework and has a great potential in the agent-environment paradigm. The interactive setting of two parties i.e., agent and the environment can be formulated even for a quantum information treatment. The superposition and parallelism concepts of quantum mechanics can be used to represent and identify the eigenstates in quantum-powered reinforcement learning, by observing a random quantum state simulated through the collapse postulate of quantum measurement. The reward from the environment can be used to update the probability of Eigen actions in a parallel manner. The probability of the Eigen action is determined by the probability amplitude. This is then updated in parallel according to the rewards. In [56], a quantum value updating algorithm for quantum powered reinforcement learning has been proposed.

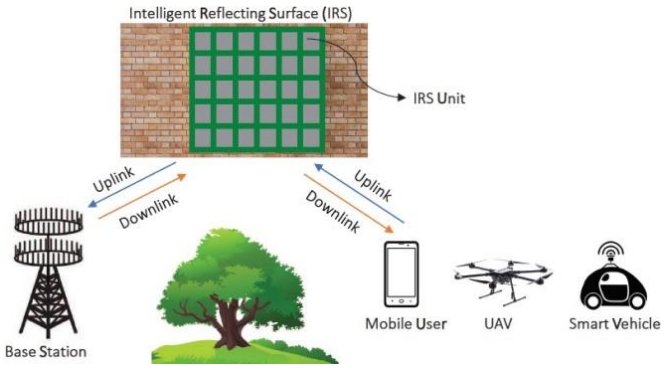

Fig. 2. IRS-assisted Communication [7].

VI. VI. Intelligent Reflective Surfaces for Aiding Communication

A. A. Channel Estimation for IRS-Aided Communications

Intelligent reflecting surfaces are a type of passive system and do not have the ability to recognize actively, this means that their downlinks are generally stationed/employed at the base station. The IRS shifts the phase of a received signal accordingly when a channel information is communicated by the base station. Some of the problems associated with the phase shifts during channel estimation have been addressed by [57], [58], the authors of [59] have suggested a method using compressive sensing to tackle this problem and deep learning methods were suggested in [60]. The model suggested previously by Taha et al. [58] accommodates a number of passive IRS units that are synchronized with an IRS controller which is the only active component. The model was then accompanied with compressive sensing and deep learning methods that are observed only at the active IRS unit to estimate the channel at all IRS unit

B. Deep Learning-Based Design for IRS-Aided Communications

As mentioned earlier the authors of [58] used a deep learning method in their IRS aided communication network for estimation. With the help of an artificial neural networks the required phase shift and channel estimation by learning the information from channels at only the active IRS units. In another conference [61] the authors were able to guide the IRS to accommodate itself based on the incident signal to optimize the interaction between one another.

C. Reliability Analysis of IRS-Aided Communications

There have also been methods to analyse the reliability of an IRS supported communication network, especially with respect to outage probability and the uplink rate distribution [64]. Though the authors have tried to use mean and variance to compute the outage probability a new method was then found by using the Lyapunov central theorem. To distribute the data sum rate and assign the value to the outage probability by computing it such that the data sum-rate is lower than the desired value, by using the LCT as mentioned earlier.

D. Implementations of IRSs

In attempts to implement IRSs, Hu et al. [65] investigated that to diminish the dimensions of various independent signals they had to employ hexagonal lattice for its surface area. This examination allowed the authors to open gateways to a range of applications in BSG networks some of which include security and machine learning [66]–[70]. This also strengthens a classical theory of surfaces and lattice theory for IRS surfaces.

E. IRS for Secure Communications

Various recent studies [79], [71]–[73] have leveraged IRSs to protect the physical layer of wireless communications. In the simplest wiretap channel introduced first by Wyner [74], a transmitter and a legitimate receiver setup communication, and are simultaneously wiretapped by an eavesdropper. This model has been extended to the broadcast wiretap channel [75], compound wiretap channel [76], Gaussian wiretap channel [77], and MIMO wiretap channel [78]. The sole purpose of applying an IRS to secure communications under a wiretap channel is that an IRS, while decreasing the data rate at an eavesdropper, can be used for increasing the data rate at the receiver end. This improves the difference between the two rates considerably, which is defined as the secrecy data rate.

VII. Conclusion

This paper surveys the key enabling techniques for the next generation of wireless communication networks, outlines their essential use cases, and provides a perspective on current as well as future research and development efforts. We envision that 6G wireless systems will be largely driven by a focus on wireless ubiquity, i.e., the unrestricted availability of high-

quality wireless access. To this end, we have highlighted the key enabling technologies that are vital to the success of 6G. In this survey paper, we categorize recent studies of quantum technology and IRSs. As promising technologies to facilitate 6G wireless communications, IRSs induce smart ra- dio environments to increase spectrum and energy efficiencies whereas quantum tech gives various opportunities to replace the traditional methods with it. We envision that the coming years will see much research and development for the IRS and quantum technology to build 6G communications.

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Digital Signature Verification For Cloud Storage Using ECC

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***Abstract*—The Elliptic Curve Cryptography (ECC) is a modern family of public-key cryptosystems. We can use an Elliptic Curve algorithm for public/private key cryptography. To be able to use ECC such as cryptographic signatures, hash functions and others that help secure the messages or files are to be studied at a deeper level. Signatures prevent forgeries, infeasible to sign a message without the knowledge of the key. Performs all the major functions of an asymmetric cryptosystem(encryption, signatures and key exchange). The main advantage is that keys are a lot smaller. RSA requires a key server for public key distribution. With Elliptic Curves, you can provide your own public key. In python, the above described method can be implemented using the library fastecdsa. We use python IDE for coding. Implementation of digital signature has to be done to every document using Elliptic curve cryptography. Later the documents are to be verified by creating a platform where it shows the status of any document, whether it may be successfully secured or not. Schnorr digital signatures are both a fairly simple signature scheme yet very powerful at the same time.**

***Index Terms*—Digital signatures, public keys, python, fastecdsa library, python IDE**

I. Introduction

Elliptic Curve Cryptography (ECC) is one of the latest developments in the field of cryptography, with a key length advantage over other cryptosystems such as RSA and other traditional D cryptosystems, as we know. The short key length is well suited when the computing power of the device using the encryption system is low. This attractive property gives it a key length advantage over other cryptosystems such as RSA and other traditional cryptosystems. The very short key length of ECC provides better security, which is a very good choice when the computing power of devices uses weak cryptography. This attractive property makes it compatible with many standards bodies such as ANSI, IEEE, ISO and NIST. ECC provides all the tasks required for public key cryptography: authentication, encryption, key sharing, and digital signatures. Elliptic curve cryptography is nothing but a class of public key cryptosystems proposed by Coblitz and V. Miller. The ECC protocol finds that the discrete elliptical curve algorithm cannot be found. ECC offers as strong security as RSA. The bitkey is as small as , which improves performance and reduces computational complexity. The 160-bit ECC key has the same security level as the 1024-bit RSA key. There are parameter and algorithm options to consider before implementing an ECC system. Various curve domain parameters (field representation, curve type), algorithms for field operations, elliptical curve operations, and protocol operations can be affected by safety. .It should be noted that this does not perform the best optimized optimization studies.

II. Literature Survey

In 2011, Amarsiad and Moncef Amara proposed a treatise called "Elliptic Curve Cryptography and Its Applications". Elliptical Curve Cryptography includes all relevant asymmetric cryptographic primitives, including digital signatures and key exchange algorithms. The function used for this purpose is a scalar function. The multiplication kP (k is an integer, p is the point on the curve), is the central operation of the ECC. ECC uses smaller keys for greater security and higher speed.

In 2013, Priyank R, Varun S and Priyanka submitted an article on data protection in cloud computing. Their approach is to protect the privacy of user data with service providers and prevent third-party service providers from accessing or disclosing user information processed and stored in the cloud. Its method has three main aspects that are very important for data protection. That is, the separation of infrastructure and software service providers in cloud computing, hiding owner information, data ownership, data protection and data disruption.

III. Proposed System

Asymmetric encryption does not need a secure way to exchange the keys. Public keys can be shared to anyone and the message can be encrypted but only the one with the private key can decrypt the message. By using hybrid algorithms we can make use of the advantages of different algorithms. Using

elliptical curve cryptography which uses less key length and provides greater security and it uses a function called trap door which makes the guessing of the key difficult.

Digital signature schemes can be used to provide the following basic cryptographic services: data integrity (the assurance that data has not been altered by unauthorized or unknown means) data origin authentication (the assurance that the source of data is as claimed) non-repudiation (the assurance that an entity cannot deny previous actions or commitments).

IV. IV. System Design

A. Input Design

Entrance design is a part of overall system design. The main goals of input design are

- Create a cost-effective method of input.
- To achieve the highest level of accuracy possible.
- To ensure that the input is acceptable and understood by the user.

B. Input Media

At this stage, you need to select an input method. You should consider drawing conclusions about the means of entry:

- Input type
- Format flexibility
- Speed
- Accuracy
- Verification
- Method Rejection rate
- Ease of repair
- Storage and handling requirements
- Security
- Ease of use
- Portability

Considering the explanation above suffice it to say, input types and input medium, most of the input is in form of internal format and interactive format. The keyboard is the most suitable input device because the user must enter the input data directly.

C. Output Design

The output of the computer system is mainly necessary to convey the result of the process to the user. It is also used to provide a permanent copy of the results for future reference. The different types of output are generally: External output with a destination outside the organization Internal output with a destination inside the organization and the main user interface with the computer. Performance results fully utilized in the IT industry. The user communicates directly.

V. Implementation

ECC is a relative of discrete logarithm cryptography. An elliptic curve E over Zp is described within side the Cartesian coordinate gadget with the aid of using an equation of the form:

$$y^2= x^3+ax+b$$

where $4a^3+27b^2\neq 0 \pmod p$, collectively with a unique factor O, known as the factor at infinity. The set E(Zp) includes all points (x, y), x ε Zp, y ε Zp, which fulfill the defining equation, collectively with O.

A. ECDSA Key Generation

The key pair for entity A is associated with a specific set of domain parameters EC D = (q, FR, a, b, G, n, h). E is the elliptical curve defined by Fq and P is the point of the first degree. N and q of E (Fq) are prime numbers. Each entity A does the following:

1. Choose a random integer d from the range [1, n-1] .
2. Calculate Q = dP.
3. A's public key is Q, A's private key is d.

B. ECDSA Signature Generation

To signal a message m, an entity A with area parameters D= (q, FR, a, b, G, n, h) does the following:

1. Select a random or pseudo random integer okay with inside the interval [1, n-1].
2. Compute kP =x1, y1 and r= x1 mod n (wherein x1 is appeared as an integer among zero and q-1). If r= zero then move again to step1.
3. Compute okay -1mod n
4. Compute s= okay -1 mod n, wherein h is the Secure Hash Algorithm (SHA-1). If s = zero, then move again to step 1.
5. The signature for the message m is the pair of integers (r, s).

C. ECDSA Signature Verification

To confirm the signature of A (r,s) in m, B gets an authenticated reproduction of the area configuration with AD = (q , FR, a, b, G, n, h) and the general public key Q, then run the following

1. Make positive that r and s are integers within side the range [1, n-1].
2. Calculation w = s -1 mod and h (m)
3. Calculation u1 = h (m) w mod and u2 = rw mod n.
4. Compute u1P + u2Q =(x0, y0) and v= x0 mod n.
5. Accept the signature if and best if v = r.

VI. Working

Normally we use the digital signatures for the softwares and open source files to check the authenticity and integrity of the files. Here the files or the locations of the file is taken from the user and the content is parsed and by using any of the cryptographic hash functions such as SHA256 and a message digest of 256 bit is generated. The digest is created by the application present in the user end to avoid the middle man attacks and also attacks that can happen during the storage of the data in the cloud.

A pair of public and private keys are generated using the elliptical curve algorithm (SECP256k1) and private key which is also called as the signature key is fed to the elliptic curve algorithm along with the data to generate a digital signature for the hash value generated. The digital signature is appended to the data and is stored in the cloud which is used later.

This is done for each and every file that is being uploaded by the owner and the files can only be uploaded by the owners who have a specific access. Once uploaded in the cloud the files which are kept are visible to everyone but the contents of the files are hidden. The user can request the owner to access the file. Only when the owner gives the digital signature and the public key the user can verify. The public key is also called as the verification key is given to the verification algorithm along with the digital signature and a value is generated. The hash function that is being used by the user and the owner needs to be the same. The user runs the same hash function on the received data to generate hash value.

The value generated by the output verification algorithm and the hash function are compared. From that comparison the user verifies the authenticity and the integrity of the data. The verification is done on the user side to reduce the computational load on the server side.

VII. System Architecture

The purpose of the design phase is to organize responses to questions, such as required documents. This section is an introduction to migration when moving from the problem domain to the response domain. The design phase meets the system requirements. Design Perhaps the most important problem with the system is the standard of the software packages. This has serious implications for subsequent parts, especially inspection and maintenance. The output in this section is a document type similar to the response template and is used during deployment, testing, and maintenance. Design work is generally divided into two phases: system design and detailed design. Collectively referred to as the highest rated type, for the purpose of examining the modules required for the system, the specifications of those modules, and how they work together to provide the results. The main knowledge structure, file format, output format, as well as the main modules and specifications of the system measure the technology. System design is a method or technique that deals with the design, components, modules, interfaces, and knowledge of a system to meet those needs, and by applying system theory, the system is under development, users they will read it. Throughout this section, information clearly printed on the square scale of the module can be displayed in a high-level type description language independent of the target language contained in the software. The main objective is to plan the logic of each module.

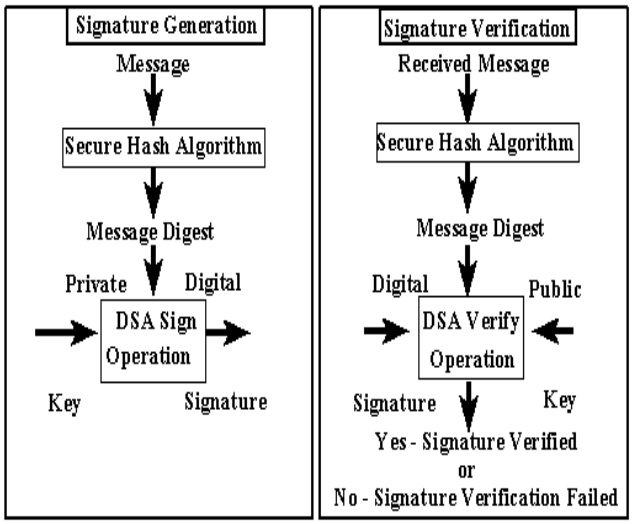

Fig. 1. Architecture diagram.

VIII. Sequence Diagram

A sequence diagram is a type of interactive diagram that shows how and in what order processes work together. This is the structure of the message chain diagram. A series of messages on the stage are exchanged between the objects necessary to realize the function of the stage. Sequence diagrams are often associated with the implementation of use cases in the logical view of the system being developed. Sequence diagrams are sometimes called event diagrams, event scenarios, and timeline diagrams.

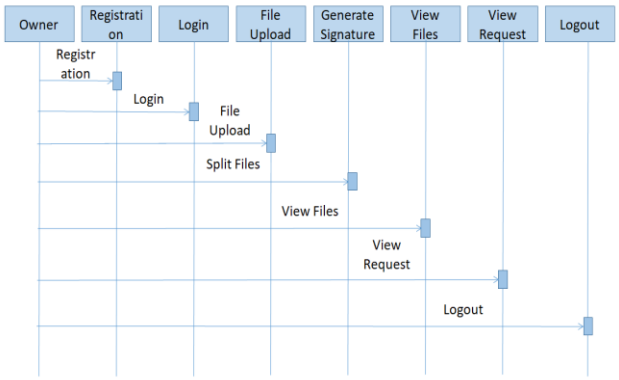

Fig. 2. Owner Sequence diagram.

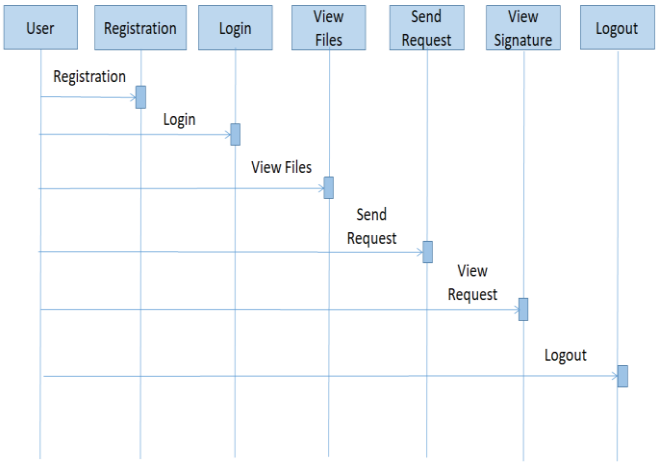

Fig. 3. User sequence diagram.

IX. Conclusion

The Elliptic Curve Digital Signature Algorithm (ECDSA) is one of the proposed variations of Elliptic Curve Cryptography (ECC) as an alternative to established public key systems such as the Digital Signature Algorithm (DSA) and Riverst Shamir Adleman (RSA). It has It has been receiving a lot of attention in industry and academia. The main reason for the appeal of ECDSA is the fact that there is no known sub-exponential algorithm to solve problems of discrete logarithms of elliptic curves on well-chosen elliptic curves. The most popular algorithms for RSA basic integer factorization and the DSA discrete logarithm problem are very time consuming. ECDSA allows you to use significantly smaller settings than other competitive systems such as RSA and DSA, but with a security level of 1.The benefits of lower key sizes include reduced computation time, processing power, storage space, and reduced bandwidth. This makes ECDSA ideal for confined environments such as pagers, PDAs, mobile phones, and smart cards. Low processing power, storage space, bandwidth, or power consumption. Digital signatures can be extended to images and documents to verify and authenticate them.

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First Response Drone

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***Abstract*—An emergency/response vehicle is any vehicle that is designated to respond to an emergency in a life-threatening situation. The conventional emergency/response vehicles have been our main preference for all these years, but the main drawback is the wait time. Studies show that in India the average time for a response vehicle to reach the scene is about 15 minutes. This is mainly because of the extreme population density and poor traffic management. With UAVs (Unmanned Aerial Vehicles)/drones this delay can be reduced down to a significant amount. We aim to aid and support Civil Service Departments such as Medical Department, Fire and Rescue and Police Department. Once the user reports an emergency, our server will pick it up and map the user to the nearest available FRD (First Response Drone). The assigned FRD will autonomously reach the addressed destination. It's equipped with a non-lethal dart gun, a container carrying medicines in a cold state with a Peltier module and an onboard camera to provide a bird's eye view of the area in case of a police or fire emergency. The drone sends a live feed to the administrator which then is passed through an object detection algorithm to detect human beings in real-time.**

***Index Terms*—UAV, FRD, Civil Service, aid, support, autonomous, emergency, object detection**

I. Introduction

Unmanned aerial vehicles (UAVs) are gaining significance these days. Detailed information and techniques of UAVs in smart and modern cities are brought out. Having a human commandeer an aerial vehicle especially during an emergency like accidents can be a very challenging task. By deploying a drone, the task can be carried out almost instantaneously. Drones can be used for a wide range of applications ranging from defense to agriculture. A typical unmanned aircraft is made of light composite materials to reduce weight and increase maneuverability. The unmanned aerial vehicle is capable of navigating autonomously without any real-time input from the user and also is programmed to follow a specified path. The algorithm enables a control technique by which the drone is facilitated to fly autonomously. The trajectory of the drone, accurate altitude holds performance and its smooth motion can all be monitored autonomously. Drones have a wide range of applications that have led industries to invest in this technology. They have proven to be safe for the environment and also to be a cost-saving technology at the same time. They are also flexible for quick inspections. Drone markets are considered to be a great commercial opportunity since the market is expected to grow in the following years.

It is necessary to view and analyze the state of the drone's environment to give the civil service officials' an overview of the emergency. With object detection, it'll be possible to provide a bird's eye view of the current emergency and pinpoint the subjects accurately by drawing a bounding box over them. This is achieved with the help of the Haar cascade classifier. The video frames are transferred to an IP address and the IP address is pinged to get the frames and is run through the classifier, whose output will enable us to draw the bounding box. This will happen in real-time.

The UAV will also be equipped with a non-lethal dart gun, which is custom designed and printed with Creality Ender3. The dart gun is re-loadable, efficient and lightweight equipment, which can be used to apprehend escapees.

The UAV will also be equipped with a container, which will be cooled with a Peltier module all the time to transfer a first aid kit, medicines, defibrillator and other necessary medical equipment to provide first aid.

The main purpose of the drone is to minimize response time and to support civil service departments. During emergencies like fire accidents or robbery, the response time of civil service departments like Medical, Police and fire department haven't been promising in INDIA. Therefore, to provide aid before the arrival of civil service departments drones can be deployed. These drones can be quick and efficient when navigating through rough conditions and unpredictable terrain.

II. Related Work

Drones have been a breakthrough during recent times, the drone family is not composed solely of flying objects. There may be as many different kinds as there are concepts: terrestrial drones, marine drones, submarine drones, agriculture drones, medical drones. Provided there is no longer any human crew aboard, any kind of vehicle or piloted engine can be "dronized".

An ambulance drone is one such drone, created solely for medical emergencies, with essential medical supplies, when called upon, the administrator will manually navigate the drone to the destination to provide medical aid. As per [3] there is a drone that is equipped with a non-lethal weapon, which can fire up to 80 balls per second. These balls can either

be pepper balls or darts. This drone was created for the sole purpose of aiding the police force during an emergency. There are several autonomous drones, which accurately takes off from specified location and travels towards preset destination. These drones are equipped with several cameras for object detection, object avoidance and landing. Firefighting drones as discussed in [4] are used for aiding firefighters during emergencies, they aid them by providing a view of the surrounding area, which then helps them to make the best decision in the situation.

III. Proposed System

FRD (First Response Drone) implements several features of drones that have been discussed in the previous section into one. The drone acts as an instant response medium for medical, police and fire emergency. The raspberry pi is used to send commands to Pixhawk for autonomous flight, and also uses a raspberry pi cam v1.3 for capturing frames and streaming them to the admin. The emergency is reported to the server from the client mobile app. At the same time the user data, type of emergency and current GPS coordinates from the mobile app are updated to the database in real-time, once reported algorithm pings data from the database node, and maps the nearest FRD to the emergency. Once mapped, the raspberry pi in the appropriate FRD receives the destination coordinates, the raspberry pi with the help of DroneKit sends flight instructions to the Pixhawk flight controller for autonomous flight. The drone continuously updates the database, its coordinates from the connected GPS module. The FRD is made durable and lightweight with a carbon fibre frame, and a seamless autonomous flight algorithm. The above-proposed system architecture can be seen in the below figure.

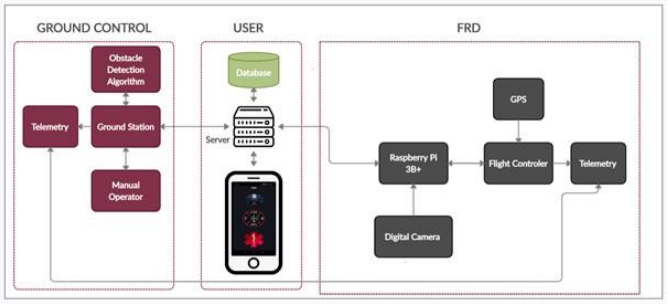

Fig. 1. System architecture.

IV. FRD Hexacopter

A multicopter, more commonly known as a drone, is a helicopter with more than two propellers. Some of the different types of multi-copters are quadcopter, hexacopter and octocopter. Hexacopter type has been selected for FRD for its flight stability. It has been made as lightweight as possible and as durable as possible. The materials used are aluminum,

PLA, PVC and carbon fibre. It uses an onboard processor Raspberry Pi 3B+ and a Pixhawk 3DR flight controller.

A. Build

The FRD hexacopter uses 6 carbon fibre arms, which are attached to two plates. One the upper plate which connects all the arms together, another is the bottom plate which is otherwise called the distribution board. Both the upper and bottom plates are made of carbon fibre. The bottom plate is soldered with the battery and all six ESCs which are further connected to motors.

1. *Motors and Blades:* Six BLDC motors have been used for each arm, it differs from the conventional DC motors as it doesn't contain brushes, it works by the electromotive forces generated by the permanent magnets located in the rotor and the coil wound poles in the stators. The advantage of this motor is that it doesn't produce magnetic interference. Their small size, low cost and the above-mentioned properties have led us to use this motor for the hexacopter. Spinning blades are the wings to the craft, the very part that creates the airflow that lifts the machine into the air, the blade material used in the hexacopter drone is plastic, it has been selected for its durability, lightweight and cost.
2. *Telemetry and GPS:* The function of telemetry is to provide a channel to transfer flight data in real-time. The GPS is used to estimate the global position of the drone by measuring the relative positions concerning several satellites. The GPS selected for this project includes an inbuilt compass.
3. *Landing Gear:* Landing gear plays an important role in elevating the drone above ground level while landing and also provides space for carrying loads. Six landing gears have been designed for 6 propellers. The landing gear's main tube is a 30cm tall PVC and the top and bottom connectors are 3D printed with PLA (Polylactic Acid). The top and bottom connectors are connected to the PVC and the top connector is screwed exactly under the motors. This can be seen in Fig. 2.

B. Model

The mathematical model for the hexacopter is developed in this section. The hexacopter is considered a rigid body, which consists of the main airframe and four arms. This, the links between the arms and the airframe are assumed to be ideal constraints, which means, there is no dissipation on them. The arms meet at the center at right angles. The center of gravity of the hexacopter is located at the center of the airframe.

1. *Thrust:* As the propulsion element for the hexacopter, the motor is the most important component. However, before determining the capacity of the motor applied in the design, it is necessary to know the total weight that will be lifted and the thrust which is required to lift the heavy load of the hexacopter. The calculation to determine the thrust per motor as in the following equation:

$$Thrust = \frac{total\,weight\ x\ 2}{number\,of\ \ motor} \quad (1)$$

2. *Propeller Performance:* The distance streamed by the fluid due to one rotation of the propeller's blade is defined as the pitch parameter that is often noticed in the selection of propellers. Therefore, as discussed in [5], if the pitch and diameter of the propeller are larger, so the motor rotation will be slower and the lifting force that is produced is large. So, if the hexacopter can lift the heavy load, it required large diameter propellers and large pitch. The thrust style equation of this propeller is:

$$F_{TH} = \rho C_t n^2 D^4 \tag{2}$$

Where ρ, is the air density, n is the rotational speed of the propeller, D in meters is the diameter of the propeller, and Ct is the thrust propeller coefficient. The power that is generated from the propeller can be calculated with the below equation:

$$P_p = \rho C_p n^3 D^5 \tag{3}$$

Cp is the power coefficient of the propeller that is obtained from the rotation. This Cp value changes with speed. The torque on the propeller is generated based on the following equation:

$$T_q = \frac{P_p}{\omega} \tag{4}$$

Where ω is the propeller's angular speed.

3. *Mass and Moment of Inertia:* The mass moment of inertia of an object (J) plays a similar role in the rotational motion to the role that mass plays in translational motion. It determines how the rotational velocity is affected by the applied torque. This depends not only on the mass of the object but also on how the mass is distributed around the rotation axis. Here the hexacopter is assumed to be perfectly symmetric about the x y and z axes and to have its center of mass at the geometric center of the arms. With these assumptions, the matrix becomes a diagonal matrix.

$$J_b = \begin{bmatrix} J_{xx} & 0 & 0 \\ 0 & J_{yy} & 0 \\ 0 & 0 & J_{zz} \end{bmatrix} \tag{5}$$

V. Autonomous Flight

A typical unmanned aircraft is made of light composite materials to reduce weight and increase maneuverability. The unmanned aerial vehicle is capable of navigating autonomously without any real-time input from the user and also is programmed to follow a specified path. The algorithm enables a control technique by which the drone is facilitated to fly autonomously. The trajectory of the drone, accurate altitude holds performance and its smooth motion can all be monitored autonomously.

Once a new emergency request is posted, the service side algorithm will pick it up from the database and map its coordinates with the nearest drone in a 3000m radius. Once the drone is mapped, the appropriate destination coordinates are set to the appropriate FRDs, which will then be picked up by the onboard Raspberry Pi microprocessor or which continuously pings the server for data. The raspberry pi sends commands to the Pixhawk flight controller through serial communication.

MAVProxy is a UAV ground station software package for MAVLink based systems. MAVProxy is a fully-functioning GCS for UAV's, designed as a minimalist, portable and extendable GCS for any autonomous system supporting the MAVLink protocol. It also has a powerful command-line based functionality. It can be extended via add-on modules or complemented with another ground station, such as Mission Planner, APM Planner 2, QGroundControl etc., to provide a graphical user interface. It has the ability to forward the messages from your UAV over the network via UDP to multiple other ground station software on other devices. MAVProxy is common with SITL. With the help of this software, the Raspberry Pi commands the Pixhawk flight controller.

VI. Real-Time Streaming and Object Detection

Once the user interacts with the mobile app, selects the type of emergency and reports one, the request will be placed in the database and the server will catch and assign a drone to the location. The drone will instantly pick it up and will navigate to the addressed coordinates. Once reached, the raspberry pi camera will pick up the frames and send a post request to the server, this happens in real-time.

The administrator application will be using a get request in a loop to get these frames. These frames are nothing but images, these images are then passed through a Haarcascade Frontal Face classifier, Object Detection using Haar feature-based cascade classifiers is an effective object detection method. It is a machine learning-based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. This process is achieved with the help of the OpenCV library both in the Raspberry Pi and in the server back-end. The OpenCV library is used to pick up the frames from the camera and sends a post request to the server, the administrator then pings the server to get these images and is converted to gray scale. The new converted grey image is then passed through the Haar classifier, the classifier then returns four-pixel coordinates as a result, with these coordinates we'll be able to plot a box over these pixel coordinates over the colored frame. This happens in a loop, so the administrator will be able to identify the person in the frame with minimal effort. This will be an efficient method during fire and police emergencies Haar Cascade classifiers are an effective way for object detection. This method was proposed in [7]. A lot of positive and negative images are used to train the classifier with a machine learning-based approach. Positive images are those images contain the images which we want our classifier to

identify. Negative Images are images of everything else, which do not contain the object we want to detect.

VII. IMPLEMENTATION AND RESULTS

First Response Drone is a hexacopter with a carbon fibre frame, custom landing gear, and is also an autonomous drone equipped with a first aid box, dart gun and does real-time streaming and object detection.

Fig. 2. FRD Front view.

Fig. 3. FRD top view.

The simulator is entirely been designed and developed from scratch due to certain limitations with existing simulators and certain custom requirements. The administrator side was designed with Flask as its backend and implements OpenCV and Google Maps API. The customer side mobile application was designed with Flutter SDK and implements Geolocation and Google Maps API. It has been split into two modules Client-side and Administrator Side.

A. Client-Side

Once the client opens the app, they have to log in with their Google Account, Google-auth (OAuth 2) is one of the most secure authentication methods as in [10]. Once registered they're redirected to the emergency screen. Then the client has to select the type of emergency, each type of emergency has a preset list of names and the client has to select any one of the existing ones there is, the client application will also assist with a haptic vibration on selection and will also give a voice note on what is currently selected.

Once the type of emergency is selected, the algorithm will fetch the current latitude and longitude coordinates with the help of the Geo-Location library and set the necessary details in the database. Then it is pushed to the waiting screen while the algorithm assigns the nearest FRD. Meanwhile, with the current coordinates and the type of emergency, the algorithm also identifies the nearest police station or hospital or fire station with the data in the database and maps the nearest appropriate station to the reported area and notifies them about the emergency.

Fig. 4. FRD Mobile app.

Fig. 5. FRD emergency screen.

Fig. 6. FRD Waiting screen.

Once the nearest FRD is assigned to the response, the administrator sends a confirmation and the screen changes to a polyline screen, where the current status and location of the FRD, the path traced by it and the ETA are updated to the client in real-time. Once the emergency is addressed the screen pops back to the emergency screen and the data is deleted from the database for maintaining database health.

Fig. 7. FRD In pursuit.

B. Administrator side

The administrator side has been developed with JavaScript and Flask. It uses Google Maps API and OpenCV with Haar Classifier for object detection in real-time. Here, the administrator will be able to view all the emergency requests in one screen and the screen refreshes every 5 seconds automatically to check for any new requests. Then the administrator has to select any one of the emergencies to start the simulation. Once launched the MAVProxy runs with SITL to fetch the current FRD coordinates from the drone, current status and continuously feeds it to the database to update the maps on both the client-side and administrator side. After successfully addressing the emergency, the algorithm updates the status and clears the current record from the database to maintain the health of the database.

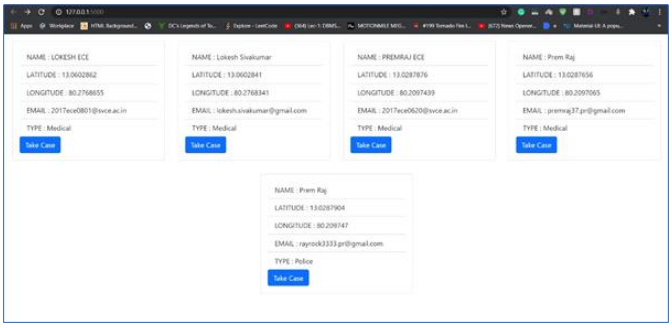

Fig. 8. Emergency details screen.

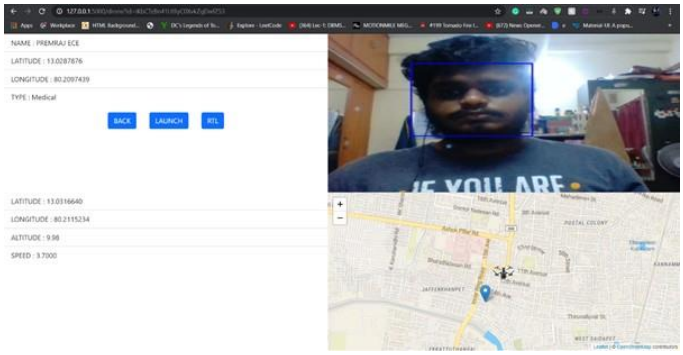

Fig. 9. Simulator main screen.

VIII. CONCLUSION

The outcome of this project is to propose an innovative addition to the pre-existing UAVs and drones by equipping them with cutting edge autonomy. The features and methodologies proposed will display a significant elevation in terms of performance and efficiency when compared to other UAV's. The core aspects of the drone are to carry a first aid box in a cold state and provide a bird's eye view of the situation and autonomous flight. The camera-equipped in drone provides a live feed to the server which is tapped and being fed to the object detection algorithm in real-time stands out compared to other existing models. The autonomous aspect of the drone is a huge plus, this will result in much less response times than the manually controlled UAVs which are available.

As discussed earlier the application of the drone is to provide aid and support to civil service departments like the Medical, Police and Fire department in India. However, over the years, the structure of the drones can be enhanced to support payloads of greater weight for a longer duration, better implementation of non-lethal weapons and flight path. The future scope of drone involvement is vast. The FRD will be a valuable piece of technology that can be used to save a lot of lives.

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DÉCOR : Augmented Reality Based Application To Enhance Interior Designing Using Marker-less Tracking

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***Abstract*—Today information and communication technology support the development of the interaction of humans with the virtual environment such as medical, science, education, etc. The field of computer science innovation known as augmented reality deals with combining the real world with computer-related data. Earlier, if customers wanted to buy furniture without visiting the showrooms it was not possible because it is very important to check how the object actually looks in their home structure. Now in our proposed system, it is possible for the users to purchase the furniture objects while staying in the home without having to visit the furniture showrooms. The main purpose of the "DÉCOR : Augmented Reality Based Application To Enhance Interior Designing Using Marker-less Tracking" is to develop an android application for trying different furniture in a virtual way using a mobile which has a camera that supports AR. The application will eradicate the human efforts of physically visiting the furniture stores which is a very time-consuming activity. Besides this, it might be easier to use this technology in online shopping such that the user gets to try the variety of furniture items in their room or house that they wish to purchase and allowing the user to visualize the room as to how it will look after placing the desired furniture in it. The user can try different types of furniture virtually, without any physical movement of the furniture items. By developing an augmented reality application that allows us to imagine the furniture in the appropriate arena, we hope to improve time efficiency and increase accessibility to the furniture that can be tried on. Before purchasing furniture equipment, the buyer will be able to digitally visualize it in a real-world environment. The consumer will be able to see how his home will look after buying the appropriate furniture equipment as a result of this method. This system would let the user to try out the various set of combinations of the furniture objects virtually without any actual movement of the furniture objects. This will help the customer to determine how to decorate the furniture in his/her home structure.**

***Index Terms*–Augmented reality, marker detection, rendering.**

I. INTRODUCTION

Augmented reality and virtual reality have been interesting topics in the tech industry for many years, but with the advent of devices like Google Glass, they are gaining new attention and visibility. Augmented reality is a technology that uses vision-based algorithms to enhance environmental senses like sound, video, audio, and other inputs using sensors on real-world objects and our devices' cameras. It's a more efficient way of making real-world data and communicating it, allowing virtual elements to be superimposed on the real-world environment. Augmented reality superimposes data on top of our immediate surroundings, transporting us to a digital universe in which the physical and virtual worlds are inextricably linked.

The idea behind Augmented Reality is that when a user takes a picture of a real-world object, the underlying software senses a target and triggers it, causing it to overlay a virtual object (a 3D image) on top of the real-world image and display it on our camera screen.

Our application allows the users to view a 3D model - a virtual similitude of the physical piece of furniture without any disruption of the markers - which can be viewed and configured in real time by making use of our Augmented reality application.

With the aid of a dynamic and interactive GUI, a user can imagine the image of virtual furniture presented in the real world, which is a modern technique for applying Augmented Reality technology to the furniture industry.

II. RELATED WORKS

1. Mami Mori et al proposed a system called "A Transitional AR Furniture Arrangement System with Automatic View Recommend ation" in 2016. It is a transitional AR furniture arrangement system that recommends a secondary view that can improve a user's understanding of a room layout and contains two scenes high occlusion and low occlusion.
2. Snehal Mangale, et al proposed a technique named "Virtual Furniture Using Augmented Reality" in 2016 which is a web based application where the user, have to place the marker in a room where they want to try out the

furniture items.

3. Elizabeth Carvalho et al proposed a system for "Use of Augmented Reality in furniture industry" which uses Simultaneous Localization and Mapping (SLAM) that helps in fixing to rigid body and makes use of markers to reference object to the rigid image.
4. Khushal Khairnar et al proposed a technique named "Furniture Layout Application Based on Marker Detection and Using Augmented Reality" to develop an application where user have to place the marker in a room where he want to try out furniture items. The user's webcam will be on and through the webcam he will capture the live feed of the room. Then application search the marker using fiducial marker detection algorithm. To identify the position of marker using direct linear transformation algorithm. Whichever furniture object the user want to try out he will select that object from the database. Then the application will superimpose 3D object. In three dimensional objects are overlaid on to the two dimensional image frame acquire from webcam.
5. Santosh Sharma et al proposed technique named "Marker less Augmented Reality based Interior Designing system", which uses Markerless Augmented Reality as a basis for enhancing user experience and for a better perception of things. It has advantage of no need of markers in the surface area and disadvantage is Object is aligned with camera so that it moves as we move a camera.

III. PROPOSED WORK

Using an augmented reality program, this is simple to achieve. The promise of augmented reality in the field of interior design has yet to be fully realized. People nowadays are technologically savvy and use smartphones with augmented reality cameras. As a result, the idea of designing a furniture layout-based application takes the designer one step closer to being technologically advanced.

With the recent emergence of better quality cameras and more accurate sensors in about to be mainstream devices. In our current implementations of application, we use Vuforia to accurately determine the real-world environment, allowing users to place virtual 3D objects into a real world context.

The proposed framework relies on marker-less Augmented Reality to improve user experience and perception. Marker-less tracking is a spatial tracking technique that allows us to determine an object's location and orientation within a given context. Since this framework does not use labels, it is a dynamic and versatile GUI.

The basic idea of the proposed system is to place the digital 3D models the on top of real things using a camera.

- This Application will use the mobile phone which is AR supported to scan the living area and display the augmented 3D image of furniture to check whether it fits in the environment or not and thus helps with better choice of furniture for our home.
- Augmented objects are the virtual objects (3D Models) that are modelled to look like the furniture objects that we will us in our app.
- The next step is to use the Unity 3D platform's various components to set up light, shadow, and camera positioning for these models.
- The next step is to choose the suitable furniture model, which is then manufactured and processed before Vuforia packages are loaded onto the scanned surface.
- A 3D model is mapped onto the mobile device, which determines the model's dimensions, which are then rendered and projected on the screen.

IV. MODULES

The proposed system consists of:

- Creation of Augmented Reality Objects.
- Developing Scenes for User Interface.
- Placement of the 3D Object on the Surface Area.
- Verification of placed objects

A. Creation of Augmented Reality Objects

The Unity 3D project must first be opened. Then, from the menu bar, choose the GameObject menu. There are several items in the GameObject. Menu that can be used to create a game. From there, we can choose a 3D object and the form choices that best fit our needs. We can choose the rotation tool to aid in the rotation of our plane object. It also assists us in rotating the items in our scene. We can create the assets by using the hierarchy view which helps us to combine various shapes within the unity. There is a pro builder in Unity which allows us to edit our shapes helping us to obtain our 3D furniture objects.

B. Developing Scenes For User Interface

In this module, we create the scenes necessary for every slide of our application using the Unity 3D platform. The main interface contains furniture model, buttons that helps to move to next model, to scan the surface area of living room, description of model such as length, width, height. In order to implement these functions, we make the scene display to ratio of Android display and add the buttons to the scene that helps in moving to the next scene. Later we use the 3D model developed in Unity 3D and functionalities like rotating the chair will be displayed using C# code for that object and add functionalities to move to next scene.

C. Placement of the 3D Object on the Surface Area

For this project Android studio is used with the Vuforia package. Vuforia packages is used because it offers 3D model demonstrations, to create applications for customers to personalize their products and gives a robust AR experience with the vision technology. We upload our target image in the Vuforia cloud, it renders the features of the target image and stores it such that when we scan the environment it identifies the target image. After the identification, our 3D object gets

placed over the target image. Target image acts as a position indicator such that the 3D furniture image gets fixed wherever we place our target image.

D. Verification of Placed Objects

Once the user thinks that the object is well suited to his need, he can check the description by selecting the information button that helps in describing the width, height and length of object. In order to view this description, we create another scene that helps in displaying all the required information. We add one more button that helps in rotating object by an angle of 30°. For this rotation and link redirection we use two classes which are programmed with C#.

V. System Architecture

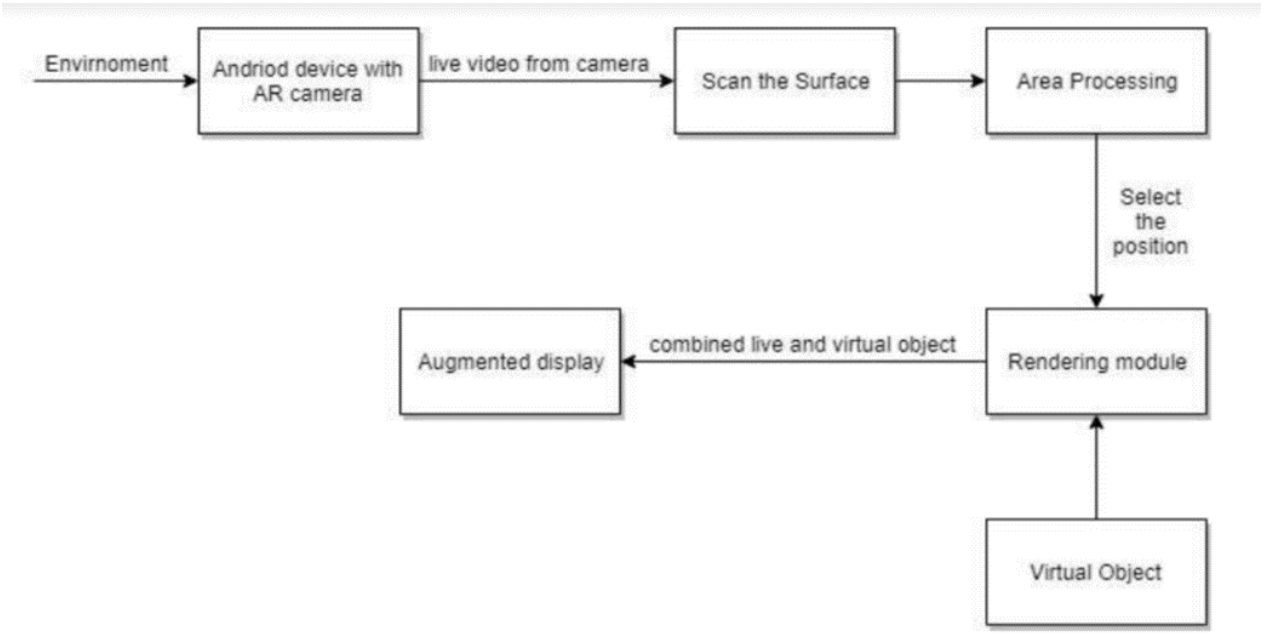

Fig. 1. System architecture.

VI. Advantages

- In interior design industry, AR will help the designers to visualize their project even before actually building it. Thus, making the design process ten times easier.
- Using AR in interior design the user can also participate in the designing process by instructing the designer the changes he requires which thereby increases the creativity of both the parties.
- A good AR visualization for the customers will help in quickening the purchase along with designing process and thus increasing the profit.
- The best of all, it saves time. Heard of the popular saying? "TIME IS MONEY" thus, save time, save money and be completely satisfied with the choices you visualize.

VII. Experimental Results

Our project was created using Unity 3D, Vuforia, and Android Studio.

- Unity 3D is game creation software that provides a development environment for interactive 2D and 3D content, as well as a rendering and physics engine, a scripting interface for programming interactive content, and a content exporter for a variety of platforms (web, mobile, etc). It is used to create our software's scenarios.
- Vuforia is a mobile-based augmented reality software development kit that allows developers to construct augmented reality apps. Using computer vision technology, it recognizes and tracks planar images and simple 3D objects like boxes in real time. The target image is scanned and stored using Vuforia so that when the camera is put over it, it identifies it and inserts our 3D item on top of it.
- The android studio aids in the creation of the .apk file.

A. Home Page

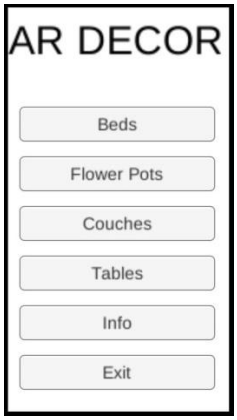

Fig. 2. Home page.

This is the home page of our app and it consists of five sections of varied furniture pieces: Beds, Flower Pots, Couches, Tables and Information.

B. Ouput 1(Bed 3D Image)

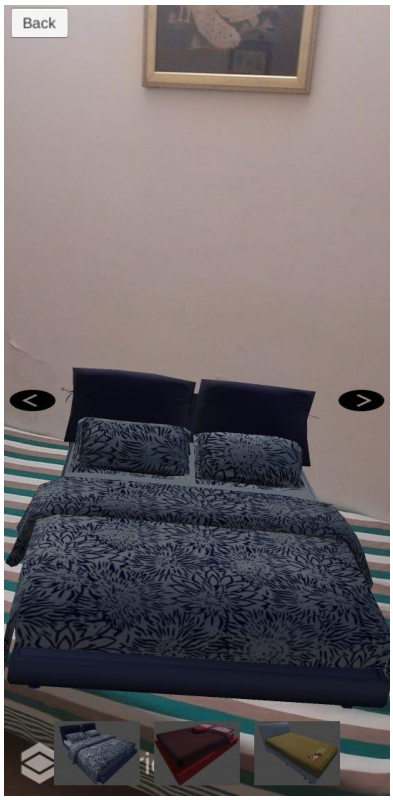

Fig. 3. Bed 3D image.

The 3D image of the L shaped sofa has been successfully positioned on the target image and now we can check if it fits in our home set up. We can rotate the sofa using the arrows provided and there are 3 options of beds where we can choose from.

C. Output 2(L Shaped Sofa)

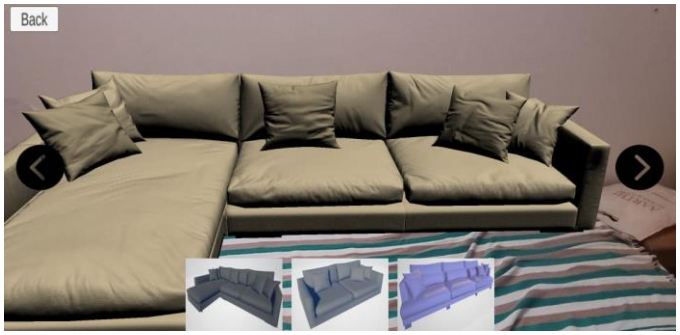

Fig. 4. L-shaped sofa 3D image.

The 3D image of the L shaped sofa has been successfully positioned on the target image and now we can check if it fits in our home set up. We can rotate the sofa using the arrows provided and there are 3 options of sofas where we can choose from.

VIII. CONCLUSION

This system is used to analyze the use of augmented reality to render the furniture model in real world. Augmented reality is a technology that allows the customers to decide the furniture to buy by allowing interaction between the 3D images and the real world, offering new possibilities for furniture online shopping. It helps the customer to view and understand the furniture for his/her requirements. Due to this customer will know how the furniture be setup in his house. Augmented reality's support for furniture helps in creating many new opportunities for future research to anticipate new ideas in the field of online shopping as customer will get benefit with these types of applications and gives a better understanding and decision making for purchasing a furniture in an efficient way. Augmented reality is new evolving technology in the field of computer science and will make us much more helpful than the traditional technologies .

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Block Chain in Food Supply Chain

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***Abstract*—The concept of guaranteeing the quality and secured food delivery to the customers for online booking by blockchain mechanism. It consists of temperature sensors and infrared sensors to track the pack placed inside the box. The values generated are sent to the server using Zigbee. A unique id is generated while placing the order and it is used as the blockchain's genesis block and this id is based on the hash of the name, weight and other properties of the order. It clear that, this is originally packed at the right place and not been replaced by them. Next, when the pack is kept in the box the sensors are activated. Now every second the temperature of the pack and the location of the delivery guys are monitored and placed in the blocks of the block chain. Thus, altering the blockchain values, like changing the id or location breaks the whole chain.**

***Index Terms*—Block chain, food delivery, food monitoring, security.**

I. Introduction

Foodstuff's journey from hotels, farms and various other manufacturing industries to table usually comprises many transactions between different organizations and people. At every stage it is necessary to check and validate if the food is safe or not. In the current pandemic situation, the disease mostly spreads through food delivery people. We don't have a guaranteed food safety, freshness and regulatory compliance system. Trade in counterfeit foods have become a flourishing venture due to the inaccuracy of supply chain management and lack of a technological framework that can differentiate fakes from genuine foodstuffs, trade in counterfeit foods has become a flourishing venture. This paper discusses a secured blockchain based system that helps in effective food monitoring

II. Background

Now-a-days misuse of packed foods by online delivery boys happens at many sites and the trust of customers over that online company is greatly reduced due to such activities. They are also scared to order as the guys are altering the packs from cheap hotels. To avoid this, tracking of food at regular time and the information are stored in the unalterable blockchain [5]. The sensors are positioned in such a place that these delivery packs and the data must be sent to the chain in order to tamper it. Any changes to the information, breaks the chain. Thus, the trust of customers over the company is developed and made sure that the foods are delivered to the customers with prepared quality without any tamper.

III. Material and Methodology

The paper proposes a system that would constantly monitor food conditions in real time and send data to the applications and feed in a block of chain. Fig. 1 shows the functional block diagram of the system. The proposed system consists of a controller that acquires data from various sensors which are used to monitor various physical parameters of the food conditions in which the food is placed. These physical data acquired from the sensors are processed by the controller and generated suitable signals that are given as control input, that is then feed to computer for further calculations.

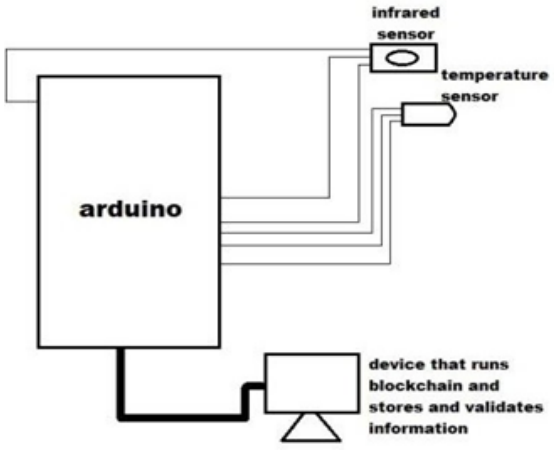

Fig. 1. Functional block diagram of the system.

The system essentially consists of a microcontroller,zigbee transmitter and receiver,power supply unit, switches, electronic lock, gps module, number of sensors for monitoring various physical parameters.

A. Arduino Uno

Arduino Uno is a microcontroller based on ATmega328 board.

1. It Comprises of 14 input and output pins in which 6 are analog inputs, a 16 MHZ resonator,USB connection,a power jack, ICSP header, and a reset button.

2. The unique feature of Arduino UNO is , it doesn't use FTDI USB.
3. Instead ATmega16U2 is used by Arduino UNO
4. It Useful in food security and management.
5. In the Revision 2 of the Uno board, there is a resistor which pulls the 8U2 HWB line to ground, that makes it easier to put into DFU mode.

Fig. 2. View of the Arduino microcontroller.

B. Temperature Sensor

The system uses LM35 series of temperature sensors as shown in Fig. 3. These sensors provide low-cost solution along with fairly good accuracy level for determination of the temperature of rooms. The sensor operates properly when input power supply lies from 4 volt to 30 Volt and can measure temperatures of -55o to 150o Celsius with an accuracy of 0.5o. The output of the sensor is a voltage (mV range) which is calibrated to read the temperature in Celsius directly. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in oC). The sensor circuitry is sealed so oxidation and other process are prevented. LM35 measures temperature more accurately compared to thermistor. It also possess low self-heating and does not cause more than 0.1 oC temperature rise in still air The output voltage varies by 10mV in response to every oC rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ oC.

Fig. 3. View of the Temperature sensor LM35.

The LM35 Sensor is a Fidel IC temperature sensor with it's output proportional to temperature (degrees).The sensor networking is compacted in order to prevent from oxidation. It is also Used to measure temperature accurately with low self heating. It Doesn't cause more than 0.1degree raise. It does not require any external calibration circuitry. The sensitivity of this sensor is around 10m/v. The range lies within -40 to 100 degree Celsius. They can also used to measure body temperature. This sensor Allows to measure mean atrial pressure (MAP) in about one minute and the accurate temperature is displayed on Android.

The main feature of this sensor is that the LM34 and LM35 can be put on work with ease due to their linearity. It Best scale factor of 0.01v/degree c and Doesn't require offset voltage subtraction to Celsius and Fahrenheit scales.

C. Infrared Sensor

As there's a massive demand and development regarding the sensors domain, IR sensors are opted for many innovative robotic applications and problem statements as red line, typical black/white line etc.

If the IR'S operation is quite known, the granular control can be exercised upon robotic performance.

Advantages of using this sensor are that these sensors are diodes having Transmitter (TX) and receiver (RX) terminals. It's inexpensive. Costs around 5-7 rupees only.
The features of this sensor include

a. 5v DC operating voltage.
b. I/O pins are 5v and 3.3v
c. Range is upto 20cm
d. Adjustable sensing range
e. Mounting hole.

This is how a typical Tx/Rx looks like:

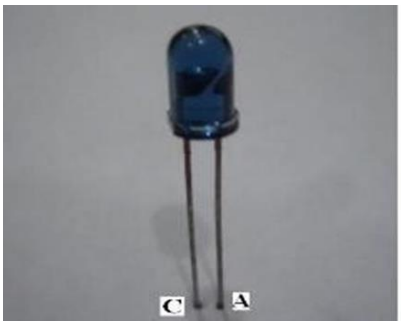

Fig. 4. View of the infrared sensor.

IR sensors are used to sense the surrounding environment such as detection of heat of an object or its motion by measuring the amount of infrared radiation that is naturally emitted by the objects. These sensors can be used provide more detail description Detection of movement by measuring fluctuations in temperature field is also possible and They won't wear

D. GPS (Global Positioning System)

Arduino GPS is bread -out-board module combined with SD interface. It's easy to recording position in SD.

The advantages of GPS module include:

- 5-3.3v operational voltage level makes it similar to leaf maple, IFLAT32, and based on RoyalTEKREB-4216 module.
- Foot prints are compatible with Arduino /mega boards.
- TX, RX are provided connections to D0-D7 pins of Arduino and hence multiple GPS receivers attached to the same shield can access the exact location.

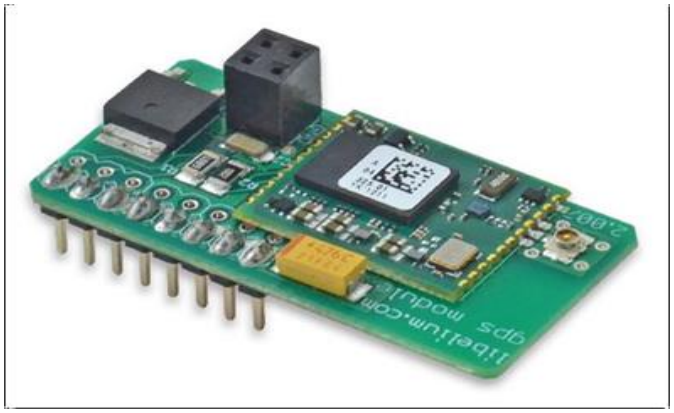

Fig. 5. View of the GPS module.

E. Zigbee Module

ZIGBEE is a high level communication protocol, wireless mesh network that uses less power, categorized under IEEE802.15.4-2003 for Low rate wireless personal area network (LR-WPAN) which is unique from other WPAN'S such as Bluetooth. The main target is towards RF applications.

The advantages of ZigBee include:

- Low cost allows the technology to deploy wider.
- Supports longer battery life due to lesser power usage.
- Mesh networking provides higher reliability.
- It can't support power line openHAN networking.
- The duty cycle and latency are less.
  Based on Direct sequence spread spectrum (DSSS).
- Uses more than 65,000 nodes per a circuitry.
- Provides long battery life.

ZIGBEE smart devices can communicate using radio transceiver. The Chip operates on IEEE802.15.4 protocol, over 2.4 GHZ .They can also copy and forward a ZigBee message from one device to other.

Fig. 6. View of the Zigbee module.

The applications of ZigBee include Home, Industrial automation and Smart meter reading.

First ZigBee 1.0 was specified on Dec 2004; later ZigBee 2007 was launched on 30 October 2007.

Nowadays ZigBee is preferred because of its Lower power consumption. It's easy to install and it has Very low cost and It has firm and Flexible circuitry.

F. Hardware Connections

Here is the complete connection of components that is connected to the Arduino and it looks like:

Fig. 7. Entire circuit connection view.

This figure is the block diagram of the circuit and finally the data is fed through UART serial communication link to the personal computer and further feed to the blockchain processing methods and that's how the food is monitored safely.

Fig. 7. Circuit connections.

G. *Blockchain Algorithm*

Block chain is a broadcast, value exchanged protocol, public digital ledger that used to file transactions between computers if so no alterations in consecutive blocks.

Independent, inexpensive database that is managed individually by peer-to-peer network and time stamping server. It can preserve title rights as when correctly set up to detail the exchange agreement.

It's an assumption that Blockchain and Bitcoin can be used interchangeably, but not so.

Block chain is the technology capable of supporting various applications related to multiple industries like supply chain, finance, manufacturing unit etc. But Bitcoin is the currency that relies on Blockchain technology to achieve security.

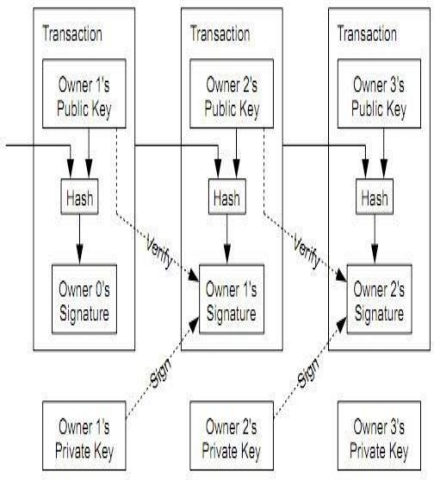

Fig. 8. View of the Block chain ledger transactions.

The technologies used in blockchain are Cryptographic keys, A peer- to- peer network consisting of a common shared ledger, A means of computing , to store the transactions and records of the network.

H. *Mobile Application*

The mobile application works with the blockchain algorithm, thus providing security over the entire food supply chain. It has some additional features, which allows the user to monitor the real-time location of his order. And also he is able to monitor their food by seeing the Sensor values and food parameters.

Fig. 9. Icon of the mobile application.

IV. WORKING OF THE SYSTEM

The sensors described above are suitably positioned and food conditions are monitored and also the physical parameters like temperature, closing and opening of the box is determined where the food is positioned. These parameters are sensed by the various sensors and the output of the sensors is given as input to the controller. The controller monitors and acquires data from the sensors in real time basis and process the information. It uses built-in ADC to process the analog inputs given to its pins to equivalent digital values [4].

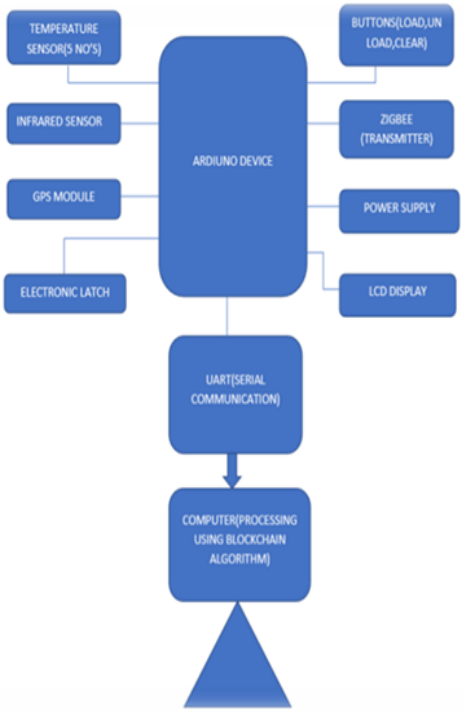

Fig. 10. View of the blockchain ledger transactions.

A. *Purpose of Temperature Sensor*

Temperature sensor used here is to monitor the food's temperature conditions and the food temperature conditions gets updated for a certain time period according to the value set in microcontroller[2,3]. In this food delivery box, 5 temperature sensors are place in order to obtain an average amount of temperature of the food So any attempt to alter the food will be result in a vast change in the temperature and thus will alert the user and will lead to cancelation of the order.

Infrared sensor is used for the counting of open/close of the delivery box lid. Every time the lid of the box is open and closed, the count is incremented and noted. When the count exceeds the fixed limit for each user (that is 3 or 4 count for each user) an alert is sent to the user, that the food is being is tampered. The delivery guy can adjust the food item when the food is mispositioned, so for that uncertain conditions, an extra count can be added. By monitoring the open/close of the food tampering is further prevented.

B. *Purpose of Switches*

Switches are used for the loading the input and output data for the box. The delivery guy can add how many users and food items is loaded, for that purpose Load, Unload and Clear buttons are placed. So every time when user is loading the food, the load button is pressed for 1 time ,this load button is placed according to the number of users, and unloaded when the user delivers the food.

C. *Purpose of Zigbee Controller*

The main purpose of the Zigbee controller is to collect the data from temperature and infrared sensor and also location from gps module and also various other parameters and thereby feeding the data by means of wireless communication to the server. This data is further feed to the blockchain for security monitoring of the food, so preventing hackers form tampering the information.

V. PURPOSE OF BLOCKCHAIN

Using blockchain algorithm food safety can be achieved.

1. Safety of food is guaranteed: This app traces foodstuffs with utmost security in seconds. This can be used to mitigate cross- contamination, the spread of food-related illness, and unnecessary wastages.
2. Freshness of Food is guaranteed: transparency into supply chain data is provided to stakeholders who can be used to enhance food freshness, increase its shelf life and minimize losses.
3. Wastage of food is minimized: Maximizes food shelf life by optimizing the supply chain and providing quick responses about food recalls.

The information must be stored in a trustful way that increases the customer trust. Blockchain is the most trustful record management algorithm in which the inserted data is unalterable. The id represents the genesis block and temperature, location and other properties of the pack gets hashed which fills the fore coming blocks of the blockchain. Any latter change of data cuts the entire chain making the tamper visible. Here is the sample data that is being feed to the blockchain before tampering of the food data

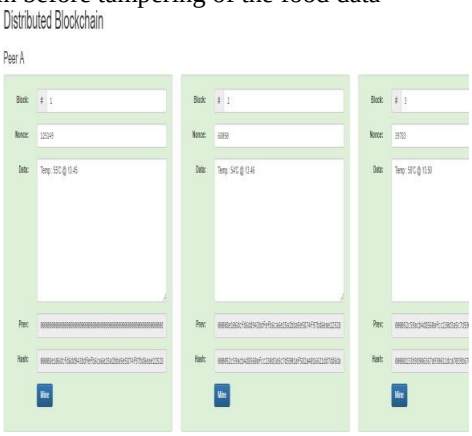

Fig. 11. View of the Original data of the block.

The mining process is done to maintain a relationship between the block of the chain. If one block of the blockchain is disturbed or tampered, the entire block gets affected. Here the block 1 is having a nonce value, which is used for security purpose, one can increase the security by increasing the nonce value and while mining the block, a hash with 4 or more zeros are embedded at the beginning of the hash, according to nonce value. So now the block is mined and hash is generated.

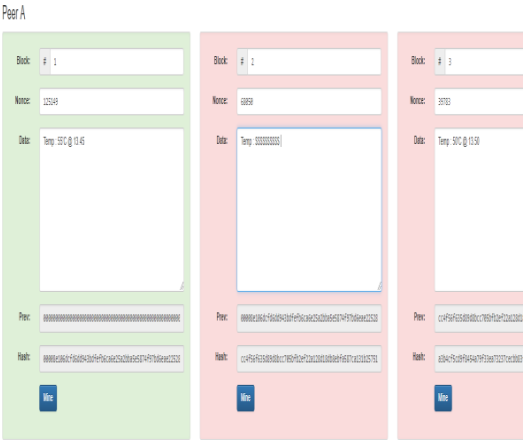

Fig. 12. View of the altered data of the block.

Now the second data is feed to the block and mined, before mining it adds the previous hash, along with the new hash and gets mined and so the mining of many blocks continue.

Here in this above Fig. 12, we have tampered the data of the second block by adding "$$$$$$$". By tampering only the second block the entire block after the second block gets affected. So in-order to change the block to its normal state, again mining of the block is required. But the concept is that, one cannot mine the block unless the nonce and previous hash values are known. So it prevents tampering of data effectively and used for secure transactions of data

A. *Maps SDK:*

With the Maps SDK for Android, add maps to the Android app using Google Maps data, map displays, and map gesture responses. It also provides additional information for map locations and supports user interaction by adding markers, polygons, and overlays to your map.

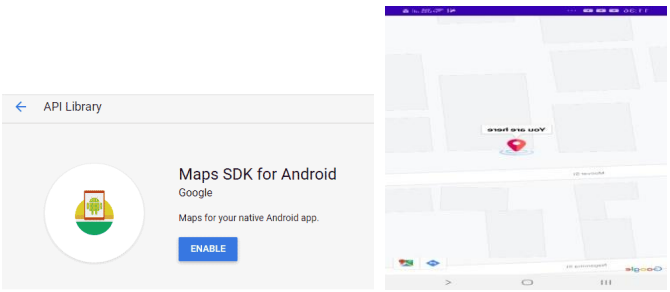

Fig. 13. Location of the user.

B. *Direction API:*

The Directions API is a web service that uses an HTTP request to return JSON or XML-formatted directions between locations. You can receive directions for several modes of transportation, such as transit, driving, walking, or cycling

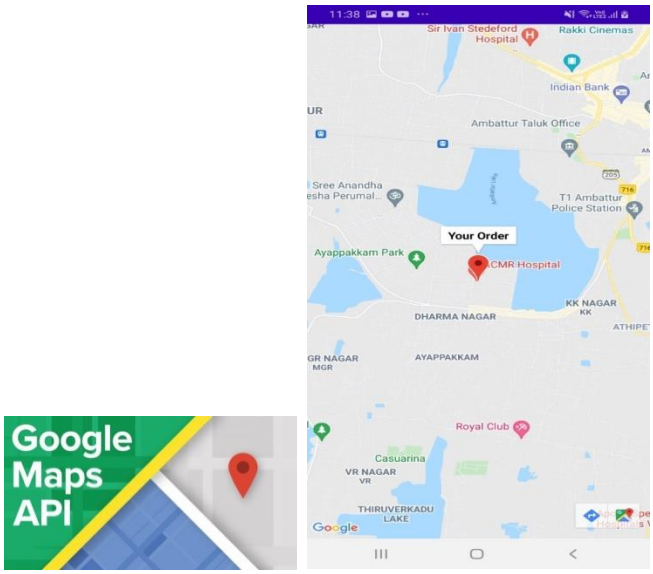

Fig. 14. Real-time location of the order.

C. *Firebase Realtime Database:*

The firebase real-time database helps the user to monitor the sensor values in real-time. It's a NoSQL cloud database that is used to store and sync data. Data is synced across in real-time and remains available even if the application goes offline.

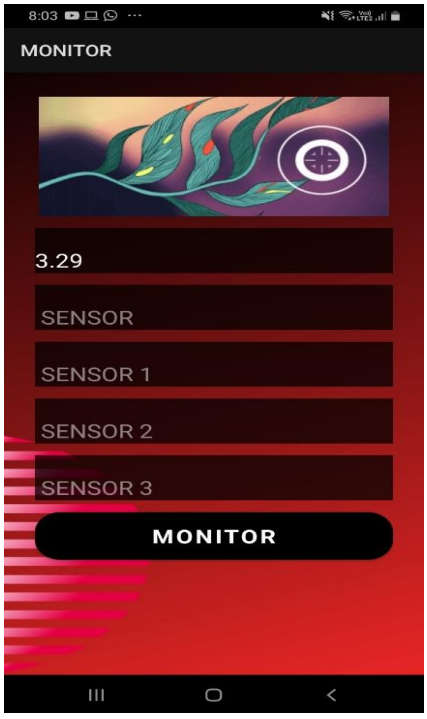

Fig. 15. Slide for Monitoring.

VI. Future Scope

The real purpose of this project is to implement the blockchain in all industry for security transactions of data. The above discussed Food delivery monitoring is just a prototype for a large-scale industry purpose food monitoring. Such as meat, fruits and vegetables and also agricultural products can be also monitored with the help of necessary sensors like temperature, humidity sensor and various other sensor that will be helpful in monitoring the external parameter of the food conditions.

For example, local farms can employ an IoT integrated NEM blockchain system. In this example, the temperature of a shipment of beef is tracked from it's departure from the farm till it's arrival at the local supermarket. Data like the name of the farm, the owner of the farm and the name of animal can be logged, to ensure that the temperature of meat is safe throughout the shipment This helps to avoid the consumption of food stuffs that are blemished. If the meat reaches a temperature higher than the optimum temperature, Bacteria start to grow on the meat. The growth of Bacteria generates proteins that are toxic. So, using our solution, supermarkets can trace back to the farms where food poisoning occurs frequently.

Recently in Chennai, there was an adulteration of food stuffs like replacing cow's meat instead of dog's meat, which lead to many serious court issues and health issues. With a method(monitoring food using blockchain with necessary hardware) like this it is easy to hunt down a particular batch or crate of food and separate it from the rest.

In NEM, a single transaction can contain a message up to 1024 characters. For example, a sample transaction looks like this:

Pork-crate#150&temperature@41F&time@11:50:35PM

This message means that a crate of pork whose ID is 150 (This is same as that of the Pig it was from) has an average temperature reading of 41 degrees Fahrenheit at 11:50 PM. This reading process takes place every 10 to 15 minutes. This is noted and sent to the pork NEM address of the farm. Similarly lamb, duck, fish etc… have their own NEM address. When the crate containing the meat comes to the supermarket, the device is returned back to the farm and the supermarket stocks the meat. The customer's index identifies if the meat is safe for consumption or not and thus helps the customer to make a decision.

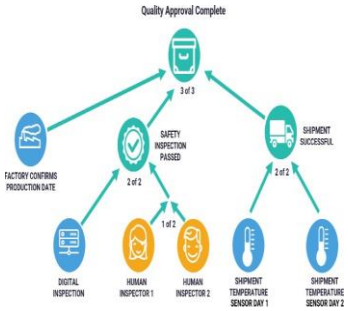

Fig. 16. View of the block chain ledger transactions.

VII. Conclusion

The advent of blockchain can be a great boon in a food tracking system. This makes the system entirely transparent and gains the trust of customers. Thus by dumping the data to the blockchain it remains unaltered and the trust of the customer can be gained. We can make sure that the foods are prepared and packed at the right hotel, that they are not replaced at cheap stores. We can also guarantee that those foods are not misused by the delivery guys. Thus the food is delivered to the customer at the prepared quality without any known food tampering. This open distributed blockchain system used in bitcoin and other crypto currencies, is highly beneficial to record transactions in a permanent way that is verifiable.

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An Ultra-Low Power integrated circuit design for Implantable Medical Devices (IMDs)

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Abstract—Implantable Medical Devices (IMDs) reside within human bodies either temporarily or permanently, for diagnostic, monitoring, or therapeutic purposes. IMDs have a history of outstanding success in the treatment of many diseases, including heart diseases, neurological disorders, and deafness etc., With the ever-increasing clinical need for implantable devices comes along with the continuous flow of technical challenges. Comparing with the commercial portable products, implantable devices share the same need to reduce size, weight and power. Thus, the need for device integration becomes very much imperative. There are many challenges faced when creating an implantable medical device. While this paper focuses on various techniques adapted to design a reliable device and also focus on the important electronic features of designing an ultra-low power implantable medical circuits for devices and systems for better efficiency.

***Index Terms*–Implantable medical devices, low power, biocompatible materials, bio amplifiers, neural amplifiers, CMOS, FINFETs.**

I. INTRODUCTION

An Implantable Medical Device (IMD) is either partially or totally introduced into the human body by therapeutically or surgically and it is planned to persist there after the procedure. Implants can provide medication, monitor the body functions, or offer support to the organs and tissues. Implantable medical devices in some cases implanted for long term and contain electronic circuits and batteries that are either replaceable or rechargeable. For such cases, wireless technology is used to supply power and provide communication for implantable devices which paves a path for internet of medical things (IOMTs). The IOMTs collects data by the connected system of medical devices and through its applications then it is provided to healthcare information technology (IT) systems through computer networks connected in online for further diagnosis.

IMDs are generally made from bone, skin, or other body tissues or by artificial elements such as plastic, ceramic or by several biocompatible materials such as titanium and its alloys, aluminium, cobalt-alloys, stainless steel, poly-ethylene, polyurethanes, polyglycolide and polylactides, etc. These are been generally used for commercial fabrication [1]. These medical implants are to be placed either permanently or they can be detached once they are not needed. For an example, medical implants such as, stents used in case of heart failure or implants in hip are intended to be eternal in a human body. But in case of broken bones the screws used in the surgery or in case of chemotherapy ports those screws should be removed when they no longer needed [2]. IMDs have been advanced through microelectronics, biotechnology, and materials. Fig. 1 shows the various examples of wireless implantable medical devices currently used.

Fig. 1. Examples of wireless implantable medical devices.

Integrated circuits have incorporated more functions on single chip until now it is principally possible to put an electronic system into a single silicon chip (SoC), that usually integrates all components into a single chip. It may consist of either digital, analog, and sometimes radiofrequency (RF) functions on a single chip substrate. The thrive for ultra-low power electronics has stanched from two major requirements: (1) for portable or wearable implantable battery-operated systems that are sufficiently small in weight and volume but require long battery operation time; (2) for battery less systems in which energy is harvested from environment.

To guarantee a reasonable battery operation time, various low power design techniques are demanded to make reduction in power consumption. Bulk CMOS technologies have been the basis of semiconductor devices for years. Moore's law motivates the technology scaling to improve the performance features such as speed, power consumption and area. Despite the fact that the circuit and systems take the unavoidable scaling down the technology, the effect of unsought features

such as short channel effects (SCEs) and sensitivity to process variations has been greatly increased. The SCE comprises the limitations on electron drift characteristics in the channel and the threshold voltage variation along with I_{ON}/I_{OFF} reduction and the increase in leakage current have been instigated the use of bulk CMOS transistors in sub 22nm technologies impossible. It is because the I_{ON}/I_{OFF} reduction in the circuit causes instability and bounds subthreshold circuit design. Conversely, leakage current increment causes increase in static power consumption. By using thinner gate oxide SCEs can be reduced. This in case increases total power consumption and reduces reliability of the device. Thus, new transistor structures have been proposed in order to overcome the SCEs [24]. Amid various proposed devices, FinFET is one of the best to engulf the boundaries of bulk CMOS technologies toward deep nano-scale technologies. The latest generation transistors evolved near medical electronics on electrochemical biosensors such as fin field effect transistors (FinFETs), tunnelling field effect transistors (TFETs), etc.,

The paper is organized as below: In Sections II, we will briefly see the literature survey and design challenges, in section III, we see designing of low power electronics, and in section IV we see emerging designs in IMDs. The fifth Section gives the conclusion.

II. Literature Survey and Design Challenges

The first pacemaker was implanted in 1958, from that, numerous engineering and medical activity development for IMDs have faced various challenges in functionality, materials, size shrinkage, system delivery, battery power, electrical power consumption, and wireless communication protocol. There were other important issues that are taken into consideration are fast bidirectional data communication, power delivery from outside regime to the implants, reliability and low noise for recording the information by the implants. Such issues are majorly considered by microelectronics circuit designers.

The integrated circuits of biomedical applications should consume low power and to have low input-referred noise and low cut-off frequency. In need of achieving the low power consumption the supply voltage should be reduced, also, lowering the operation current is to be done, or the signal should be compressed from current domain to voltage domain using the voltage relation of transistors versus exponential current. The important features for designing the Analog Front End (AFE) circuits includes the usage of subthreshold circuits, bulk-driven MOSFETs, floating gate MOSFETs (FGMOS), and log-domain circuits, etc. which in turn reduce the power consumption. All the physiological signals are mostly low frequency signal, for example ElectroCardioGram (ECG), ElectroEncephaloGram (EEG), etc. Their chemical quantities such as ion concentrations and physical quantities such as body temperature, blood pressure, etc are often very small signals and of low frequency only as shown in Fig. 2 [3].

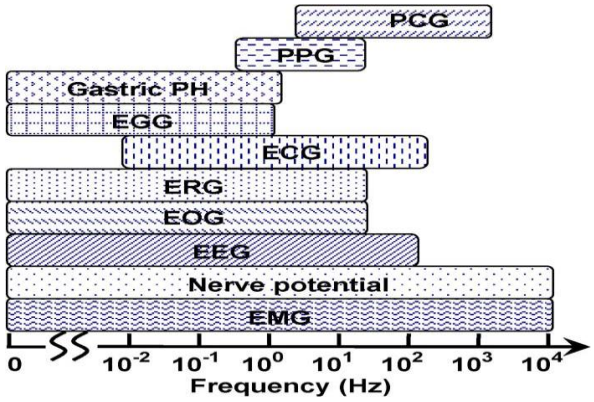

Fig. 2. Frequency ranges of some physiological signals.

Transducers is a device used to convert a physiological signal into an electrical signal. Since all the signals are low frequencies the AFE circuit is always amplified before digitizing it and also filtered for further processing. Despite all the challenges discussed above the design of analog ICs for medical implants mainly faces three challenges [3].

a. The low power design techniques to be used to reduce the amount of IC damaged or destroyed. New technologies related to battery should be incorporated which can be applied by using the bulky batteries or replacing the batteries during enduring operations frequently.
b. The physiological signals are often ranging from dc to few kilohertz [25]. Also, we can see a large dc component caused by skin interface and because of residing electrodes too. Hence, the AFE integrated circuits are implemented with low cut-off frequencies to read the signals directly from the electrodes or sensors. The designs like this require large capacitances and/or large resistances, but they can be obtained by using discrete components. The fabrication on a single chip is a tedious because they occupy bulky areas.
c. Though the frequency of physiological signals is very low, the amplitude of the signals will be in the range of a few microvolts to tens of millivolts. Because of low frequency and amplitude, the quality of the signals is mostly affected by the noises experienced from the electrodes or sensors. The power supplies will also get affected by the user's motion. Hence, there should be low input referred noises to process the weal physiological signals.

The other main challenges of IMDs are the minimum weight and minimum size, low power supply, the precise package, and the transducers/sensors integrated with signal processing electronics. Moreover, lesser value of supply voltage influences the main parameters of AFE circuits, such as dynamic range, power supply rejection, noise immunity, etc. The foremost noises in a low noise amplifier are thermal

noise and flicker noise. There are quite a lot of sources that can subsidize to the noise in a chip. For narrow band signal application, the flicker noise is usually the utmost substantial in an amplifier. The noise power can be expressed by the equation.

$$v_n^2 = \frac{K}{CoxWL} \frac{1}{f}$$

Where K is a process dependent constant. W, L is the MOSFET's size representing width and length, *Cox* is the capacitance of gate oxide which is unity. So, the flicker noise is inversely proportional to the MOSFET's area and frequency. In thermal noise, the noise power density is much lower than flicker noise in low frequency. In CMOS ICs, two varieties of thermal noise need to be considered, which are thermal noise from MOSFETs and thermal noise from physical resistors. The noise power can be expressed by

$$v_n^2 = 4KTR$$

where R is the resistance, K is boltzmann's constant, and T is the absolute temperature.

Fig. 3. Shows the generic system architecture for implantable medical devices (IMDs) [4].

III. Designing of Ultra-Low Power Electronics

In a conventional MOSFET, drain current I_D is controlled by gate to source voltage V_{GS} and the influence of bulk to source voltage V_{BS} is only considered as a parasitic effect.

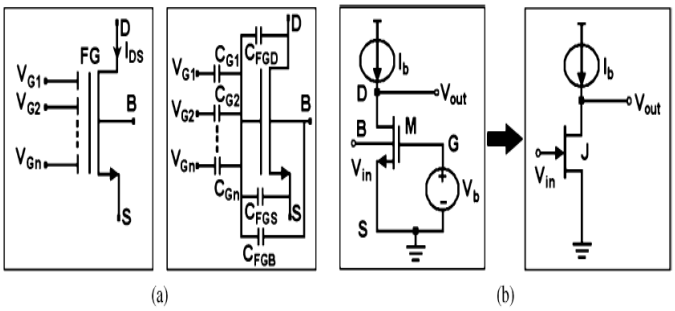

Fig. 4. (a) Equivalent circuit and respective Bulk driven MOSFET (b) Schematic symbol of multiple-input floating gate MOSFET and its equivalent circuit.

Unlike the conventional type of circuit design as shown in Fig. 4(a), in a bulk-driven MOSFET, I_D the drain current is controlled by V_{BS} the voltage between bulk to source with a constant V_{GS} the voltage between gate to the source and Fig. 4(b) presents a Floating Gate MOSFET (FGMOS) structure which is a non-volatile memory device. Mostly it is used in digital EPROM and EEPROM. The floating gate terminal is surrounded by SiO_2 layer without any physical electrical connection, and also it is capacitively coupled to the gate. The input signal is applied to the gate terminal. The low operating threshold voltage is used by setting the input voltage properly. Thus, it has been found in all sort of reliable applications such as, low voltage and low power circuits for the tuneable circuits and low threshold voltage circuits. Though, in advanced CMOS nanoscale technologies, the supply voltage has been significantly reduced.

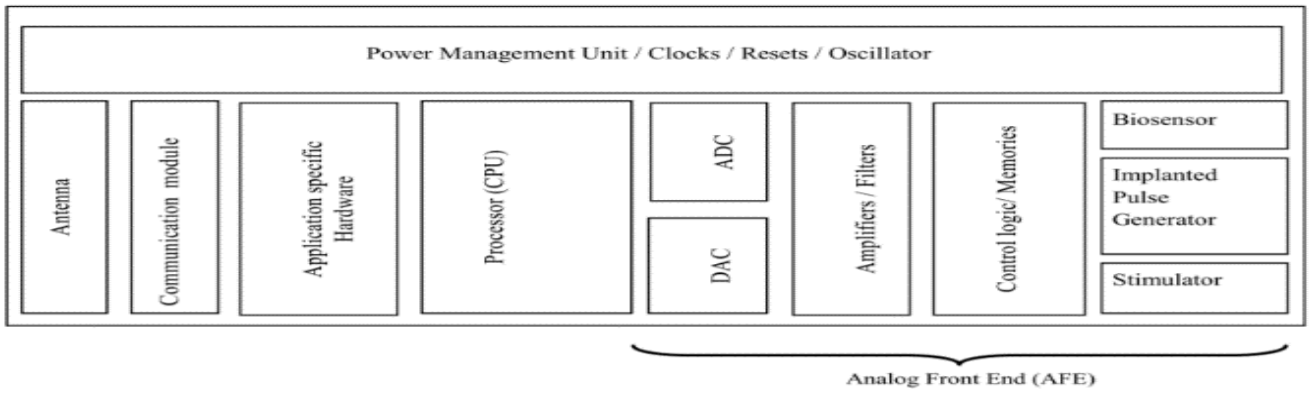

Fig. 3. The generic system architecture for implantable medical devices.

A. Analog Front End

Analog front end IC of implantable medical devices consist of various blocks such as bio amplifiers, data converters, filters etc, Generally, biological/bioelectric signals have low amplitude and low frequency. Therefore, to increase the amplitude level of biological signals, amplifier devices are designed. The outputs of the proposed amplifier are used for further study and they are represented as physiological ECG, EMG, or any bioelectric waveforms. Such amplifiers are defined as Bio Amplifiers or Biomedical Amplifiers [9], An amplifier's input referred noise with respect to its current consumption and bandwidth is called noise efficiency factor (NEF). The NEF is defined as:

$$NEF = V_{irms} \sqrt{\frac{2I_{tot}}{\pi \cdot U_t \cdot 4kT \cdot BW}}$$

where V_{irms} is the input-referred root mean square (RMS) noise voltage, I_{tot} is the total amplifier bias current, U_t is the

thermal voltage, K is the Boltzmann's constant, T is the absolute temperature, and BW is the effective noise bandwidth. Neural amplifiers usually need to have a high high-power supply rejection ratio (PSRR) and a common-mode rejection ratio (CMRR) to suppress supply voltage variations while amplifying the input neural signal by large gain.

B. Design of Low Cutoff Frequency Filter

Physiological signal processing has been commonly used with OTA (Operational Transconductance Amplifiers) filters. The small signal transconductances in voltage to current converters as shown in Fig. 6(a) has been decreased by current division technique. The designed amplifier's small signal transconductance is given by the expression

$$Gm = \frac{2gR}{1+M'}\left(2gR \ll (1+M)\,g_{m1}\right)$$

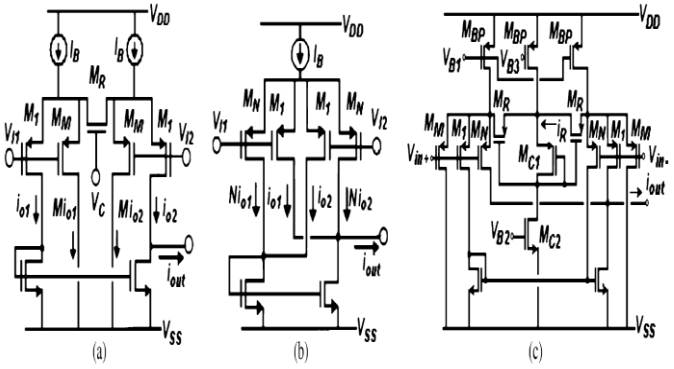

Fig. 6. schematic of OTAs based on (a) current division technique [26], (b) current cancellation technique [26], and (c) current division and current cancellation [27] tech.

Current cancellation was first presented in bipolar OTAs design and applied it into MOS amplifiers as shown in Fig. 6(b). The small signal transconductance of the OTA can be expressed as

$$Gm = g_{m1}\frac{(N-1)}{(N+1)}.$$

The current division and current cancellation techniques are insufficient to implement transconductances at the nV/A level. Hence, in order to get reduced transconductance, the mentioned methods can be combined together as showed in Fig. 6(c).

This third method has been used often when designing OTA filters, e.g., the low-pass filter for biomedical applications [27], similarly for designing EEG system the lowpass notch filter is used. All the designed filter achieved a mark transconductances of few nA/V.

C. Power Management Circuit

The process of recording the signal and transmitting a signal charges a huge power for the medical implants and it becomes one of the most tough challenges. However, there has been great evolution in miniaturized low power circuit designs for biological applications [5]. With the progress in ULP design, the concept of energy harvesting to ultra-low power (ULP) electronic circuits has also gained relevance [18]. We use batteries to power the implantable medical devices such as pacemakers and deep brain stimulation devices, etc. But the lifetime of batteries cannot be extended to a certain extend. Hence the longevity of the potential implants is in question. To replace the battery for IMDs we need to do an additional surgery, sometimes that may cause many complications to the patient. Alternatively, rechargeable batteries pave a way for longer lifetimes but need an additional circuitry for recharging, unfortunately that may require a large aligned antenna. The amount of power wirelessly transferred is limited and excessive power drained by medical implant can compromise the operations of the device and causes heating of the tissue in the surrounding medium. Since multi-channel arrays are used, each individual channel was designed to consume as little power to manage with the overall reduction in power consumption for the implanted medical devices.

IV. EMERGING DESIGNS IN IMDS

Scaling of the CMOS technology has moved to a nanometer regime, and therefore the FINFET has replaced the latest technology. The latest generation transistors, electrochemical biosensors (fin field-effect transistors (FinFETs), tunnelling field-effect transistors (TFETs), and organic electrochemical transistors (OECTs)), and the combination of electrochemical biosensors with lab-on-chips are greatly used for medical applications [12]. The constant scaling of planar metal-oxide-semiconductor field-effect transistor (MOSFET) has technological difficulties whereby the device can no longer be classified as a long channel MOSFET. The main short-channel effect is due to 2D distribution of potential and high electric fields in the channel region, which mainly lead to difference in the threshold voltage, saturation region that does not depend on drain current and drain potential. Subsequently a numerous type of different non-planar and planar topologies was investigated, such as the FinFET and the TFET. The FinFET resulted in best option for the fabrication of a non-planar device with self-aligned double-gate (as shown in Fig. 8) using a conventional complementary metal- oxide semiconductor (CMOS) process. FinFET is low power operational, has lower voltage of operation, higher speed and low static power consumption in device. Also, FinFET has reduced short channel effects (SCEs), higher trans-conductance, and ideal subthreshold voltage.

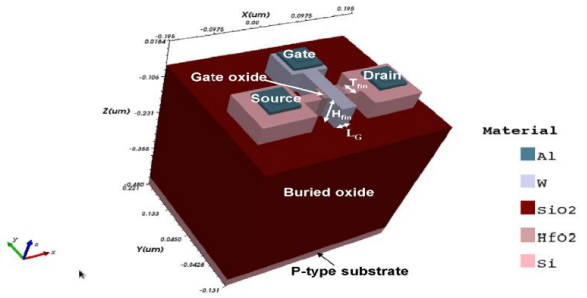

Fig. 8. 3D schematic view of simulated n-channel high-k SOI FinFET device.

The design of SOI FinFET device based on Instrumentation Amplifier (IN-Amp) is majorly used for biomedical applications. An instrumentation amplifier is operated in weak inversion region efficiently works for low power and low voltage biomedical applications. The performance metrics of the proposed IN-Amp such as Common mode rejection ratio (CMRR), DC gain, were enhanced by using nm FinFET device technology. To achieve the performance metrics, the size of transistors is optimized and passive resistances are exchanged by 30 nm SOI FinFET transistor. FinFET based DC offset removal circuit is considered to reduce the offset voltage at the output of the IN- amp. The output achieved by affixing DC offset removal circuit is exact duplication of input over extensive range of frequency, and adjusted by varying clock inputs to the circuit [10]. The design of an ultra-low power circuit is highly sensitive even at low voltages. The analog front end design is mandatory in biomedical applications. Hence the design of OTA has given much importance because it is considered to be the integral part of any analog circuit which is shown in Fig. 9. The 30 nm SOI FinFET device based two stage operational transconductance amplifier (OTA) circuit designed to operate at ±0.5 Vsupply voltage in subthreshold regime.

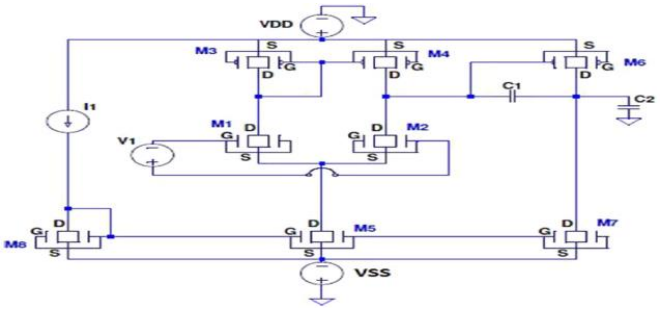

Fig. 9. An unbuffered 2 stage OTA.

In Biomedical applications the connection is resolved in huge part by usage of the VCO (Voltage Controlled Oscillator). Generally, VCOs used for low recurrence applications, however 18 nm forms in FINFET technology have permitted CMOS oscillators to accomplish frequency in gigahertz extend. This range made conceivable with utilization of programmed swing control [13].

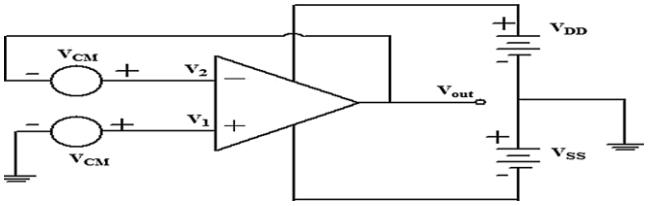

Fig. 10. Simulation setup for measuring CMMR of two stage OTA.

Figure 10 shows the configuration used for measuring the CMRR of the FinFET based OTA in subthreshold regime. For emerging designs using the lower technology nodes, the adiabatic, a non-conventional low power design methodology is identified to be an alternative circuit design approach for conventional CMOS circuit designs. The adiabatic logic retrieves a significant amount of energy from the nodal capacitances output and give it to the power clock source every time the output node switches to logic 0. The recovered energy is reused in the operation of adiabatic logic circuit [23].

V. Conclusion

The paper focused on developments in the domain of implantable medical devices and also discussed on ultra-low power circuit design. Since the implants are tend to be inside human body the material used in the device should be biocompatibility and durable. We can ensure that by doing sequence of laboratory experiments in study on animals, and so on. Following various iterations on the experiments result in suitable test results for the device. Though the power is provided by the battery, the process should be continuously monitored to ensure uninterrupted operation. For real-time monitoring of IMDs in the human body, active/passive wireless communication techniques are adapted and matched technology to be selected for the IC design for all sort of IMDs to achieve efficiency.

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FPGA Based Implementation of Real Time Event Mark for Video Surveillance

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***Abstract*–FPGA is able to perform high-speed video processing such that it could issue warnings timely and provide drivers longer time to response. Besides, the cost and power consumption of modern FPGAs, particular small size FPGAs, are considerably efficient. The main scope of our proposed system is to record the video by using sony cyber shot camera and the input video has been digitalized and we perform some image processing application such as marking in that video and further it is encoded and it can be viewed by the pilot and co pilot for monitoring. The marking is performed by removing the pixels from a particular frame and replacing it by required pixels so that it can produce differentiation in the digital video for the purpose of detection, monitoring, etc.**

***Index Terms*–FPGA, I2c, video encoder, decoder, marking, image processing application.**

I. Introduction

Surveillance is an important task in the field of security .Whether it is at the border or inside the country. One of the important aspects that we need to consider is that of marking a real time event without any delay for recording it and then marking. Marking the surveillance operation live makes it efficient. We can mark the frame where and at what time we need marking. Using FPGA makes the system even more versatile and visual friendly. We can change what kind of marking we want without much effort. Just by making the changes in the code we can get the required and desired marking shape and type. The best part of this kind of system is it makes the function of the system work at its best than other systems.

II. Modelling of the System

TABLE I. Components of the System

Video Decoder	ADV7180
FPGA	Virtex chip
Video Decoder	ADV7393
I2C	SDA,SCL
BT656 Standard	YCbCrN

The system model is a simple one. First we get the real time input video from the camera that which is used to capture the live video in a real time situation. Fig. 1 shows the SSDVR Board consists of PAL input, decoder, PAL out, encoder, decoder, JTAG, SRAM, FPGA, RESET and power up. The input video is given to the SSDVR board and it reaches the decoder board, it will not be able to accept the incoming input video until we configure using some communication protocol using I2c configuration. After decoder configuration, we will accept the incoming video using i2c protocol and convert into digitised video in bt656 standard. Then FPGA; we will be processing the digitalised video. Just like we can say it is used for surveillance application to identify or mark some place. Then we will encode and see it.

On the FPGA board we will be having two controls. One control for the reset and the other control for the real time marking. We will also be having a power supply connection on the FPGA board for it to get working i.e. for power up.

The input PAL video will get decoded first on the ssdvr board and then passes through the

FPGA for the marking function. Then the video signal is encoded on the FPGA board. Later this encoded video signal is taken out through a composite supply pin and is given to the composite accepting display i.e. monitor. Thus we can view the modified and required marked video output.

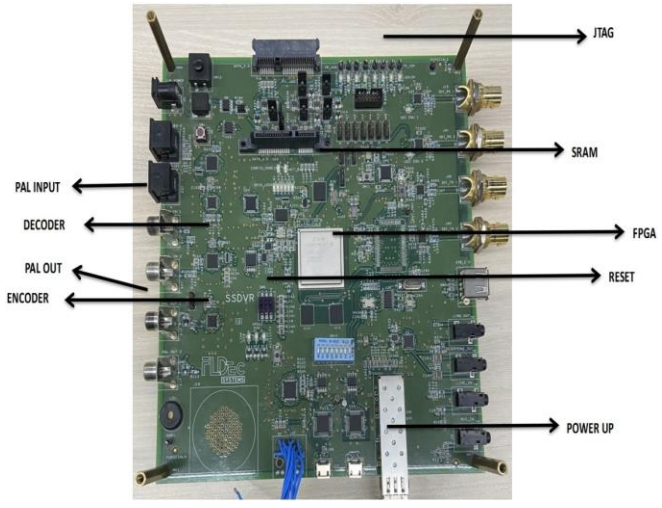


Fig. 1. SSDVR board.

III. PROPOSED METHOD

Figure 2 represents the block diagram of real time event marking using FPGA consists of mainly 3 components:

1. Video Decoder
2. FPGA
3. Video Encoder

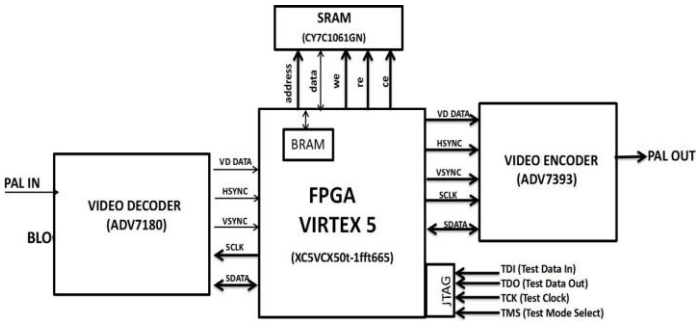


Fig. 2. Block Diagram of the real time event marking using FPGA.

A. Video Decoder

The ADV7180 is a versatile one-chip multi-format video decoder .The ADV7180 tends to automatically detects and also converts the standard such as NTSC, PAL, and SECAM standards into 4:2:2 component video data compatible with the 8-bit ITU-R BT.656 interface standard [12]. NTSC is an abbreviation for National Television Standards Committee. An NTSC picture is made up of 525 interlaced lines and is displayed at a rate of 29.97 frames per second.

Phase Alternating Line (PAL) is a colour encoding system for analog television used in broadcast television systems in most countries. A PAL picture is just made up of 625 interlaced line and it is

displayed at a rate of 25 frames per second, As PAL is interlaced model, every two fields are summed to make a complete picture frame. Active video resolutions are said to be 720 x 576 (625/50videosystems).

PAL usually have 576 visible lines compared with 480 lines of NTSC, meaning that PAL has a 20% higher resolution and even has a higher resolution than Enhanced Definition standard. SECAM which is an abbreviation for sequential color and memory. SECAM type is also made up of 625 interlaced lines and is displayed at a rate of 25 frames per second.

The adv7180 consists of a single high speed 10 bit analog to digital converter that will digitize the analog video format before giving it to the standard definition processor. It also consists of a 3 channel input multiplexer that allows multiple composite

video signals. The ADV7180 extracts syncs embedded in the analog input video signal .The sync extraction is optimized to support imperfect video sources. The sync processing on this particular decoder which includes the following post processing blocks which will filter and condition the raw sync information retrieved from the digitized analog video:

- VSYNC processor. This block provides extra filtering in the detected V Syncs to improve vertical lock.
- HSYNC processor. The HSYNC processor is designed to filter incoming H Syncs which corrupted by noise, providing much improved performance for video signals with a stable time base.

B. FPGA

The field programmable gate array (FPGA) is an integrated circuit that consists of internal hardware blocks with user-programmable interconnects to customize operation for a specific application [1]. The basic of FPGA architecture consists of thousands of fundamental elements called configurable logic blocks (CLBs) surrounded by a system of programmable interconnects, called a fabric, that routes signals between CLBs. Input/output (I/O) blocks interface between the FPGA and external devices. Virtex FPGAs include an I/O Block for controlling input/output pins on the Virtex chip that support a variety of signalling standards. All pins default to "input" mode (high impedance). I/O pins are grouped into I/O Banks, where each Bank can support a different voltage.

C. JTAG

JTAG which stands for Joint Test Access Group and it is an association that was formed to derive a specification to test connectivity between chips in a PCB. Colloquially JTAG refers to the debug and programming dongle that is used to communicate to a microcontroller during development/hacking. By

providing a mechanism to control and monitor all the enabled signals on a device from a four-pin TAP, JTAG significantly reduces the physical access required to test a board.

D. Video Encoder

The ADV7393 is a type of a encoder which is a high speed digital to analog video encoder on single monolithic chip where the complete circuit is built in a single piece of silicon. This encoder will provide support not only for s-video but also composite and component analog output in either standard definition (SD) or high definition standard (HD) video formats. We have chosen this encoder model as it has optimized low power operation and occupies very minimal external components. This encoder will supports the embedded SAV/EAV timing codes, the video synchronization signals and I2 communication protocol. Encoders are just used to translate rotary or linear motion into a digital signal. Usually this is used for the purpose of monitoring or controlling motion parameters such as speed, rate, direction, distance or position.

IV. WORKING

First we give all the connections and power up the FPGA .Then we start sending the real time input video through a camera to the PAL converter. From the PAL converter the input video signal is taken into the SSDVR Board with the

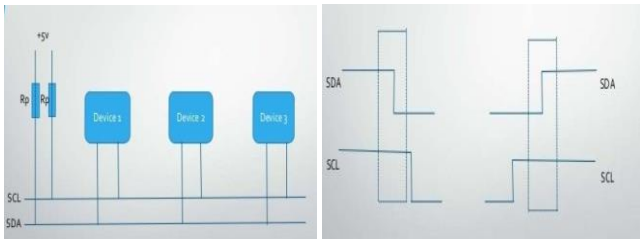
help of the composite video input pin. Inside the SSDVR board we would have dumped the code in the FPGA chip with the help of JTAG that which is used to transfer the code written in the Xilinx software.

The code part consists of 3 parts:

1. The Marking code part
2. The decoder code part
3. The encoder code part

The Marking code is the top module which includes the sub modules as decoder and encoder part. This decoder and encoder also as sub modules i.e. the I2C code part.

- I2C operation



(a) **(b)**

Fig. 3. SDA and SCL of (a) Multiple devices (b) Data lines.

In Fig. 3 (a), I2C supports multiple devices on the same bus without any other additional select lines. SPI requires additional signal (slave select lines) lines to manage multiple devices on the same bus. I2C is always better for long-distance and whereas SPI will be better for a short distance. I2C is also generally faster than UART, and can reach speed of up to 3.4 MHz.

I2C stands for the inter-integrated circuit and it requires only two wires connecting with all peripherals to the microcontroller in Fig. 3(b). I2C requires two wires SDA and SCL which are meant to carry information between the devices. It is known as master to a slave communication protocol. Each slave will be having an unique address. The master device sends the address of the target slave device and reads/writes the flag. I2C only uses two wires to transmit data between devices:

SDA (Serial Data) – The line meant for the master and slave to send and receive data.

SCL (Serial Clock) – The line actually cmeant to carry the clock signal.

Each message has an address frame that contains the binary address of the slave, and one or more data frames that contain the data being transmitted. The message includes start and stop conditions, read/write bits, and ACK/NACK bits between each data frame.

The decoder and encoder code part contains the registers that are required for decoder and encoder configuration. And it also contains frequency divider code. A complete NTSC/PAL video frame (both fields) is shown in Table 2.

A full frame of interlaced video consists of two almost identical fields. The first field contains all the odd video lines and the second field contains all the even video lines.

A logic zero on F states that a line belongs in Field 1, likewise a logic one on F states that a line belongs in Field 2.

TABLE II. NTSC/PAL VIDEO FRAME

Lines		Field/VBIK		Line Description
PAL	NTSC	F	V	Field 1 – First Vertical Blanking(Top)
22	19	‘0’	‘1’	Field 1- Active Video
288	240	‘0’	‘0’	Field 1-Second Vertical Blanking (Bottom)
2	3	‘0’	‘1’	Field 1 – First Vertical Blanking(Bottom)
23	20	‘1’	‘1’	Field 2-First Vertical Blanking(Top)
288	240	‘1’	‘0’	Field 2-Active Video
2	3	‘1’	‘1’	Field 2-Second Vertical Blanking(Bottom)
625	525			

A logic zero on V states that a line is part of the Active Video, whereas a logic one on V states that a line is part of the Vertical Blanking. Lines consist of our parts, EAV Code, Blanking Video, SAV Code and Active Video. These are shown below,

EAV Code				Blanking Video				SAV Code				Active Video			
255	0	0	EAV	Cb	Y	Cr	Y	255	0	0	SAV	Cb	Y	Cr	Y
4 Bytes				280 (268) Bytes				4 Bytes				1440 Bytes			

The EAV (End Active Video) and SAV (Start Active Video) Codes are made up of four bytes. The first three bytes provide the video synchronization and the last one byte provides the line coding.

The Blanking Video period of a line consists of 280 bytes (PAL) or 268bytes (NTSC) and the Active Video period of a line consists of 1440 bytes (PAL&NTSC).Both the EAV and SAV bytes are constructed in exactly the same way, as shown below.

Bit:	7	6	5	4	3	2	1	0
Value:	‘1’	F	v	H	V xor H	F xor H	F xor V	Fxor V xor H

The Exclusive-OR components of these bytes can be used to detect and correct errors in the F, V and H values. Both one and two bit errors can be corrected by these components. The output of I2C is shown in Fig. 4.

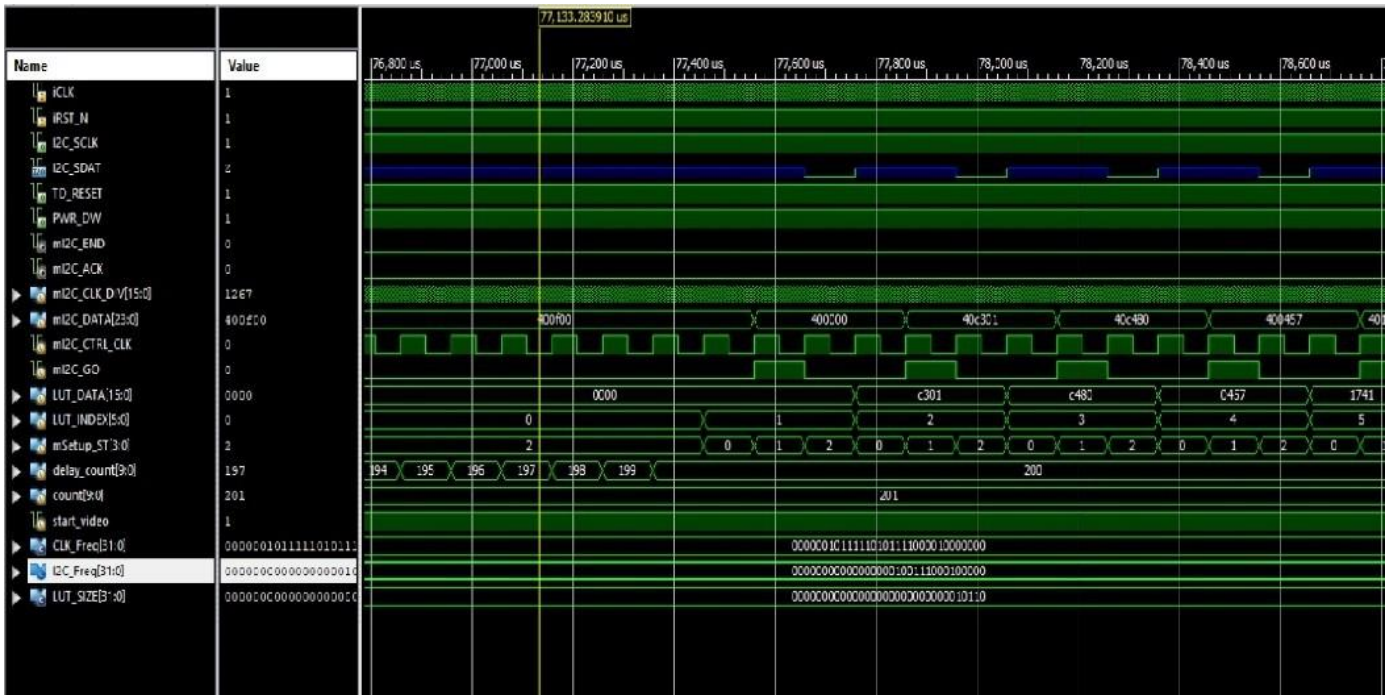
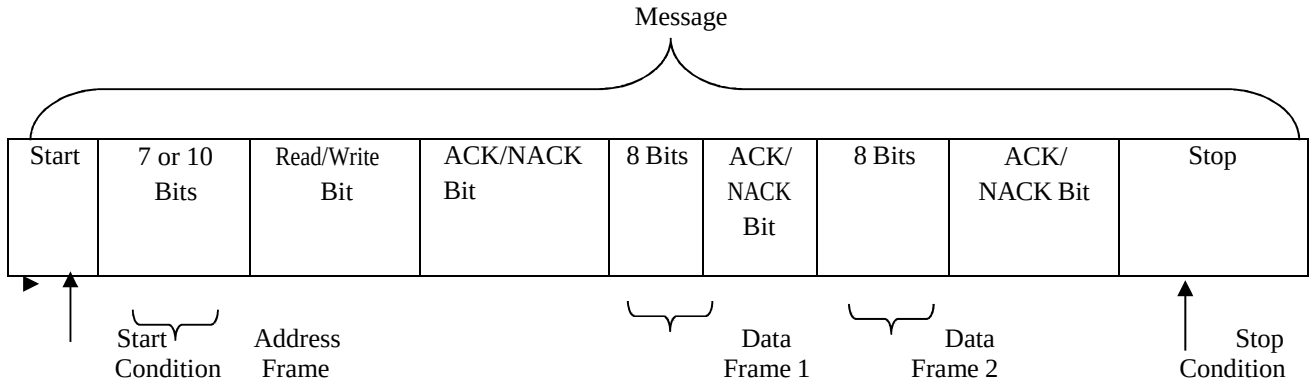


Fig. 4 Simulation output of I2C.

- I2C FRAME FORMAT:



The I2C bus consists of two bidirectional active lines one is serial Data line and an another is serial Clock line and a ground connection. To all of the connected devices master will issue an 'Attention' signal known as START. Then the Master sends the ADDRESS of the device it wants to communicate with and a Read or a Write bit. All devices compare it with their own address and the one whose address is matched will produce a response signal as an acknowledgement. If it doesn't match, they simply wait until the bus is released. On receiving acknowledgement, master can start transmitting or receiving data. The transferred data is 8 bits long followed by an acknowledgement bit which is repeated till whole transmission takes place. When all is done, the master will issue the STOP condition.

- BT656 Standard

BT.656 defined the parallel and serial interfaces for transmitting a video of format 4:2:2 YCbCrN digital video between equipment in studio and pro-video applications. In Fig. 5 represents that this is the active video resolutions of 720 x 486(525/60 video systems) or 720 x 576(625/50 video systems). The BT.656 parallel interface uses 8 or 10 bits of multiplexed YCbCr data and a 27MHz clock (ECL levels are used for the Data and clock signals). Instead of the

conventional video timing signals (HSYNC, VSYNC, and BLANK) also being transmitted, BT.656 uses unique timing code which is embedded within the video stream. This reduces

the number of wires (and IC pins) required for a BT.656 video interface. Ancillary digital information (such as audio, closed captioning, and tele- text) may also be transmitted during the blanking intervals. This tends to eliminate the need for a separate audio interface and additional control signals. The output of BT656 is shown in Fig. 6.

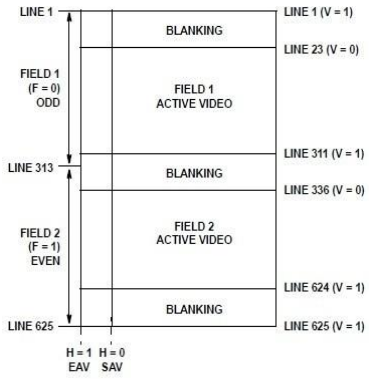


Fig. 5. BT.656vertical blanking intervals for 625/50 video systems.

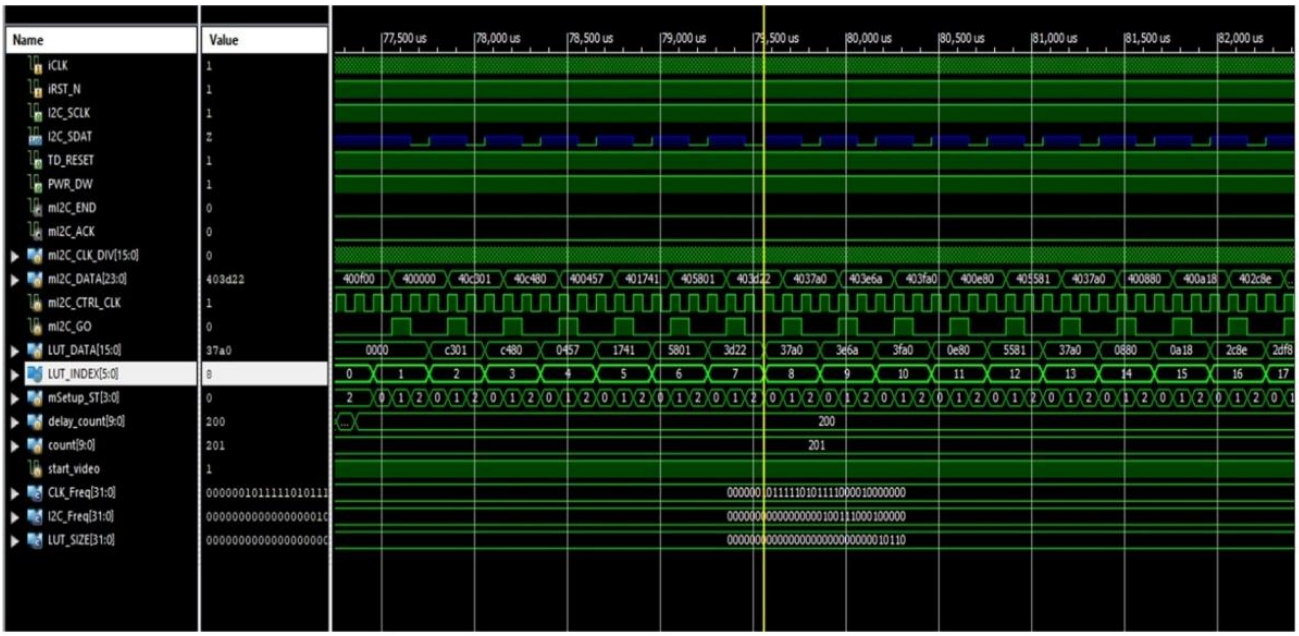


Fig. 6. Simulation output of BT656 standard.

V. Systematic Flow of the Coding

In the code, the given real time input video signal from the camera can be accepted with the help of decoder and encoder. In the code we have the decoder I2C and encoder I2C code part. It is used for the I2C configuration so that ADV7180 is a versatile one-chip multi format video decoder .The ADV7180 automatically detects and converts standard analog baseband television signals compatible with worldwide NTSC, PAL, and SECAM standards into 4:2:2 component video data compatible with the 8-bit ITU-R BT.656 interface standard [6]. The algorithm starts from first finding the first odd line of the frame. Once it is recognized then it starts to send the line signal to the encoder and then the line goes to the monitor display. Based on the bt656 standard we calculate at what line and at what place we need the marking in the frame. Accordingly we write the code .The marking is done by giving a control switch on the FPGA board. Whenever the switch is made on the marking code gets activated and it changes the pixels values of the image. This modified line goes to be encoder and then it is given to the display monitor.

VI. RESULTS

In Fig. 7, we get the required output that is marked event of an input signal that is taken for the marking operation.

Fig. 7. The red marked frame of the video output.

VII. APPLICATION

Digital video recorders configured for physical security applications record video signals from closed-circuit television cameras for detection and documentation purposes. DVRs have evolved into devices that are feature rich and provide services that exceed the simple recording of video images that was previously done through VCRs. A DVR CCTV system provides a multitude of advanced functions over VCR technology including video searches by event, time, date and camera. Some of the latest professional digital video recorders include video analytics firmware, to enable functionality such as 'virtual tripwire' or even the detection of abandoned objects on the scene.

VIII. CONCLUSION

We would like to conclude that to mark an important event from a real time input video we can use the FPGA based system. It is a simple program oriented and versatile system. Even we can able to modify the code accordingly to get the desired marking stamp.

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Analysis of OFDM Based Orthogonal and Non Orthogonal Modulation for Cognitive Networks

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***Abstract*–A novel waveform in 5G ought to facilitate supple coexistence with the intention to sustain varied service and deployment state of affairs in a carrier band and offer incredibly superior spectrum localization, at the same time inheriting the benefits of Orthogonal Frequency Division Multiplexing. The candidate for the above requirements is classified as Orthogonal based OFDM waveform and Non Orthogonal based OFDM waveform with multi carriers. In this paper, a detailed investigation, simulation, comparison and analysis of Filtered-OFDM (F-OFDM), Universal Filtered Multi Carrier which are OFDM based orthogonal waveform and Filter Bank Multi Carrier (FBMC) which is a OFDM based non orthogonal waveform is carried out. The simulation is accomplished by means of Matlab R2020 software at a frequency of 15 MHz, Signal to Noise Ratio of 18dB with diverse modulations like QPSK, 16QAM, 64QAM and 256QAM. The performance evaluation metric Peak to Average Power Ratio (PAPR) is evaluated and the comparison of the simulation results illustrates that the FBMC is an efficient method and a better candidate for 5G applications.**

***Index Terms*–OFDM, 5G, MCM, F-OFDM, UFMC, FBMC, PAPR, BER, PSD.**

I. INTRODUCTION

The 5G radio access technology aims at the waveform depending on OFDM, with latent support of non-orthogonal waveform and multiple accesses. OFDM based Orthogonal waveform and Non orthogonal waveform are considered as better options for the 5G technology. Universal Filtered OFDM (UFMC), Windowing OFDM (W-OFDM) Filtered OFDM (F-OFDM) are some of the OFDM based orthogonal waveforms which further uses either Zero Prefix OFDM (ZP-OFDM) or Cyclic Prefix OFDM (CP-OFDM) to provide the transient response of the sub-band filter in an attempt to attain an ISI-free waveform at the transmitter. Spectrally Precoded OFDM (SP-OFDM) and Filter Bank Multi Carrier (FBMC) technique are some of the non - orthogonal based waveform which further uses either OQAM or QAM modulation techniques. Figs. 1, 2 & 3 illustrates the Transmitter block diagram of Orthogonal and Non Orthogonal based OFDM (SP-OFDM, FBMC).

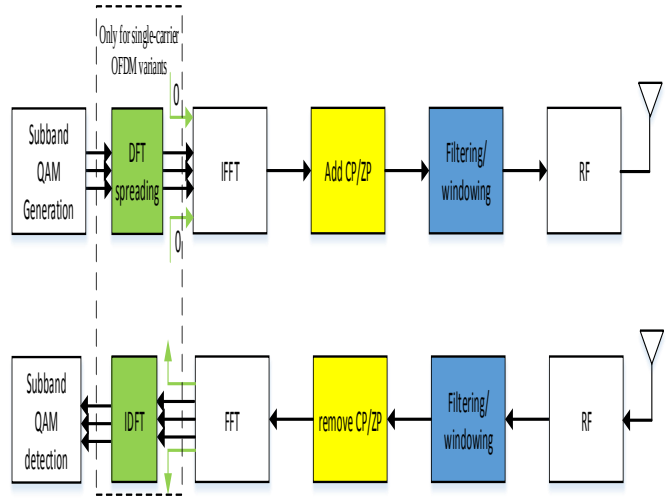

Fig.1. The Transmitter Block Diagram of an Orthogonal Based OFDM Waveform.

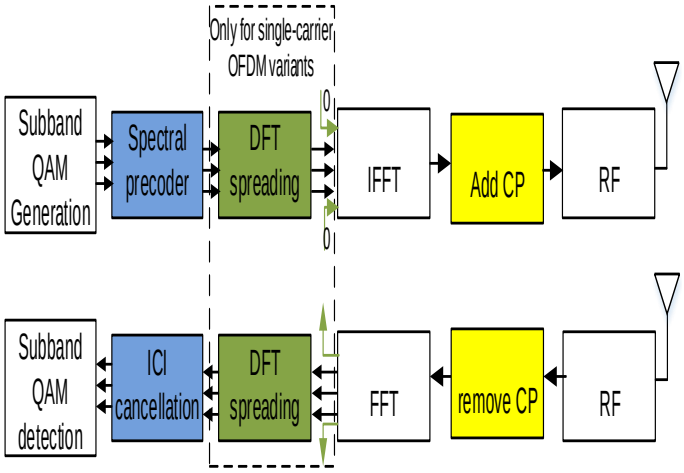

Fig. 2. The Transmitter Block Diagram of an Non Orthogonal Based OFDM Waveform (SP-OFDM).

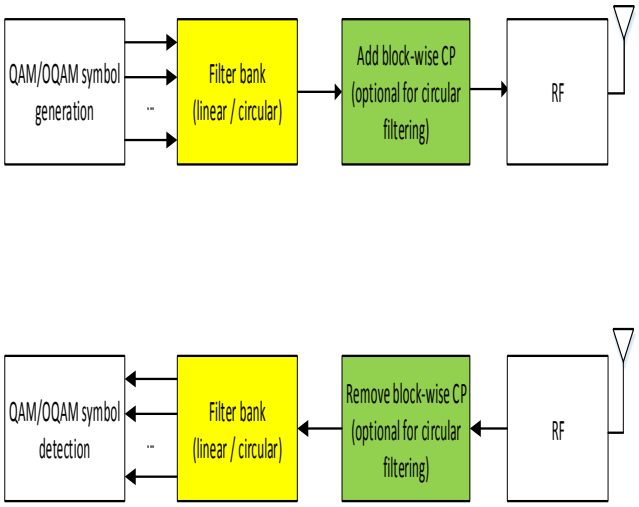

Fig. 3. The Transmitter Block Diagram of an Non Orthogonal Based OFDM Waveform (FBMC).

II. Related Work

B.Kedarnath et al in [1], has analysed Bit Error Rate and PAPR for FBMC with OQAM systems. Tensubam, Bidyalaxmi Devi et al in [2], has compared the performance of FBMC with OFDM systems for wireless communication applications. Kang, A.S et al in [3], had performed computer aided simulation of BER of FBMC systems for cognitive networks. The analysis has been done for a binary symmetric fading channel. Kang, A. et al in [4], has reviewed the GFDM and UFMC techniques for dispersive wireless channel of cognitive networks. Schaich, F et al in [5], has proposed various 5G waveform contenders for low latency transmissions. Wild, T. et al in [6] has explained 5G air interface design with UF-OFDM scheme. R. Nissel et al in [7], has calculated the bit error probability in dispersive channels for OFDM and FBMC systems. Abdoli J et al in [8], has proposed a novel scheme for future wireless communication named Filtered OFDM. Authors in [9] & [10], has proposed OFDM based flexible waveform for and filter design for 5G applications. Goldsmith, A. in [11], has explained the multi carrier modulation schemes for wireless communication. F. Schaich et al in [12], has explained 5G air boundary less than 6 GHz. N. Michailow et al in [13], presented Generalized FDM for fifth generation communication networks. L. Zhang et al in [14], proposed multi-carrier scheme depending on filtering for wireless communications. J. Li et al in [15], proposed a competent scheme for power systems depending on FOFDM. H. Kim et al in [16], has explained a Less-composite Single Vector Decomposition Based F-OFDM. Lin H. Et al in [17] has analyzed MCM and WCP-COQAM schemes. L. Zhang et al in [18], has analyzed the performance of a FOFDM Schemes, for fifth generation applications. Authors in [19], has explained in detail the FBMC physical layer. Schellman.M et al in [20] has presented FBMC method for 5G mobiles. Farhang et al in [21], has compared the OFDM with filter bank multi carrier. Wunder.G et al in [22], has presented Intermediate frame structure and transceiver concepts. Bharathy et al in [23] & [24], has made a detailed review of spectrum sensing techniques and developments in cognitive networks. B.Thangalakshmi, et al in [25] & [26] has surveyed the cognitive networks and also simulated a detector technique for the same.

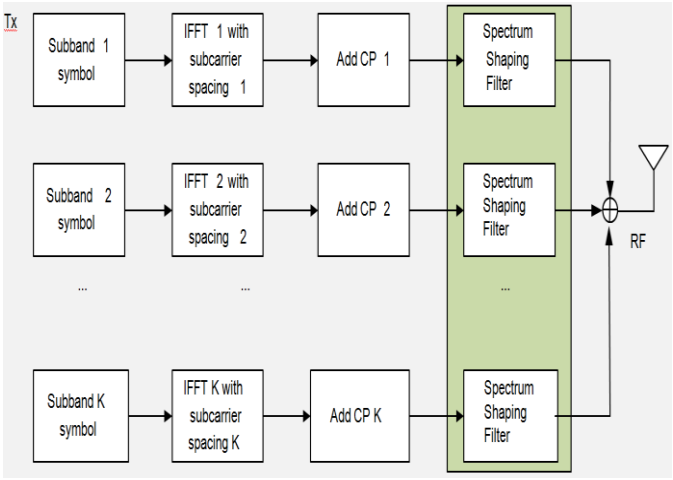

Fig. 4. The Transmitter Block Diagram of F-OFDM Waveform.

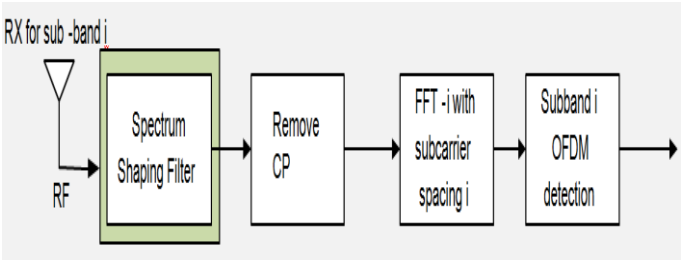

Fig. 5. The Receiver Block Diagram of F-OFDM Waveform

III. Orthogonal Waveform Based OFDM Schemes

The Universal Filtered OFDM, W-OFDM and F-OFDM are some of the orthogonal based waveform schemes where the OFDM symbols orthogonality is preserved. The time domain OFDM symbols are applied to a well-made filter or a window at the similar sub band frequency so as to preserve the orthogonality of the symbols.

A. F-OFDM

The baseband OFDM signal of every subband is transmitted through a "spectrum shaping filter". The key function of this filtering is to evade interference leakage to the adjacent subbands.

In sub carrier filtering, a sinc pulse for every independent carrier is filtered to obtain the W-OFDM signal. In sub band filtering, the Cyclic Prefix OFDM (CP-OFDM) is passed to the designed filter to get the F-OFDM signal. In this technique, the length of the filter can surpass the CP length to mitigate the ISI in comparison to the sub carrier filtering. Figs.

4 & 5 illustrates the transmitter block and receiver block of the F-OFDM waveform.

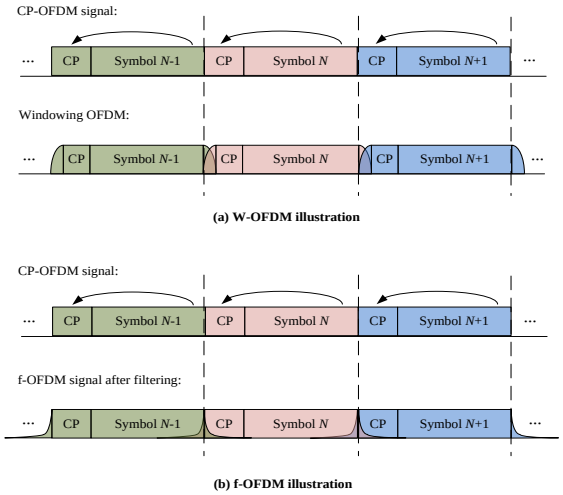

Fig.6. Illustration of Transmitted Time domain F-OFDM signal

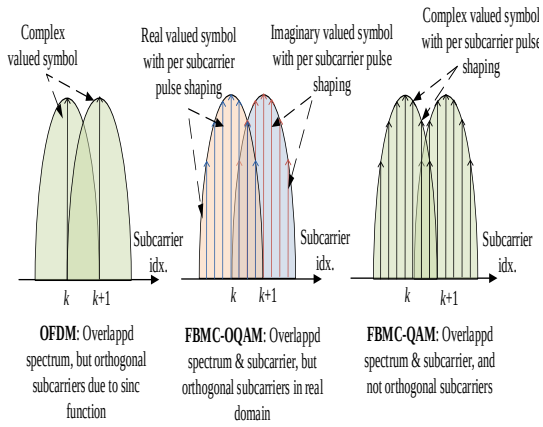

Fig.8. Illustration of ICI in Frequency Domain

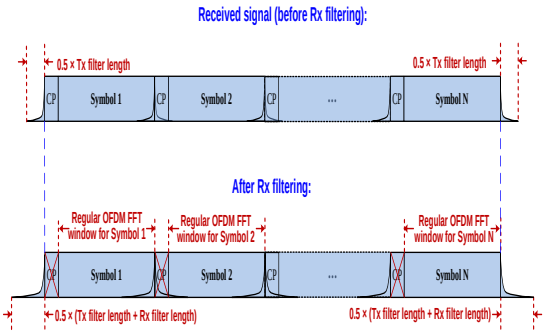

Fig.7. Illustration of Received Time domain F-OFDM signal

Figs. 6 & 7 illustrates the transmitted and received time domain F-OFDM signal. It is seen that W-OFDM is a better candidate for subcarrier based filtering and F-OFDM is the best contender for the subband based filtering.

IV. Non Orthogonal Waveform Based OFDM Schemes

The Spectrally Precoded OFDM (SP-OFDM) and Filtered Bank Multi Carrier (FBMC) techniques are some of the non orthogonal based waveform schemes where the OFDM symbols orthogonality is not preserved. Prior to the OFDM modulation, the signal is precoded in the SP-OFDM method to mitigate the Inter Carrier Interference (ICI). Figs. 8 & 9 illustrates the ICI in frequency domain and the Filter extension in time domain.

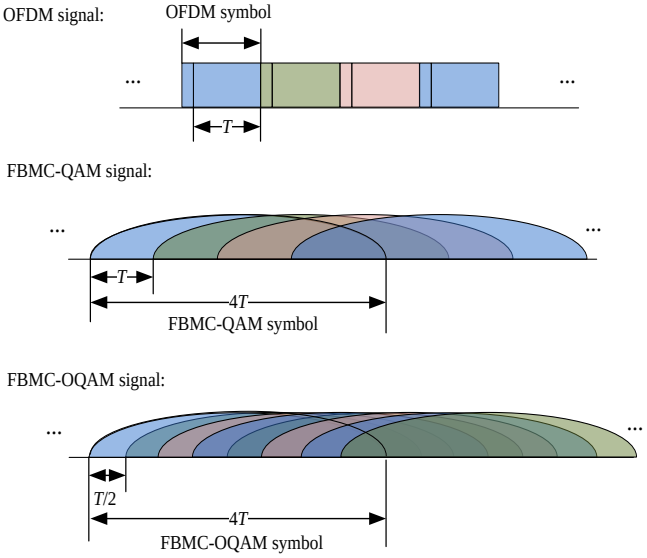

Fig.9. Illustration of Time Domain Filter Extension

A. FBMC

Filter Bank Multi Carrier (FBMC) modulation scheme offers a enhanced spectral competence and needs the stringent synchronization. This technique of FBMC provides a filtering of every subcarrier modulated output signal in a multicarrier system. The characterization of this sample filter is done by the overlapping factor K indicating overlap between the multi carrier symbols in the time domain. The implementation of the FBMC is done by using the spreading of the frequency. If N is the count of the subcarriers, the N*K count IFFT with a symbol overlapping delay of N/2 is utilized for the simulation design.

Figs. 10 & 11 illustrates the FBMC transmitter diagram and receiver block. FBMC is a beneficial method compared to OFDM providing a larger spectral efficiency. As a consequence of filtering of each and every subcarrier, FBMC incurs a greater delay in filtering compared to Universal Filtered Multi Carrier technique.

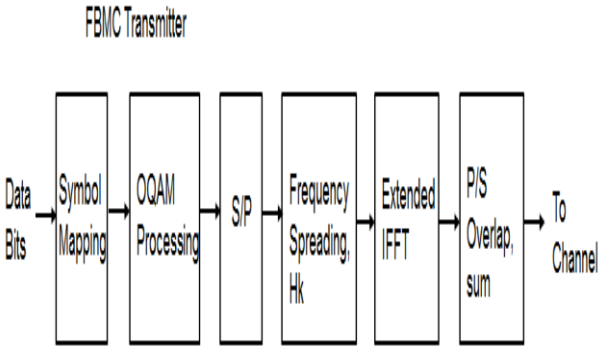

Fig. 10. Block Diagram of FBMC Transmitter.

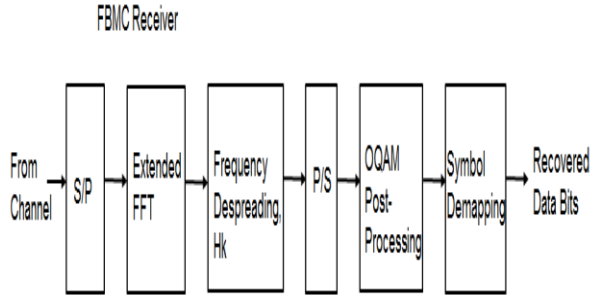

Fig. 11. Block Diagram of FBMC Receiver.

V. System Requirement Specifications

MATLAB (R2020a), a refined language tool, is employed to design and examine the characteristics of OFDM, F-OFDM, UFMC and FBMC with the following design settings.

TABLE I. Simulation specifications

Parameters	Values/Types
Size of FFT points	1024,2048
Size of Resource Blocks	50
Size of Subcarriers per Resource Block	12
No of bits Per Sub Carrier	2,4,6,8
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
SNR in dB	18
Sampling Frequency	15 MHz
Filter Structure	Dolph - Chebyshev
Filter Length	513
Number of Multipliers	511
Number of Adders	510
Number of States	512
Channel	AWGN

VI. Simulation Results Comparison and Analysis

A. *PAPR in dB for OFDM, F-OFDM, UFMC and FBMC*

TABLE II. PAPR Values in dB of OFDM

OFDM	QPSK	16 QAM	64 QAM	256 QAM
No of FFT 1024	9.5988	9.5307	11.371	9.4842
No of FFT 2048	8.9949	8.9212	10.6678	9.3447

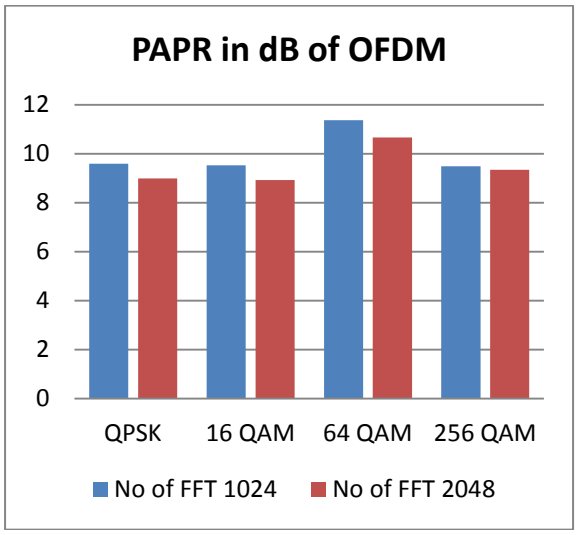

Fig. 12. PAPR in dB of OFDM.

Table II and Fig. 12 shows the simulated value of Peak to Average Power Ratio of OFDM for various modulation methods like QPSK, 16 , 64 & 256 QAM for size of FFT of 1024 and 2048. It is concluded from the results that the PAPR value is mitigated with the increase in the count of FFT. It is also noted that the least PAPR value of 9.3447 dB is obtained for 256 QAM with 2048 FFT points.

TABLE III. PAPR Values in dB of F-OFDM.

F-OFDM	QPSK	16 QAM	64 QAM	256 QAM
No of FFT 1024	7.9283	7.8622	9.721	8.4101
No of FFT 2048	8.0617	7.9482	9.7044	7.8176

Table III and Fig. 13 shows the simulated value of Peak to Average Power Ratio of F-OFDM for various modulation methods like QPSK, 16 , 64 & 256 QAM for size of FFT of 1024 and 2048. It is concluded from the results that the PAPR value is mitigated with the increase in the count of FFT. It is also noted that the least PAPR value of 7.8176 dB is obtained for 256 QAM with 2048 FFT points.

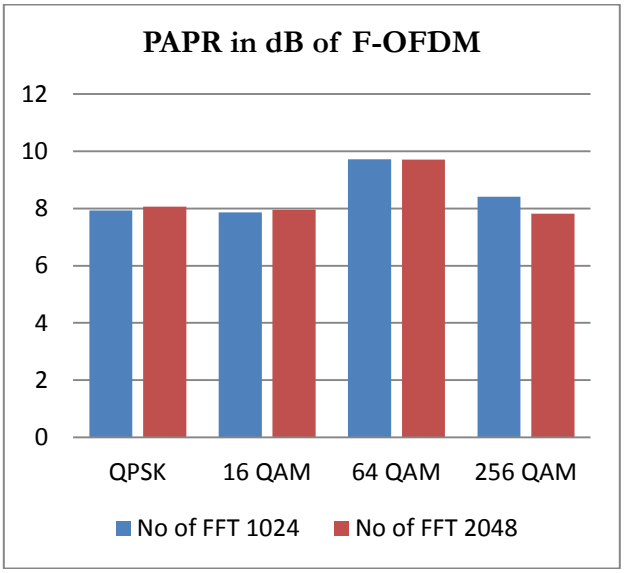

Fig.13. PAPR in dB of F-OFDM

TABLE IV. PAPR VALUES IN DB OF UFMC

UFMC	QPSK	16 QAM	64 QAM	256 QAM
No of FFT 1024	7.7732	8.2967	9.6202	7.5373
No of FFT 2048	8.1008	8.0195	9.2209	**7.3563**

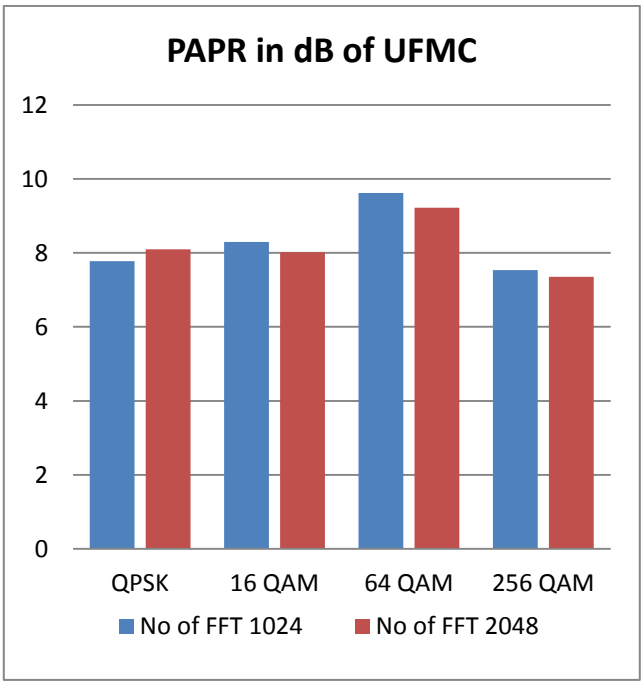

Fig.14. PAPR in dB of UFMC

Table IV and Fig. 14 shows the simulated value of Peak to Average Power Ratio of UFMC for various modulation methods like QPSK, 16 , 64 & 256 QAM for size of FFT of 1024 and 2048. It is concluded from the results that the PAPR value is mitigated with the increase in the count of FFT. It is also noted that the least PAPR value of 7.3563 dB is obtained for 256 QAM with 2048 FFT points.

TABLE V. PAPR VALUES IN DB OF FBMC

FBMC	QPSK	16 QAM	64 QAM	256 QAM
No of FFT 1024	7.654	7.523	7.472	7.4133
No of FFT 2048	7.608	7.501	7.345	7.3033

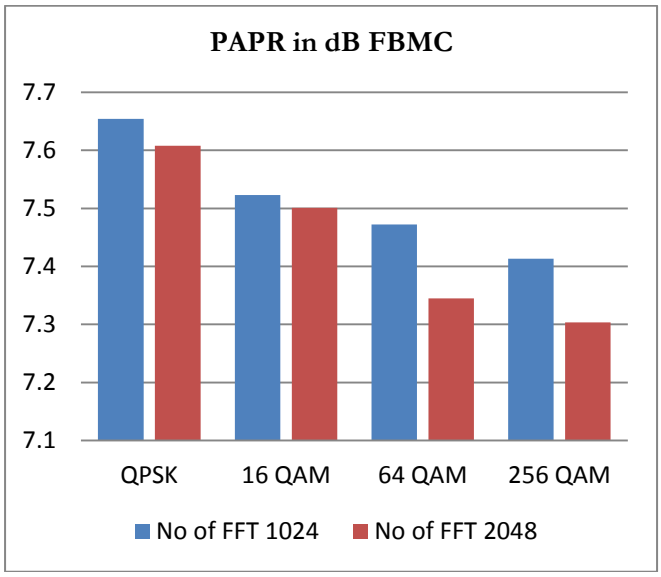

Fig.15. PAPR in dB of UFMC

Table V and Fig. 15 shows the simulated value of Peak to Average Power Ratio of FBMC for various modulation methods like QPSK, 16 , 64 & 256 QAM for size of FFT of 1024 and 2048. It is concluded from the results that the PAPR value is mitigated with the increase in the count of FFT. It is also noted that the least PAPR value of 7.3033 dB is obtained for 256 QAM with 2048 FFT points.

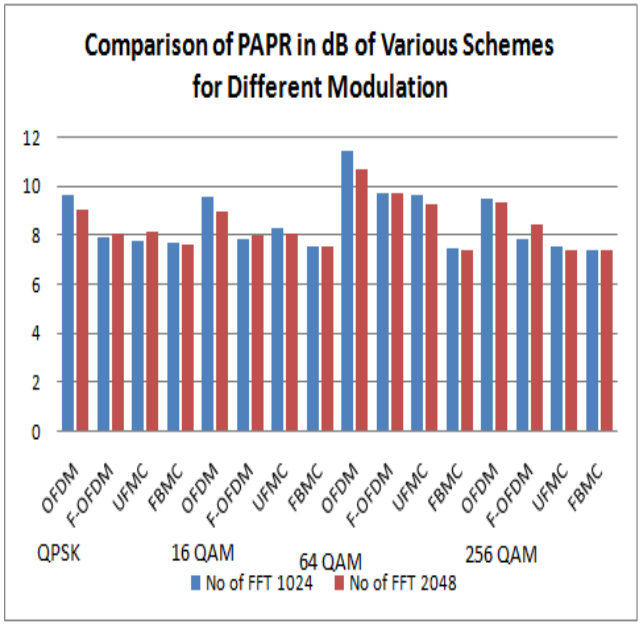

Fig.16. Comparison of PAPR in dB for Various Schemes with QPSK, 16QAM, 64QAM, 256QAM

Figure 16 shows the comparison of simulated value of Peak to Average Power Ratio of OFDM, F-OFDM, UFMC and FBMC for various modulation methods like QPSK, 16, 64 & 256 QAM for size of FFT of 1024 and 2048. It is concluded from the results that the PAPR value is mitigated with the increase in the count of FFT and also the increase in the QAM value. It is also noted that the least PAPR value of 7.3033 dB is obtained for 256 QAM with 2048 FFT points.

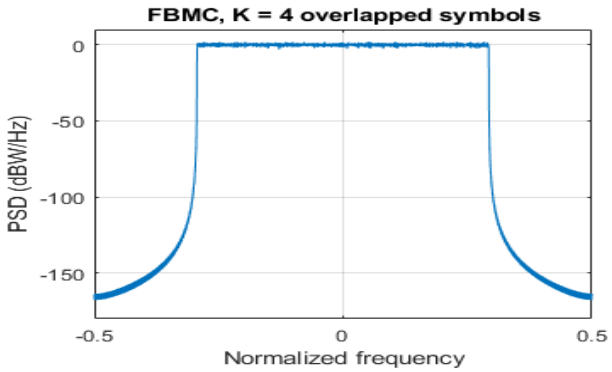

Fig.17. Illustration of power spectral density of the FBMC

Figure 17 illustrates the power spectral density of the FBMC transmit signal plotted to emphasize the low out-of-band leakage.

VII. Conclusion

A detailed investigation of the principle and the performance evaluation metrics such as Bit Error Rate (BER), Signal Power, Power Spectral Density (PSD) and the Peak to Average Power Ratio (PAPR) is carried out in this paper. The simulated results and the comparison of the same illustrates that the Filtered Bank Multi Carrier (FBMC) with 256 QAM modulation offers a lesser PAPR value and a enhanced results in comparison to the OFDM, Filtered - OFDM (F-OFDM) and Universal Filter Multi Carrier (UFMC). It is concluded that FBMC is an efficient method and a better candidate for 5G applications.

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Implementation of Smart Vehicle Collision Warning System under V2V and V2P Concepts Using BLE And GPS

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***Abstract*—Vehicular accident is extremely increasing day by day. Vehicular communication system will help to get rid of it. The key impulse for Vehicular communication systems is safety. Collision has become a key issue. Implementation of V2V and V2P communication is performed using BLE technology. This technology not only have ability to talk to proximity vehicles and increases the safety aspects but also can talk to nearby pedestrians through smart devices and warn them for any possible accidents. So communication between the vehicles and between pedestrians can enable travellers for responding to emergencies. Given that vehicles are designed to facilitate a smooth means of transportation, manufacturers have long been in the process of designing vehicles based on principles of reliability and safety. Vehicular communication networks will provide a wide range of applications with di erent characteristics. GPS receiver receives the remote vehicle data and transmits it to host vehicle through NRF24l01 module. Host vehicle data and remote vehicle data is processed in Arduino UNO and corresponding warning signal are given to drivers to prevent accidents.**

***Index Terms*—Vehicle-to-Vehicle communication, Vehicle-to-Pedestrian communication, GPS, Bluetooth Low Energy. Remote vehicle (RV), Host Vehicle (HV).**

I. Introduction

Nowadays, road accidents are becoming a common phenomenon in our country. The Major problem of this case is not getting proper direction and information of other vehicles in the lane. According to the report of the World Health Organization (WHO), 1.2 million deaths are caused by road accidents in the whole world. Of all deaths, One fourth is caused by injury. Also, about 50 million persons are injured in traffic and road accidents.

Through Bluetooth Low Energy technology vehicles can be given the warning to be aware of surrounding remote vehicles so that accidents can be prevented. Vehicle communication networks will provide many applications with different characteristics. As these networks have not yet been implemented. Ultimately, the classifications of applications are numerous and many institutions are involved in intelligent transportation systems for their own propose, different set of applications and classifications [1].

Around 1-2 million accidents happened every year because of a lack of communication between vehicles. Total number of people injured in accidents are more in numbers in Tamil Nadu and Karnataka when compared with other southern Indian states [2]. As per the survey from deaths due to road accidents in India keep on increasing [3]. GPS technology to get the location of the vehicle. All the vehicles will know each other's location and the respective vehicle will get threat notification when another vehicle is a short distance.

II. Proposed Methodology

A. Third Generation Partnership Project (3GPP TR 22.885)

This is Technical Report has been shaped by the Third Generation Partnership Project (3GPP). The document is subject to ongoing work at intervals. The TSG and will alteration be following formal TSG approval. Ought to the TSG modify the contents of this document, it's going to be re-released by the TSG with distinguishing modification of unharnessing date and an increase in version variety. the most aim of this study is to classify use cases and associated potential needs for LTE support of V2X services taking into consideration V2X Services and parameters outlined in alternative SDOs (e.g., ETSI ITS (Intelligent Transportation System), North American nation SAE), or connected governmental agency (e.g., C-ITS project in Korean). The essential use cases for LTE V2X to be thought-about and needs recognized area unit as follows

V2P: covering LTE-based communication between a vehicle and a tool carried by a person (e.g., hand-held terminal carried by a pedestrian, cyclist, driver, or passenger).

V2V: covering LTE-based communication between vehicles.

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B. NRF24L01 Transceiver

After analysing lots of methods to wirelessly Communicate from one vehicle to another NRF24L01+PA+LNA SMA wireless transceiver Antenna module is used. RFX2401C chip integrates the PA, LNA, and transmit-receive switching circuitry. RFX2401C is a range extender chip. This NRF24L01along with a duck- antenna helps the unit reach a considerably larger transmission range of about 1000m.

C. GPS Position Determination

In open places, the accuracy of the device will be high with no signal obstruction. If a device is enclosed around large buildings, there is a possibility for the satellite signal to be blocked. The signal may also be bounced off a tall building. Without signal blocks, the accuracy provided by the receiver will be high. It is better than 2.2-meter level accuracy for 95% of cases. It is far better within 99% of cases when compared to three-meter accuracy. The major operation of the GPS is based on the 'trilateration' principle. The position of the GPS receiver is determined based on accuracy and the number of satellites in view with the satellite receiver. Minimum four satellites are used to determine the position of the receiver on the earth.

D. Bluetooth Low Energy (BLE)

Proposed model is implemented using Bluetooth Low Energy as it intend to provide considerably reduced power consumption and cost while maintaining a similar communication range. BLE achieves optimized and low power consumption by keeping the radio off as much as possible and sending small amounts of data at low transfer speeds. Free of cost to access the official specification documents

Bluetooth Low Energy is also known as Bluetooth Smart is a wireless personal area network technology designed to aim at novel applications in the healthcare, beacons, security, and home entertainment industries. It is independent of classic Bluetooth.

The original BLE architecture was developed by Nokia in 2006 under the name Wibree which was integrated into Bluetooth 4.0 in December 2009 as Bluetooth Low Energy. In BLE different types of beacons like URIBeacon, AltBeacon, iBeacon are available each with their standards and advantages. Some of them are open source.

BLE technology is the best and cheapest way to avoid accidents between two vehicles. Bluetooth Low Energy technology has good range for communication between two or more vehicles communicating with each other when they come in the range of corresponding Radio Frequency (RF) signal [4].

III. Implementation

Base module is designed with the help of Arduino UNO, GPS module and NRF24L01 module.

A. Base Moudle

Modules are connected to the Arduino board to their pin configurations. When the Arduino is provided with the power supply, communication takes place between vehicles with the help of the NRF Transceiver module. GPS in RV gets its location from the satellite and it is shared with Arduino. Arduino helps in transmitting the location and speed of RV to HV through the nRF transceiver module. Arduino in HV does distance calculations between vehicles. Based on the distance, alarm system will function. LCD displays the distance speed as well as the location of remote and host vehicle. The ultrasonic sensor is used to calculate the sudden and unexpected barriers as in Fig. 3.1.

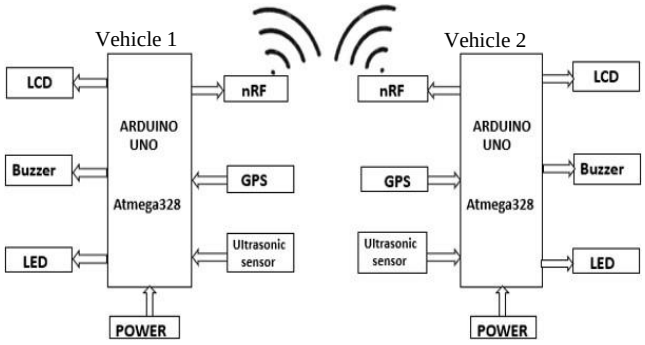

Fig. 3.1. Base module bock diagram.

B. General Flow of V2V Communication

If any vehicle enters the range of Nrf24L01, then latitude and longitude value (GPS Coordinates) are received from the respective remote vehicle using the GPS module. The GPS receives those coordinates from satellites. These coordinates and speed of the vehicle will be shared with Host side vehicles using the Nrf24L01 transceiver module as shown in Fig. 3.2.

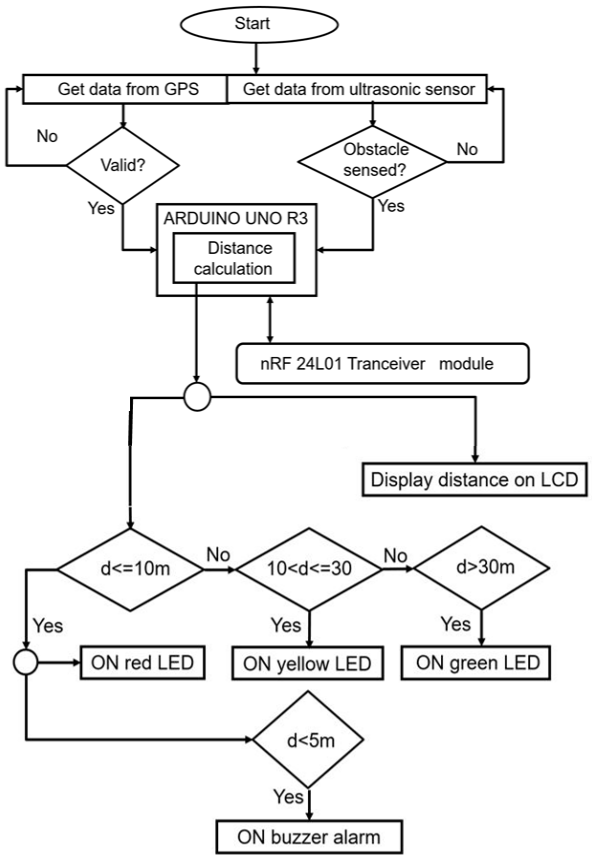

Fig. 3.2. Flow diagram for V2V.

The distance between remote vehicles and the host vehicle is calculated using the Haversine Algorithm in Arduino. The distance between remote vehicle and host vehicle and the speed of the remote vehicle is displayed host vehicle's LCD. If distance and speed exceeds the threshold value it will result from any fatal accidents. Thus warning system is activated to prevent those accidents. The ultrasonic sensor is also used to detect speed breakers, animals while driving So that the drivers would be alert.

C. Mathematical Analysis

This proposed method involves two major calculations. Speed of RV and Distance between HV and RV

Distance

Distance calculation for GPS coordinates is calculated through Haversine Algorithm

Haversine formula

$$\Delta\varphi = (\varphi 2 - \varphi 1) * pi/180 \quad (3.1)$$

$$\Delta\lambda = (\lambda 2 - \lambda 1) * pi/180 \quad (3.2)$$

$$a=\sin^2(\Delta\varphi/2)+\cos(\varphi 1)*\cos(\varphi 2)*\sin^2(\Delta\lambda/2) \quad (3.3)$$

In Equation (3.1),(3.2)and(3.3) φ1 and φ2 denotes latitude of host vehicle and remote vehicle respectively. The term pi/180 is multiplied to convert latitude and longitude values from degrees to radian. Thus, Equations (3.1) and (3.2) calculates latitude change (Δφ) and longitude change (Δλ) in radians.

$$c=2 * \arcsin(\sqrt{a}) \quad (3.4)$$

$$d = R * c \quad (3.5)$$

In equation (3.5) R denotes radius of the earth measured in terms of meters (R=6371000m.).d is the calculated distance between remote vehicle and host vehicle in meters.

Speed

The speed of the RV is calculated in order for the driver to be aware of the speed of the approaching vehicle.

$$\text{Speed}=\text{Distance} / \text{Time} \quad (3.6)$$

In equation (3.6) shows HV, the speed in which RV is approaching HV.

D. Scenariosconsidered

To avoid accidents some common scenarios are considered to ensure safety on roads

Scenario 1: Forward Collision

The latitude and longitude values are received from the respective remote vehicle using the GPS module if any vehicle comes under the range of Nrf24L01. The coordinates will be shared with host vehicle using the Nrf24L01 transceiver module. The distance between remote vehicles and host vehicles is calculated using the haversine formula and then the calculated distance between vehicles and received speed are displayed in LCD.

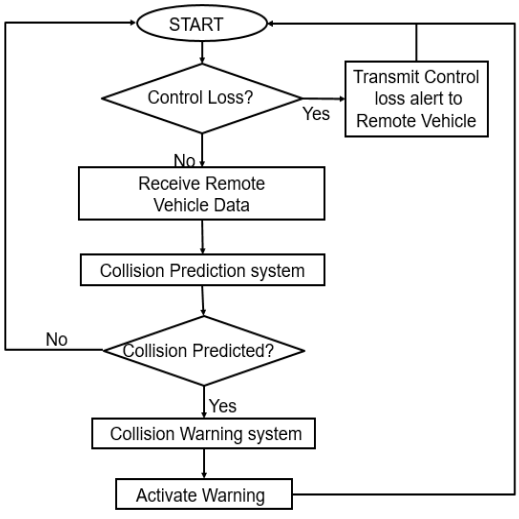

Fig. 3.3. Forwarding collision avoidance.

If the distance is less than 30m green led glows. If the distance is between 30m and 10m yellow led glows. If it is less than 10m red led will glow. If it is less than 5m buzzers will be activated. So, drivers should take respective actions to avoid accidents If Over speed is detected there may be the

possibility for accidents. So, it is also indicated to avoid deadly accidents. The ultrasonic sensor is also used to detect speed breakers, animals while driving. So that the drivers would be alert As per Fig. 3.3.

Scenario 2: To Avoid Control Loss Collision

In Fig. 3.4, the Designed model continuously checks for control loss. Because in some cases there might be a sudden and unexpected situation that may be due to buildings, brake failure, engine malfunction, vehicle collapse, etc. so, the driver will be able to give warnings to nearby approaching vehicles about this control loss occurrence. This is done by giving interrupt. The switch is used to pass this interrupt signal.

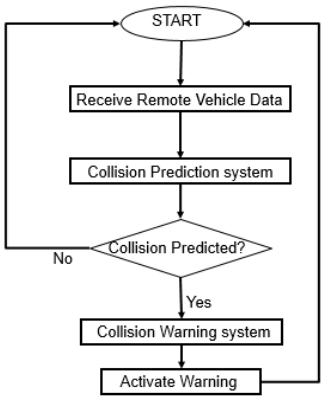

Fig. 3.4. Control loss indication.

Scenario 3: Pedestrian Road Safety through V2P awareness messages

In Fig. 3.5, the coordinates of the approaching vehicle will be shared with pedestrians through IoT. The speed and distance between remote vehicles and pedestrians are calculated using the haversine formula. The distance and speed are passed to the cloud using things peak then respective distance will be shared with a pedestrian through the mail. The IFTTT connected with webhooks, Email, and Things peak. IFTTT helps to connect all different apps and devices. In Webhooks messages are sent from the website automatically when something happens. They have a message or payload and are sent to a unique URL

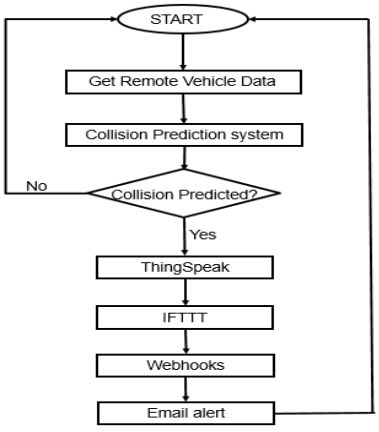

Fig. 3.5. Pedestrian Road Safety through V2P awareness messages.

Scenario 4: Accidents Detection

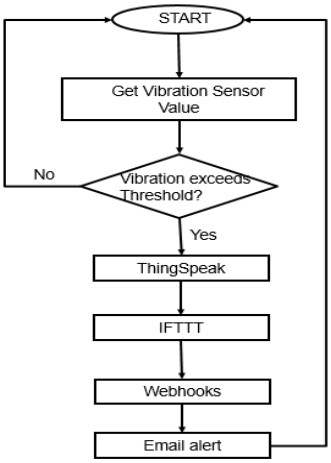

Fig. 3.6. Accidents detection.

If there is an accident it is reported to the registered Email ID. The occurrence of an accident is detected through a vibration sensor. Coordinates are obtained from the GPS module are sent to concerned officers as alert mail through IOT as shown in Fig. 3.6.

IV. Result and Discussions

V2Vand V2P communication is implemented using BLE and GPS and Location of Remote Vehicle and Host Vehicle, speed of Remote Vehicle and the distance between Remote vehicle and Host Vehicle are recorded in serial monitor and Host Vehicle LCD.

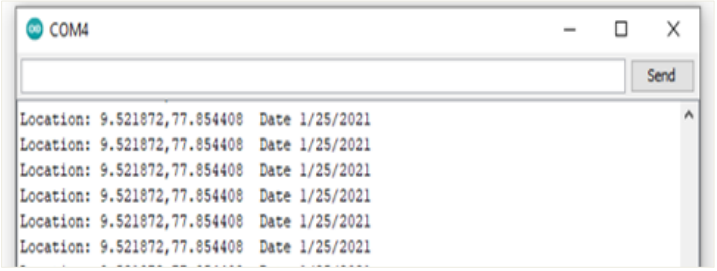

Fig. 4.1. GPS coordinates.

In Fig. 4.1 Latitude, Latitude and Time are displayed in the serial monitor. Latitude and Latitude are the GPS Coordinates. These values are received from GPS neo6mv2 module from Satellite.

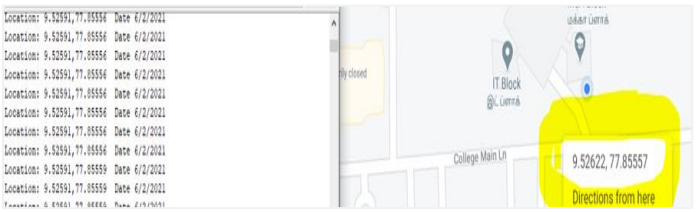

Fig. 4.2. Accuracy of GPSvsGoogle Map accuracy.

In Fig. 4.2 GPS coordinates received from GPS module (NEO 6MV2) and GPS coordinates received from Google Map are compared, and there is a minute difference in accuracy of 0.00005%.

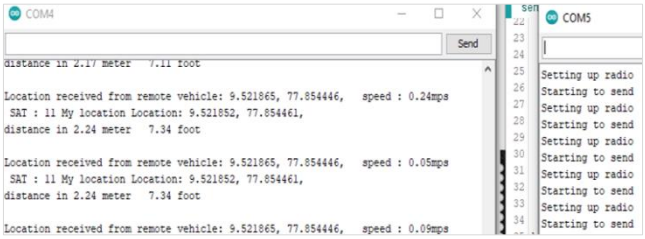

Fig. 4.3. Speed and distance between vehicles.

In Fig. 4.3 the latitude and longitude values (GPS Coordinates) are received from respective remote vehicle using GPS-neo6mv2 module. The speed of remote vehicle in which it is approaching the host vehicle and the distance between remote vehicles and host vehicle is displayed in the Serial monitor. Along with that location of host vehicle and location of remote vehicle also displayed in the serial monitor.

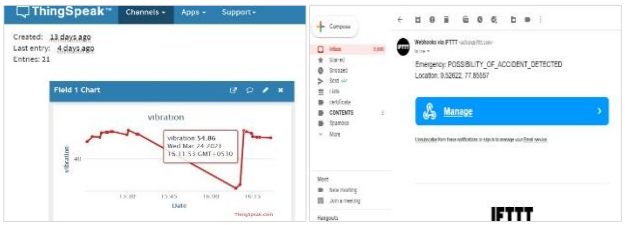

Fig. 4.4. (a)Vibration graph in thingspeak. (b) Mail alert for possibility of accident.

In Fig. 4.4 the vibration in the vehicle during accident is measured using SW420. Its range is continuously updated in the cloud and respective graph is drawn using its value. If the value exceeds beyond its threshold value the Email will be sent to registered mail Id.

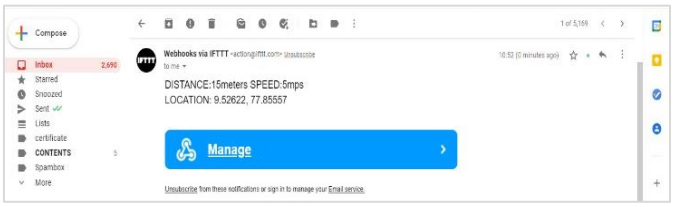

Fig. 4.5. Location, speed and distance received through Email.

In Fig. 4.5, The location, speed of Remote Vehicle and distance between Remote Vehicle and Host Vehicle is notified to pedestrian through mail id or any smart devices. This warning signal is given topedestrian (bicycler) through IoT

In Fig. 4.6 (a), RV Coordinates is received from GPS module anditis shared with HV throughNrf24L01 module and displayed in HVLCD. In Fig. 4.6 (b),the value“10” denotes the number of satellites in LOS. The Coordinates of HV is received from GPS module and displayed in HV LCD.

Fig. 4.6. GPS Coordinates of (a)RV (b)HV in LCD.

Real time implementation of the designed prototype model for Collision Warning System using Vehicle to Vehicle (V2V) and Vehicle to Pedestrian (V2P) concept using BLE and GPS is shown in Fig. 4.7.

Fig. 4.7. (a) Real time implementation. (b) Readings in the LCD of HV.

Prototype model designed for Remote Vehicle and Host Vehicle for Vehicle to vehicle Collision Warning System using BLE and GPS is shown in Fig. 4.8

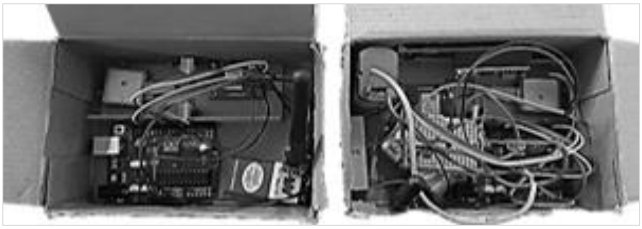

Fig. 4.8. RV and HV prototype.

V. V. Conclusion and Future Work

Collision Warning System prototype is developed for V2V and V2P communication prototype through BLE wireless technology and GPS. This prototype helps preventing road accidents. Other dimensions of V2X communication like V2I and V2N communication can be included. High end GPS can be used for better signal strength and good accuracy.

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A Secret Key Generation using Double Chaotic Maps and Hash Algorithms for Image Encryption

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***Abstract*—In recent times, cryptography has turned into a battleground of some of the world's best mathematicians and computer scientists. The ability to securely store and transfer sensitive information has proved a critical factor in success in war and business. Cryptography has been a subject to various restrictions in many countries, ranging from limitations of the usage of export of software to the public dissemination of mathematical concepts that could be used to develop cryptosystems. Hash functions have been used in the field of encryption to convert a given input message to a fixed length alphanumeric string to ensure secure transmission of data. Hash algorithms are developed with properties such as collision resistance, preimage resistance, deterministic etc. Message Digest Algorithm is one of the first few algorithms that was developed specifically for Message Authentication Codes (MAC), digital signatures, etc. However due to the security threats encountered with MD algorithm, most of the present systems make use of the Secure Hash algorithm while it may be one of the safest modes of data transmission. MD5 and SHA algorithms are vulnerable to security threats due to collision, brute force attack. This paper presents a novel key generation algorithm which incorporates the randomness exhibited by chaotic maps and hash algorithms. In this paper 2D- logistic map, Tent chaotic maps are used. The hash algorithm and its constants are filled with chaotic maps for enhancing security of secret key generation. For validation of the proposed key are tested using statistical analysis and security attacks.**

***Index Terms*—Chaos, cryptography, MD5-message digest, SHA1-secure hash algorithm, runs test, frequency test, cryptography with chaos, correlation coefficient.**

I. Introduction

In recent years, owing to the frequent flow of digital images across the world over transmission media, it has become essential to secure them from leakages. Many applications such as military image databases, confidential video conferencing, medical imaging systems, TV cable, online personal albums, etc. require reliable, fast and robust security systems to store and transmit digital images. Most conventional ciphers, such as Data Encryption Standard (DES), International Data Encryption

Algorithm (IDEA), Advanced Encryption Standard (AES), Linear Feedback Shift Register (LFSR) with high computational security consider plaintext as either block cipher or data stream and are not suitable for image/video encryption in real time because of long execution time due to large data volume and strong correlation among image pixels.

In the last decades chaotic cryptography has received considerable attention when many researchers pointed out the existence of a strong relation between chaos and cryptography. Actually, both digital and analog chaotic encryption methods have been proposed and analysed.

The main advantage of using chaos is because the signal looks like a noise for the unauthorized users. Generating chaotic signals is often of low cost with simple iterations which makes it suitable for the construction of stream ciphers. These ciphers can be used to generate pseudorandom keys to encrypt plain text element by element.

So, in order to improve the security of the transmitted signal the Chaotic maps and hash algorithms are used to improve the security of the signal by creating a highly random secret key. By implementing this the security will automatically improve and the danger of the signal being leaked can be avoided.

II. Literature Review

[5] Mahmoud Maqableh, Azman Bin Samsudin and Mohammad A. Alia, "New Hash Function Based on Chaos Theory (CHA-1)", IJCSNS International Journal of Computer Science and Network Security- 2008. This paper introduces new hash functions that generate the message digest through a randomizing process of the original message. Subsequently a chaos system also generates random behaviour, but at the same time a chaos system is completely deterministic. They proposed a new hash function (CHA-1) based on chaos, which produces 160-bit hash digest, accepts message length less than 280 bits, and has a security factor 280 of brute-force attack.

[9] Neetesh Tiwari, Amit Sinhal,'An Implementation of Secure Hash Algorithms in Wireless Algorithms to Ensure the Integrity', (IJCSIT) International Journal of Computer Science and Information Technologies- 2014. This paper proposed a fast one-way hash function to optimize the time delay with strong collision resistance, assures a good compression and one-way resistance. It is based on the

standard secure hash function (SHA-1) algorithm. they proposed algorithm called OSHA is time efficient and proven for better compression function.

[4] Dexi Wang, Yu Jiang, Houbing Song, Fei He, Ming Gu and Jiaguang Sun, 'Verification of implementations of cryptographic hash functions', IEEE-2017. This solves the challenges by introducing a novel cryptographic model design for modelling the semantics of cryptographic hash function implementations, extended array theories for analysis of operations, and compositional verification for scalability. They evaluated verification framework on two SHA-3 cryptographic hash function implementations: the winner of the NIST SHA-3 competition, Keccack; and an open-source hash program, RHash. They successfully verified the core parts of the two implementations and reproduced a bug in the published edition of RHash.

[11] Baptista.M. S, 'Cryptography with Chaos', Phys. Lett. A-1998. This journal proposes to encrypt a message (a text composed by some alphabet) using the ergodic property of the simple low-dimensional and chaotic logistic equation. The basic idea is to encrypt each character of the message as the integer number of iterations performed in the logistic equation, in order to transfer the trajectory from an initial condition towards an ε-interval inside the logistic chaotic attractor.

[7] National Institute of Standards and Technology (NIST), 'Secure Hash Standard,' Federal Information Processing Standards Publication-2012 This standard specifies hash algorithms that can be used to generate digests of messages. This also specifies the round functions and other iterative functions used in SHA. This provides the lookup table for standard constants and buffer values for initialization.

[13] Nabil Abdoun, Safwan El Assad, Mohammad Abu Taha, Rima Assaf, Olivier Deforges, Mohamad Khalil (2016) Secure Hash Algorithm based on Efficient Chaotic Neural Network Secure Hash Algorithm (SHA) is the most popular standard of Cryptographic Hash functions. Several security protocols use SHA to provide message integrity, authentication and digital signature. Nowadays, a new technology based on Chaotic Neural Networks is used to design Hash functions due to the following important properties of Chaos and Neural Networks: non-linearity, compression, confusion and diffusion. Compared to existing Hash functions based on Chaotic Neural Networks, the proposed structure integrates a strong Chaotic generator into neurons instead of using simple Chaotic maps. In fact, simple chaotic maps are not very robust, even against some statistical attacks (Uniformity and NIST). To also reduce the complexity of hash function proposed in ICITST conference (2015), while maintaining strength, we present in this paper a new structure of Hash function. The theoretical analysis and the obtained experimental performances demonstrate the efficiency of the implemented structure in terms of strong Collision Resistance and High Message Sensitivity compared to SHA-2 and some Chaos-based Hash functions.

[12] Alvarez. E, Fernandez. A, Garcia.P, J. Jimenez, and A. Marcano (1999) New approach to chaotic encryption It describes a computational procedure to encrypt a message, provided that the transmitter and the receiver dispose of identical, but otherwise not synchronized, chaotic dynamical systems. The technique is based upon the fact that the symbolic dynamics of these two systems can be used in order to sequentially construct data blocks which reproduce those from the input file.

[14] Wang. X, Yin.Y. L. and H. Yu (2005) Finding Collisions in the Full SHA-1 In this paper, A new collision search attack on the hash function SHA-1 is presented. It shows that collisions of SHA-1 can be found with complexity less than 269 hash operations. This is the worst attack on the full 80-step SHA-1 with complexity less than the 280 theoretical bound

III. Proposed Model

The proposed model is to integrate chaos theory and hash algorithms to increase the randomness of a string generated. In chaos theory the maps are functions which produce a random output for the given set of conditions irrespective of the initial conditions. In our model, the parameters of map X are decided by the outputs of map Y [2,3]. The Y maps iteration times and the initial seed is chosen randomly and map Y parameters are set within a range such that the map Ys output is highly disordered. Then from the array of the Y maps output, the initial seed and the number of iterations is picked using a random function. The map parameters of map X are selected in such a way that the X maps outputs are highly disordered. Then the required length is taken out from map X output by picking the random outputs and concat the binary values of these outputs.

This binary string output is given as the input for the hash algorithms applied. Let us consider hash functions H1 and H2. the number of times the hash applied is n times, then, a n-bit binary number is generated. So, depending upon the bit in the binary sequence [4,5]. the hash H1 and H2 are applied to the input at every iteration. From the final string, the key is trimmed from the left to the required number of bits.

A. Algorithms for Application of Chaotic Maps

1. Taking the initial conditions for both the maps
2. Setting the random parameter of tent map in the given range
3. Iterating the tent map for a fixed number of times
4. Selecting a random output of tent map for getting the iteration count for logistic map
5. Getting a random value of parameter in the given range for logistic map
6. Giving the initial conditions taken in first step to logistic map
7. With the given values iter the logistic map
8. Taking the required number of randomly selected output
9. Convert them to hexa-decimal and concat it to the required length

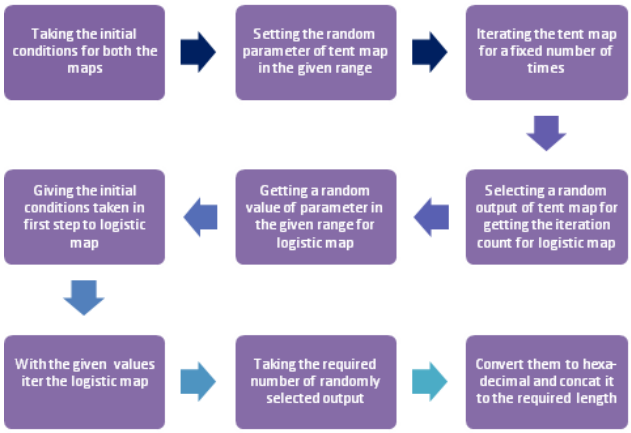

Fig. 1. Flowchart for implementing chaotic maps.

B. Algorithm for Applying Hash Algorithms

1. Generate a n-bit binary number
2. Initialize a loop for n times
3. Check the bit is either 1 or 0 at every iteration
4. if 1, apply H1 else, apply H2
5. go to step 3
6. Trim the output to 64 bits from left
7. Store the resulted key after the iteration

IV. IV. Simulation Result and Comparison

Below mentioned are the results of the simulation of the proposed model in the MATLAB using logistic [6] and tent maps [15], MD5 and SHA-1 hash algorithms [8,9,10]. After the string of 64 bit is generated using the chaotic maps and the hash algorithm, the below results are the results of the runs test and frequency test suggested by the National institute of Standards and technology (NIST) [7], and also correlation coefficient of two keys generated by the same model simultaneously has been calculated.

TABLE I. Frequency test

	1st Obs.	2nd Obs.	3rd Obs.	Avg.	Diff.
Only Chaotic Maps	0.7337	0.0133	0.0771	0.2747	0
Chaotic Map and Hash Algorithm (10 Times)	0.0771	0.0133	0.2888	0.1264	0.148
Chaotic Map and Hash algorithm (20 times)	0.0339	0.2479	0.0771	0.1196	0.0068
Chaotic Map and Hash algorithm (30 times)	0.0133	0.0771	0.1573	0.0825	0.0371

TABLE II. Runs test

	1st Obs.	2nd Obs.	3rd Obs.	Avg.	Diff.
Only Chaotic Maps	0.0121	0.4634	0.1249	0.2001	0
Chaotic Map and Hash Algorithm (10 Times)	0.1249	0.2884	0.3316	0.2483	0.0482
Chaotic Map and Hash algorithm (20 times)	0.2569	0.5055	0.5921	0.4515	0.2032
Chaotic Map and Hash algorithm (30 times)	0.8016	0.3851	0.6745	0.6204	0.1689

TABLE III. Correlation coefficient

	1st Obs.	2nd Obs.	3rd Obs.	Avg.	Diff.
Chaotic Maps	0.3506	0.2013	0.3550	0.3023	0
Chaotic Map and Hash Algorithm (10 Times)	0.2031	0.2623	0.1758	0.2137	0.0886
Chaotic Map and Hash algorithm (20 times)	0.1885	0.1879	0.1672	0.1812	0.0325
Chaotic Map and Hash algorithm (30 times)	-0.0852	0.0591	0.1216	0.0955	0.0857

From the above Tables I, II, III, the s is, the average of the and performance and reduced the execution time thereby increasing the security.

Future scope, in this paper the chaotic maps are used in nested condition so that the randomness of the key generated is very high so that the attackers cannot easily get the data from the encrypted file without the key. In future advanced chaotic maps and hash algorithms are used to increase the randomness and security level can be improved. Hence, the data will be safe during the transmission of data in an unsecured channel.

Runs test is increasing with the number of times the hashing is applied. The runs test output is directly proportional to the number of runs in a binary sequence, as the value is increasing, the generated output is having more runs compared to the outputs of the model with a smaller number of times the hash is applied. So, the inference that may be drawn is, as the number of times the hash applied increases, the number of runs increases which means the oscillations or the frequency of changing number of ones and zeroes is too fast. The correlation coefficient keeps on reducing and getting closer to zero and less than zero, which implies that the correlation between the two keys which are generated immediately, are not correlated as the number of times hash applied are increased. The frequency test declares that the string which is generated is a random number.

Even the encryption is also applied using the generated key and secure force algorithm [1]. the results were a uniform histogram for the encrypted image and there is almost no data loss while encryption and decryption.

V. Conclusion and Future Scope

In this day and age, as more and more people share information in the digital format, the amount of data being generated is increasing at a drastic pace. Therefore, cryptography is of utmost importance, however due to the standard structure of most cryptographic functions being used at present, such as Message Digest Algorithm or the Secure Hash Algorithm, the chances of data breaches continue to increase. Our paper incorporates chaotic Maps and Hash algorithms, while satisfying all the properties of a secret key. Future work would involve the real-time implementation of the chaos-hash based key generation in an application.

This paper is performed in three phases. The first phase involved the study and implementation of chaotic maps and a secret key generation using the chaotic maps. The second phase involved the implementation of hash functions generation of key using hash and have implemented image encryption and decryption. The third phase involved the implementation of randomness tests such as Frequency test and Runs test to prove the key generated is random or not based on the NIST criteria. In comparison to the existing system the proposed system has improved the randomness

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Recognition of Facial Expression Based on Multi Branch Structure

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***Abstract*—Facial expression recognition (FER) is an important means for machines to assess human emotions and interact with human beings. This paper proposes a facial expression recognition method based on multi branch structures, which extracts the global and detailed features of the face from the global and local aspects respectively, so as to make a more detailed representation of the facial expression and to further improve the accuracy of facial expression recognition. Specifically, the first branch extracts the global features of the face, whereas the second and third branch divide the face into two parts and three parts to extract the detailed features of the face. At last, the global features and detail features are combined in the full-connection layer and the input is given into the classifier for further classification. The experimental results show that the proposed method achieves 73.7% accuracy, which fully verifies the effectiveness of the method.**

I. Introduction

Facial expression is a form of non-verbal communication, and it is the main means to express people's physiological and psychological reactions in social communication. Through the analysis of facial expressions, we can roughly reflect people's current emotions and potential intentions, which plays an important role in the social interaction between people. In the past decade, with the rapid development of computer technology and the increasing maturity of image technology, facial expression recognition combined with computer technology and image technology has become a new research trend and has achieved good results in various fields. For example, the application of facial expression recognition technology in the field of transportation can determine whether the driver is in the abnormal driving state such as fatigue driving, drunk driving and drug driving by monitoring the driver's expression; in the field of medical treatment, the psychiatrist can master the patient's psychological state through expression recognition and assist the psychiatrist in diagnosis and treatment; in the field of network education, According to the different learning ability of different students, through the expression recognition, analyze the learning situation of students, and feedback to the teacher, so as to facilitate the teacher to adjust the teaching plan in time; applied in the field of criminal investigation, it can help the police to analyze the psychological state and psychological changes of suspects, and assist in handling cases. Therefore, facial expression recognition has shown high application value in various fields. But at present, facial expression recognition is still facing great challenges. The deep network focuses on the global feature extraction of facial contour information and facial spatial distribution, and ignores the detail feature extraction such as texture, which makes a great contribution to facial expression recognition, resulting in low accuracy of facial expression recognition.

In order to solve the above problems of facial expression recognition, this paper proposes a multi branch structure expression recognition method. First of all, the multi branch network is designed. The backbone network uses resnet50, and the part after conv block 3 is divided into three branches. The structures of the three branches are similar, but the structures are different. After conv block 5, branch 2 and branch 3 divide the face into two parts and three parts longitudinally to extract local features. The first branch is used to extract global features of the human face. Finally, the weighted fusion of global and local features is input into the classifier for classification, and softmax loss is used to calculate the network loss in the loss layer.

II. Related Work

A. Facial Expression Recognition Process

Facial expression recognition is an important biometric recognition technology, which extracts the facial expression features from the detected face by computer, and classifies the facial expressions according to the way of human thinking, so as to realize automatic and intelligent human-computer interaction. According to the principle of facial expression recognition, the recognition process can be roughly divided into four steps: face detection, image preprocessing, feature extraction, expression classification. The specific process is shown in Fig. 1.

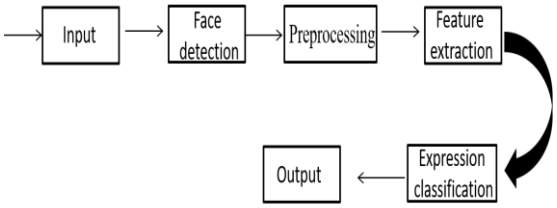

Fig. 1. Facial expression recognition process

Face detection is the use of computer knowledge in the detection area of the existing photos or facial features in the location, shape, size and other scanning detection to determine whether there is a face in the scanning area. If there is a face, the region where the face exists is extracted. For example, the mosaic method proposed by Yang *et al.* [1] establishes the gray distribution rules of the face region, and filters the qualified faces according to these rules. The subspace method proposed by Pentland *et al.* [2] [2] divides the space into principal subspace and secondary subspace. The principal subspace is used for face recognition, and the secondary subspace is used for face detection. The projection energy of the area to be detected in the statistical secondary subspace is calculated. The smaller the distance is, the greater the probability of face recognition is. R-CNN [3-4] uses the second-order algorithm. In the first stage, it uses the selective search method to generate a large number of candidate regions that may be the detection object. In the second stage, it uses the convolution neural network to identify whether these candidate regions have faces. MTCNN[5-6] is a second-order network for face detection, which is usually composed of p-net, R-Net and o-net. P-net is the recommendation network to generate candidate regions, R-Net is the perfection network to improve candidate regions, and o-net is the final output of face detection region.

Preprocessing is to input the detected image into the computer to reduce noise, eliminate interference and recover useful information. It usually includes image normalization and data enhancement. The main normalization operations are gray normalization, size normalization, pixel normalization and so on. Gray normalization is mainly used to compensate the illumination of the image to overcome the influence of illumination changes in image detection and improve the recognition efficiency. Size normalization is to adjust the image to a uniform size according to a certain proportion. Pixel normalization is to place the distribution of image pixels between 0-1, which makes it easier to converge in the subsequent network training process. Data enhancement can effectively alleviate the over fitting problem by changing the image spatial geometric position and image information while keeping the image content unchanged, generating new images and adding them to the expression database to expand the sample size. Data enhancement generally includes random clipping, random mirror, adding Gaussian noise to the original image, modifying the original image brightness, contrast, saturation, sharpness and other information, angle rotation, image radiation transformation and so on.

Feature extraction is to transform the facial features in images into numerical forms that can be recognized by a computer. According to the different extraction methods, it is usually divided into manual feature extraction and deep learning feature extraction. For example, lanitis *et al.* [7] analyzed a series of facial feature points, established deformable models of global parameters for seven facial expressions, and then compared the calculated position and shape of facial feature points with the models of seven facial expressions, so as to recognize facial expressions. Coote[8] proposed ASM based on the idea of statistics, and then added texture information to ASM to propose AAM. SIFT[9], LBP[10], HOG[11], Haar [12] are all classic texture feature-based extraction modes. Considering that the traditional face recognition research usually inputs the whole original image into the network model, which easily leads to the loss of important face information, such as uniform and regular texture, as well as the invariance of image illumination, occlusion, scaling, rotation and so on, some researchers try to use the manually extracted face features as input to solve this problem. For example, to improve the robustness of face recognition to illumination, LBP features of face are extracted and SIFT features of face are taken as input to improve the robustness of face pose[14]. According to the classic CNN architecture, some researches have performed good auxiliary modules to enhance the ability of network feature learning. For example, in view of the low inter class discrimination of expressions, inspired by the center loss, two variants are proposed: Island loss (regularized to increase the center distance between different classes), locality preserving loss (LP loss) (making the local group of each class compact) to assist softmax loss to obtain more expression features[15]. According to the experience and previous studies, it is shown that using the diversity and complementarity of different networks and effective integration methods to integrate multiple networks can also improve network performance. There are many ways to generate the diversity of networks. Different training data, different training methods, different preprocessing methods, different number of neurons and different network models can generate different networks. Wen Yuanmei *et al.* [16] divided the pooled feature map of pooling layer into two paths for convolution, extracted high-level features and low-level features of each layer, and then input them into the classifier for classification. The most commonly used integration method is to connect the features obtained from different network learning, and fuse them into a new feature to represent the image.

Expression classification is the last step in the whole process of facial expression recognition, and it is also the ultimate goal of expression recognition. It selects the appropriate classifier according to the extracted expression features, and divides the expression image into corresponding categories. Commonly used expression classification methods include SVM classification method, softmax classification method and so on. Lekdioui *et al.* [17] proposed a feature extraction method for the face region, and then used SVM for classification. Ollison[18] combines PCA and SVM in face recognition, which improves the accuracy of face recognition.

Researchers have also proposed improved SVM methods, such as combining k-nearest neighbor method with SVM, integrating the nearest neighbor information into the construction of SVM, and proposing SVM classifier based on local; or combining CSVMT model with SVM and tree module to solve the classification sub problem with lower algorithm complexity.

B. *Convolutional Neural Networks*

Convolutional neural network[19-26] is an improvement of artificial neural network. It is the most widely used network structure in the field of facial expression recognition. It mainly consists of three different structures: convolution layer, pooling layer and full connection layer, as shown in Fig. 2.

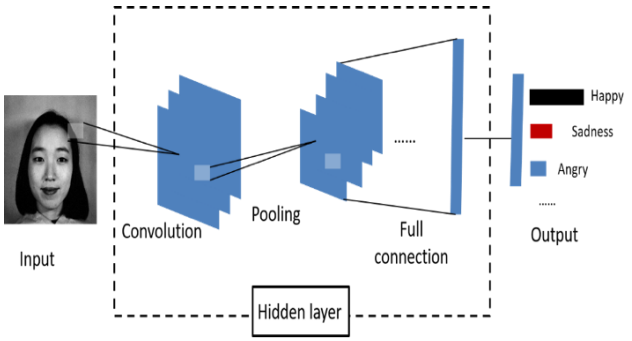

Fig. 2. Convolutional neural network structure.

Convolution layer is the key component of convolution neural network, which is usually directly connected with the input image. By processing the image pixel value, the input image is transformed into the form that the convolution network can understand, and then the image features are extracted and the feature map is output. Convolution layer parameters usually include convolution kernel size, step size and fill. By moving the fixed step size of the convolution kernel, the local features in the receptive field and the weight coefficients of the convolution kernel are summed and superimposed to obtain the convolution value of the local region. After moving, various specific types of activation feature graphs are generated.

According to the output feature map of the convolution layer, the pooling layer effectively reduces the size of the image, further reduces the number of parameters, speeds up the operation, and prevents over fitting. At the same time, the output sensitivity to displacement, tilt and other forms of deformation is reduced, and the generalization ability of the model is enhanced. Pooling layer can reduce the dimension of a feature and retain the original feature information.

After the data goes through the pooling layer, it will enter the next convolution layer, extract deeper features, and then pool again. This is repeated until a certain level of features are extracted. After feature extraction, it enters the full-connection layer. The fully connected layer is usually at the end of the network to ensure that all neurons in the layer are fully connected with the active neurons in the previous layer, and the 2D feature mapping can be converted into 1D feature mapping for further feature representation and classification.

III. Facial Expression Recognition Method Based on Multi Branch Structure

A. *Method Overview*

This paper proposes a multi-granularity facial expression recognition method. The network structure is shown in Fig. 3. The backbone network uses resnet50, and the part after conv block3 is divided into three branches. The parameters of each network layer are shown in TableI. The leftmost branch is called the global branch, which is used to extract global features. After the network layer of conv block 5, the convolution of stride = 2 is used for down sampling, and the global maximum pooling is used to generate 2048 dimensional eigenvectors of the obtained feature graph, which are compressed into 256 dimensional eigenvectors by 1 * 1 convolution. The middle (Part-2 branch) and right (Part-3 branch) branches are used to extract local features. Different from global branch, Part-2 is divided into two blocks and Part-3 is divided into three blocks without down sampling operation after conv block5. After segmentation, two maximally pooled feature vectors are used to generate 2048 dimension feature vectors, which are compressed into 256 dimension feature vectors by 1 * 1 convolution. Finally, three 256 dimensional global feature vectors and five 256 dimensional local feature vectors are concatenated to obtain a 2048 dimensional vector for expression recognition and classification.

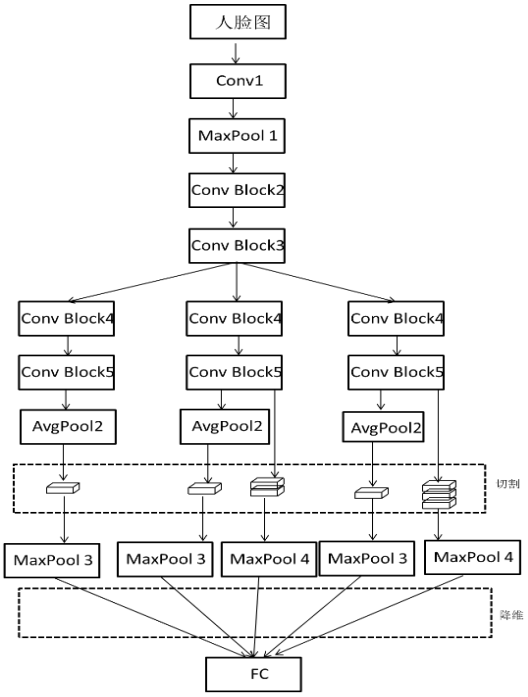

Fig. 3. Network structure diagram.

B. *Feature Fusion Method*

Feature fusion is a way of fusing different features extracted from the network to form a new target. The fusion of target

features is to combine the advantages of different feature extraction in order to achieve the purpose of complementary advantages. In this paper, the weighted fusion method is used to fuse the global and local features. As shown in the following formula 1, different features of the same position (i, j) and the same channel d are weighted and summed by setting the weighting coefficient α 。 Among them, the value of α is obtained by experimental verification, and different weight values are set for different features, which can better fuse different features and increase the accuracy of image classification.

$$z_d(i, j) = \alpha x_d(i, j) + (1-\alpha)\, y_d(i, j)$$

TABLE 1. NETWORK PARAMETERS OF EACH LAYER (1)

Network layer name	Nuclear parameters	Stride& Padding	Output size
Conv1	7*7	s=2,p=3	32*32*64
MaxPool 1	3*3	s=2,p=1	16*16*64
Conv Block2	[1*1 3*3 1*1] *3	[s=1,p=0 s=1,p=1 s=1,p=0] *3	16*16*256
Conv Block3	[1*1 3*3 1*1] *4	[s=1,p=0 s=2,p=1 s=1,p=0] [s=1,p=0 s=1,p=1 s=1,p=0] *3	8*8*512
Conv Block4	[1*1 3*3 1*1] *6	[s=1,p=0 s=2,p=1 s=1,p=0] [s=1,p=0 s=1,p=1 s=1,p=0] *5	4*4*1024
Conv Block5	[1*1 3*3 1*1] *3	[s=1,p=0 s=2,p=1 s=1,p=0] [s=1,p=0 s=1,p=1 s=1,p=0] *2	2*2*2048
AvgPool2	3*3	s=2,p=1	1*1*2048
MaxPool 3	1*1	-	1*1*2048
MaxPool 4	2*2	-	1*1*2048

C. Loss function

In our method, softmax loss is used to calculate the network loss. The principle of softmax loss function is to use cross entropy to calculate the loss function of the network, and use gradient descent algorithm for error back propagation to update the weight (w) and bias (b) of the network. So the loss function can be reduced as much as possible to increase the probability of the output target. As shown in the following formula 2, m represents the total number of input samples, n represents the number of categories, and w represents the network weight. $p\left\{y^i = j\right\}$ is used to calculate whether the real label and the output label are equal. If they are equal, then $p\left\{y^i = j\right\} = 1$; otherwise, the value is 0.

$$LOSS = -\frac{1}{m}\sum_{i=1}^{m}\left[\sum_{j=1}^{n} p\left\{y^i = j\right\}\log\frac{e^{w_j^T x^{(i)}}}{\sum_{z=1}^{n} e^{w_z^T x^{(i)}}}\right] \quad (2)$$

IV. Experimental Results and Analysis

All the experiments in this paper run on the system of Ubuntu 16.04. The CPU is Intel (R) core (TM) i5-7500, the hard disk is 1T, and the memory is 8GB. The multi branch network model designed in Section 3 is constructed and trained by using the deep learning tool of Python. The training parameters are shown in Table II. The whole test process is implemented in the Python language.

TABLE II. Training parameter setting of multi-granularity network in fer2013

Parameter	Parameter size
Learning rate	0.01
Batch_size	32
Momentum	0.9
Gamma	0.1
Weight_decay	0.0003
Decay_type	step
Lr_ decay	150

A. Database Designing

The Fer2013 database is introduced in ICML 2013 representative learning challenge, which contains 26190 images. All the images in the database are automatically collected by Google Image Search API. After correcting the wrong labels in the database, they are adjusted and cropped to 48 × 48 gray scale images, so the resolution of the images is relatively low. There were 7 expressions corresponding to the data tag 0-6:0 anger; 1 disgust; 2 fear; 3 happy; 4 sad; 5 surprised; 6 neutral.

B. Pre-Processing

This paper mainly uses pixel normalization to preprocess the image. After that, data enhancement techniques such as translation transformation, rotation transformation, mirror transformation and affine transformation are used to expand the sample size of the data set, which can effectively alleviate the over fitting problem in the training process of deep convolution neural network.

C. Experimental Results and Analysis

Fig. 4. Shows the confusion matrix of the method's expression recognition results on the fer2013 database. The diagonal of the confusion matrix is the average recognition rate of each expression, and the other results show the confusion degree with other expressions. It can be seen from the figure that the average recognition rate of this method on the fer2013 database is 74.1%. Among the seven expressions, the recognition accuracy of happiness and fear is 86.5% and 82.3% respectively, which is mainly due to the fact that the texture changes of these two expressions are more obvious than other expressions. In addition, it can be seen that the recognition of sadness and anger is more confused, and the probability of mistaking sadness into anger is 16.8%. The probability of false recognition of anger as sadness is 9.4%. Careful observation shows that the texture changes of the two expressions are similar near the forehead and eyes, and this part of the region is a greater contribution to expression recognition, which leads to the confusion between them.

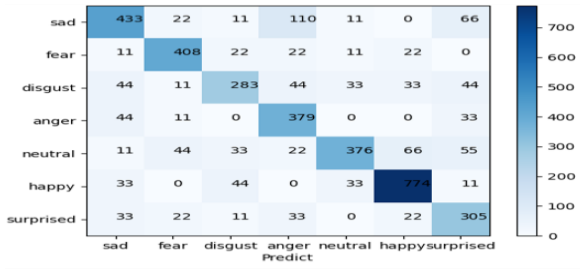

Fig. 4. Confusion matrix of multi branch network in fer2013 (73.7%).

In order to verify the effectiveness of the proposed algorithm, the proposed algorithm is compared with other algorithms on the fer2013 dataset. The results are shown in Table III. Liu *et al.* Trained three subnets with different structures respectively, and then combined the output of the subnets to make the integrated CNN pay more attention to face features.

Guo's neural network and relative learning learns the mapping from the original image to Euclidean space, where the relative distance correlates with the measurement of facial expression similarity. The model can update parameters according to the importance of samples Wang *et al.* Designed an architecture combining local and global information to extract different scale features from the middle layer, considering that the mouth, nose, eyes and eyebrows of the human face contain representative expression information. By comparison, it is found that the proposed method has an improvement of 0.88% - 8.67% compared with other algorithms, which fully proves that dividing the face into multiple granularities can effectively improve the accuracy of

facial expression recognition.

TABLE III. COMPARISON OF RECOGNITION ACCURACY OF DIFFERENT ALGORITHMS IN FER2013

Network Model	CK+(%)
Liu, *et al.* [27]	65.03
Guo, *et al.* [28]	71.33
Wang, *et al.* [29]	72.82
Our work	73.7

V. CONCLUSION

On the basis of previous studies, aiming at the low recognition rate in the traditional manual feature extraction process and the problem that deep convolution neural network only retains the global features of the face in the feature extraction process, ignores the local features, and loses some details of the face, this paper proposes a facial expression recognition method based on multi branch structure. Three branches are designed in the network. One global branch is used to extract the global features of the face. The two local branches are divided into different parts to extract the detailed features of the face respectively. Finally, the global features and local features are fused in the full connection layer and output to the classifier for classification. The experimental results on the fer2013 public dataset show that the proposed method shows good results and can improve the facial expression recognition rate.

Considering that facial expression recognition in the real environment is vulnerable to the interference of illumination, posture, occlusion and other external environment, the accuracy of facial expression recognition is greatly reduced. Therefore, in the future work, we can collect facial expression images in the real environment for training, so that facial expression recognition can be applied in the actual environment. In addition, the network structure proposed in this paper is mainly for the training of static face images, but in the real environment, it is usually necessary to recognize and classify a video or multiple faces in real time. Therefore, in the future, we can continue to optimize the network structure of this paper and further study the real-time recognition and classification of dynamic face sequences.

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Analysis of Texture Features of Normal Brain and Glioma in MRI Images

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***Abstract*—Brain is the most vital and complex part of the human body as it controls and co-ordinates each and every organ in our body. Any problem in brain leads to abnormal functioning of the body. One of the most common and life -threatening issue nowadays is brain tumor. Early diagnosis of brain tumor is mandatory because it may raise the survival chances of the patient. Due to the rapid increase in the numbers of cases in the past few decades it became difficult to detect brain tumor manually from MRI images as it is a tedious task and depend on the decision of Radiologist or Neurologist. To overcome the difficulties in manual segmentation and to maximum avoid human intervention in this work, we propose an automatic method of extracting various texture features of Glioma and normal brain in MRI images.**

***Index Terms*—Brain MRI, glioma, median filtering, watershed segmentation, texture features**

I. Introduction

Brain is a vital and complex organ in the body compared to all other organs. Human brain is the king of all other organs in the human body because it can control and co-ordinate each and every action in our body by sending chemical and electrical signals through a network of nerves called as nervous system. Any disturbances or disease affecting this complex organ leads to abnormality. Among the various problems to the brain, the most common and the life-threatening problem these days is the brain tumor. Every year, nearabout 11,000 persons are being diagnosed of the brain tumor [10].

A. Brain Tumor

Tumor is generally multiplication of cell in any part of the body in an abnormal manner. If the abnormal growth occurs inside the brain or skull, then it is labeled as brain tumor.

B. Classification of Brain Tumor

Brain tumor is generally categorized as 1) Primary brain tumor 2) Secondary or Metastatic brain tumor.

1. *Primary brain tumor:* A primary brain tumor is an abnormal development of cells that arise in the brain and does not spread to other parts of the body. It can be benign or malignant.
2. *Secondary brain Tumor: S*econdary brain tumors moreover called as Metastatic brain tumor, arise in some other parts of the human body as cancer and spread to the brain through blood stream.

C. Types of Brain Tumor

There are more than 120 types of brain tumors. Most common brain tumors include Gliomas, Epidermoid, Lymphoma, Pituitary adenoma, Craniopharyngioma, Meningioma, Neuroma, Pinealoma and Medulloblastoma [11].

1. *Glioma*

Gliomas are one of the foremost common sorts of brain tumor that arise in glial cells. Glial cells support nerve cells by supplying energy and nutrients and also help to maintain the blood-brain barrier. Gliomas are graded by WHO based on their cell activity and aggressiveness from a scale of I to IV. On this scale, benign tumors fall under Grade I & II, whereas malignant tumors fall under Grade III & IV. Grade I & II are low grade Glioma (LGG) and Grade III & IV are labeled as a high-grade Glioma (HGG). High grade Glioma like Glioblastoma (Grade IV) are lethal and can causes headaches, seizures, confusion, memory loss, muscle weakness, visual changes, language deficit, and cognitive changes [16].

D. Methods for Diagnosing Brain Tumor

Image testing of a brain tumor is done using x-rays, strong magnets or radioactive substances to create pictures of the brain [2]. Positron Emission Tomography (PET), Computer Tomography (CT), Angiogram, Myelogram and Magnetic Resonance Imaging (MRI) are some of the techniques which are used most often to detect brain diseases. These pictures are efficient to provide the primary information about the presence and location of a tumor [12].

1) *Magnetic Resonance Imaging (MRI)*

MRI is a technique which is based upon the excitation and discovery of the changes in the orientation of protons found in the H2O molecules that present in the living tissues, without any instruments introduced into the body. It employs powerful magnets for production of strong electromagnetic field that tends to arrange the protons within the body along with the H

field. At that point, protons in H2O are incited when a RF current is passed through the person and turn out of balance by opposing against the drag of the magnetic force [13]. MRI sensors measures the signals released by the protons when it reorients with the H field when RF is switched off. The time it takes for the protons to realign with the magnetic field, as well as the amount of energy released, changes depending on the environment and the chemical nature of the molecules [13] [22]. A computer interprets the pattern into a very detailed image describing our body parts. The scan uses a dye which is a contrast material called gadolinium that is injected into the patient's veins before the scan for better details [12].

2) *MRI Imaging Sequence*

For brain we use standard 4 sequences for accurate diagnosis. They are as follows [4]:

a. T1-weighted images
b. T2-weighted images
c. FLAIR
d. Postcontrast images

3) *Need for Magnetic Resonance Imaging*

MRI scams are preferred compared to other imaging techniques because [4]

a. MRI is non-invasive
b. MRI is cost-effective
c. Provides good contrast of tumors that are present in the brain
d. Acquisition time of MRI is less compared to PET and X-Ray
e. MRI provides better details of bone structure and organs behind them, like lungs behind ribs and brain beneath the skull.

E. Need for Brain Tumor Detection

Brain tumor is a matter of life and death. The detection of a brain tumor at an early stage helps in improving treatment and chances of survival. Any delay in the treatment and misdiagnosis leads to death.

Fig. 1. Detection of Glioma in MRI brain images.

II. Related Works

A survey of literature has been carried out in order to identify the research problem, formulate the objectives and determine the methodology and to evaluate the proposed solution of this research. It has been noticed that the literature pertaining to the chosen area of research are certainly large in number, however information on noise removal, segmentation, feature selection and classifiers of MRI brain images are focused. Some of the research works are given below.

Wentao wu et al [1], has proposed an automatic segmentation model by combining deep CNN network and SVM algorithm to detect glioma from input dataset. Deep

CNN is trained and predicted labels are obtained, which is further given as input to integrated SVM along with test images. Then deep CNN and SVM are connected in series to train deep learning classifier. Fusion of deep CNN and SVM produced good segmentation results than individual segmentation. Delay in calculation time is the only disadvantage here.

V.P. Gladis Pushpa Rathi et al [2], has proposed a Multiple kernel-based probabilistic clustering and deep learning classifier for tumor classification. Here median filter is used for de-noising input MRI images as it preserves edges while removing noise. After that segmentation is done using Multiple Kernel-based probabilistic clustering. Shape, texture and intensity features are extracted and significant features are selected by LDA. Deep learning classifier is used to detect tumor or non-tumor. They have achieved average performance metrics with no improvement in specificity.

Reza Azmi et al [3], proposed an Ensemble Semi-supervised frame-work for segmenting of brain MRI tissues. In this work, they have used two semi-supervised algorithms namely expectation filtering maximization and MCo_Training to increase segmentation accuracy. Then they used these classifiers together with graph-based semi-supervised classifier as component for the ensemble frame-work. Increase in computational time is the disadvantage of this work.

Praveena Pedapati et al [4], proposed feature extraction from tumor (glioma) using Histogram of oriented gradient (HOG) and classification of tumor is done by SVM. Performance analysis of SVM is done by receiver output characteristics (ROC). Using ROC they calculated accuracy, sensitivity and specificity values for all the medical images of the database. They used BRATS dataset for the proposed technique. The development environment used is MATLAB. High accuracy obtained for T1 modality of MRI images. Accuracy obtained is less for FLAIR and T1 contrast modality of MRI.

From the works of Anne Humeau-Heurtier [5] and Renu Bala [6] we get to know about various texture feature extraction methods. From the work proposed by Patrik Brynolfsson et al [8], we could able to know more about Haralick texture features.

Anam Mustaqeem et al [14], proposed an efficient algorithm for brain tumor detection using thresholding based and watershed segmentation. Threshold segmentation converts the preprocessed input gray scale image into binary format. Watershed segmentation groups pixels of an image on the basis of their intensities. Enhancement, sharpening and edge detection is done before applying Median filter is for denoising. Then the images are segmented using threshold & watershed algorithms and morphological operation are applied to separate tumor part of the image. This is easy for execution and the results obtained are efficient.

III. Proposed Methodology

The proposed method of detecting Glioma involves pre-processing, segmentation, feature extraction and finding significant features to train a classifier, as shown in Fig. 1.

A. Pre-Processing

Pre-processing is used for filtering the data and converting it into a pattern from which conditional standards can be extracted. Filtering belongs to one of the pre-processing steps used for modifying or enhancing an image. MRI image is affected by noises like salt and pepper noise, Gaussian noise, speckle noise and fractional Brownian motion noise (fBm noise) [17]. Salt and pepper noise is said to be most common in MRI images. In our proposed work the input MRI image is filtered using Gaussian and Median filter.

1. *Gaussian filter:* A Gaussian filter is known as a non-uniform low pass linear filter [20]. It is used in order to reduce noise or blur the *image*. It will blur edges and reduce contrast. Gaussian filters may not preserve image brightness [15].
2. *Median filter:* Median filter is a non-linear digital filter which is useful for eradicating noise from an image or signal. It preserves edges while removing noise [2] [3] [21] and produce better results compared to other filters.

The input MRI image is first added with 5% and 10% salt & pepper noise since it is common in MRI images and then both filters are applied to analyse their performance. This is done for 10 input MRI images and their mean PSNR and mean SNR values for both filters are calculated.

TABLE I. Mean PSNR value of Gaussian and median filtered images.

S.no	Mean PSNR in dB for 10 input MRI images		
	Filter type	For 5% salt and pepper noise	For 10% salt and pepper noise
1	Gaussian filter	20.98	17.88
2	Median filter	32.14	30.71

Obtained results are shown in Table I. From the obtained results we conclude that Median filter is more effective in removing salt & pepper noise than Gaussian filters as its mean PSNR value is higher compared to Gaussian filter. Gaussian filtering is used to separate noise and detail, but it is not particularly potent at eliminating salt and pepper noise and it also blurs edges and decreases the contrast. But Median filters preserve borders and eliminate only the noise. So, we decided to use Median filter instead of Gaussian filter in our proposed work.

B. Segmentation

Segmentation is the procedure of dividing an image into small segments or sets of pixels. It is used for object location and boundaries. In our work, segmentation is done using K means clustering and watershed segmentation. After segmentation we could able to differentiate lesion from normal brain tissue in the MRI brain images.

1. *K means clustering*: K-means clustering algorithm is an unsupervised algorithm which is used to segment the ROI *from* the background. It partitions the given data into K-clusters or *classes* based on the K-centroids. It is used for unlabeled data. The aim is to find certain class based on similarity in the data with the number of class represented by K. The main motive of K-means clustering is to reduce the sum of squared distances between all points and the cluster center [19]. The flow chart for k means is given in Fig. 2.
2. *Watershed segmentation:* Watershed transformation is a dominant tool in image segmentation which regards the image to be handled as a topographic surface. Watershed means area of land where all the water drains off it and goes into same place [7]. A watershed line is actually a boundary or border separating two catchment basins as shown in Fig. 3. When it rains, water will flow into the same lake when the water falls on either side of the watershed line. Relief map in watershed segmentation is actually a consideration of the gradient map of the image. Based on the varying pixel intensities, it groups pixels of an image or segments the image as dams. Pixels which fall under similar intensities are grouped together. The segmented region is named as catchment basins. Watershed segmentation is a good segmentation technique for separating the tumor from the input MRI images. The flow chart of watershed algorithm is shown in Fig. 4. The segmented output is analysed by comparing it with the ground truth. In our work, evaluation metrics like Jaccard Index and Dice coefficient are used to analyse the performance of both segmentation algorithms. Comparing the results of K means clustering and watershed algorithm from Table II, we could able to conclude that watershed algorithm has higher Jaccard index and dice coefficient. It also has better segmentation results compared to K means. Therefore, we go with watershed segmented results further for feature extraction.

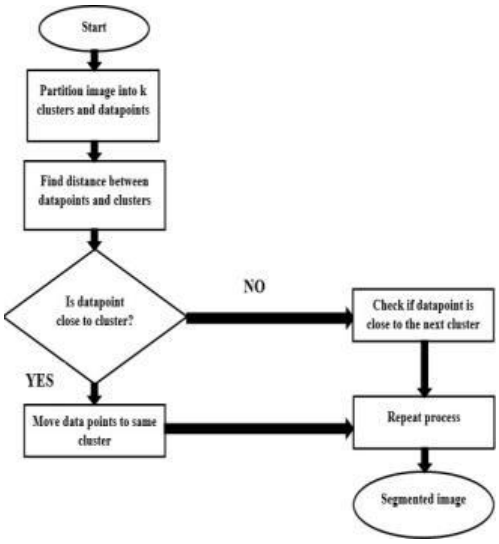

Fig. 2. Flow chart of K means clustering.

TABLE III. PERFORMANCE MEASURES OF SEGMENTATION.

S.no	Mean value for 14 input MRI images		
	Segmentation method	**Jaccard Index**	**Dice**
1	K means clustering	0.2315	0.3078
2	Watershed segmentation	0.7806	0.8668

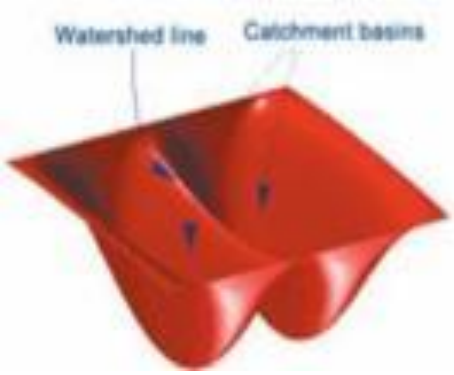

Fig. 3. Watershed segmentation simplified to two dimensions [7].

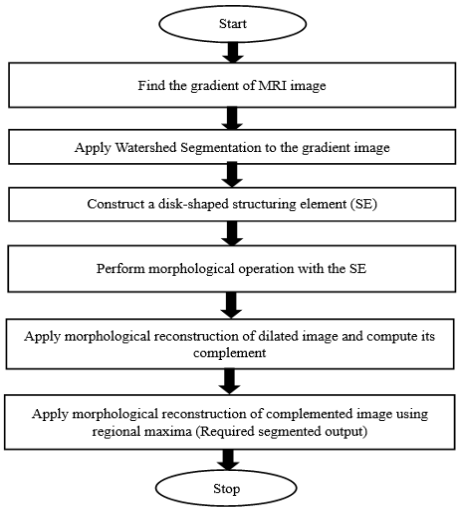

Fig. 4. Flow chart of Watershed segmentation.

C. Process Before Feature Extraction

Before doing feature extraction, pixel intensity information in the tumor region of the original image is passed on to the watershed segmented image. The original segmented image is a binary image, where the tumor region is white. By complementing the image, the white pixel (255) is converted to black pixel (0) and vice versa. Then the respective input MRI is added with the negative of the watershed segmented MRI image.

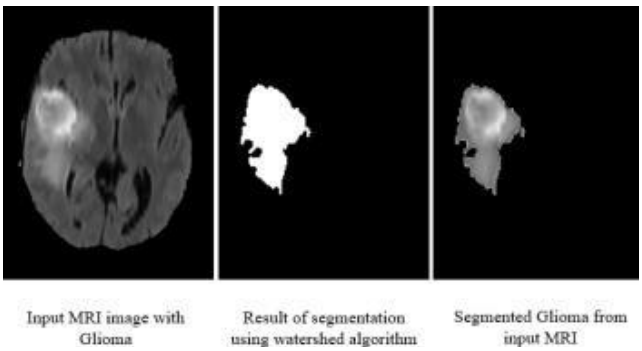

Fig. 5. Result of segmenting using Watershed Algorithm.

Now the information in the original MRI image is passed on to the segmented portion by making the pixel values in the segmented tumor region to be 0 (black). All the information in the corresponding region in the original MRI image will be added with 0 pixels in the segmented tumor region and rest all values outside the tumor region is added with 255 (white). Any values added with 0 will be the value itself and any value added with 255 will considered as 255 since it is the maximum value in a binary image. So finally, the added image will have pixel information in tumor area and remaining pixels outside the tumor area will be 255 i.e white. Then this white pixel area is further converted into black pixel. The final image obtained will have information about pixels in the tumor region surrounded by black pixel value which is 0 shown in Fig. 5.

D. Feature Extraction

Feature extraction is a dimensionality reducing method, in which, an starting set of the raw information is divided and diminished to more sensible groups which makes processing simple. Large data sets consist of a large number of variables which require a lot of computing resources to process. So, feature extraction helps to get the best features and to effectively reduce the amount of data.

1. *Texture feature:* In our work, texture features are extracted. Texture is the main term used to define objects or concepts of a given image. It can be defined as a function of spatial variation of the *brightness* intensity of the pixels. Texture features can be calculated using Statistical, Structural, Transform based, Model-based, Graph-based, Learning based and Entropy-based approaches [5].

2. *Statistical approach:* Of the different *approaches* for texture feature extraction, we have selected statistical approaches. For statistical approaches, the statistical properties of the spatial distribution of pixels/gray levels are used as texture descriptors [5]. Statistical features are of first order (one pixel), second order (two pixel), and higher order statistics (one or more pixels) [6]. Statistical texture analysis techniques describe texture of regions in an image through higher-order moments of their grayscale histograms [6].

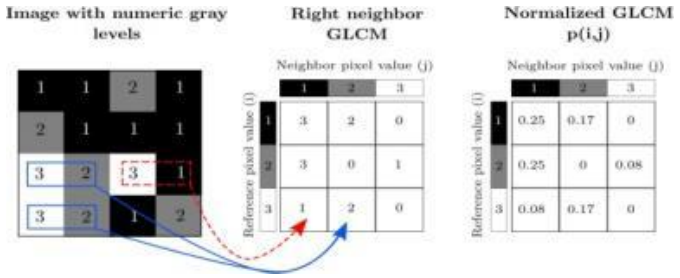

Fig. 6. Illustration of how Haralick texture features are computed [8] [18].

GLCM: The gray level co-occurrence matrix approach (GLCM), or spatial gray level dependence matrix (SGLDM), is a second order statistical approach where the number of rows and columns give rise to the number of gray levels, G, within the image. Haralick texture features obtained from a gray level co-occurrence matrix (GLCM) is a most common way for represent texture of an image, as it is simple for implement and results obtained is a set of interpretable texture descriptors.

Figure 6 is an illustration of how GLCM calculates the features (texture). GLCM counts every single pairs of gray levels that occur in the image. For each pixel, its value and its adjacent pixel value are counted in a particular GLCM element. The value of the reference pixel decides the column of the GLCM and the nearby value decides the row of the GLCM. In this region of interest, there are two cases in which a reference pixel '3' coexist with an adjacent pixel '2' (highlighted in blue), and there is one case of a reference pixel '3' with an adjacent pixel '1' (highlighted in red) [18]. The normalized symmetrical GLCM reveal the approximate value of every combination that happen within the image. The texture features obtained from normalized symmetrical GLCM are associated functions of it, in which unique feature of the gray-level dispense is represented in region of interest. For example, diagonal components in the GLCM represent pixels pairs with equal gray-level [8] [18].

TABLE III. FEATURES AND FORMULA [8] [9]

S.no	Features	Expression
1	Autocorrelation	$\sum_{i=1}^{N}\sum_{j=1}^{N}(i.j)p(i,j)$
2	Contrast	$\sum_{i=1}^{N}\sum_{j=1}^{N}(i-j)^2 p(i,j)$
3	Correlation	$\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{(i.j)p(i,j)-\mu_x\mu_y}{\sigma_x\sigma_y}$
4	Cluster Prominence	$\sum_{i=1}^{N}\sum_{j=1}^{N}(i+j-\mu_x-\mu_y)^4 p(i,j)$
5	Cluster Shade	$\sum_{i=1}^{N}\sum_{j=1}^{N}(i+j-\mu_x-\mu_y)^3 p(i,j)$
6	Dissimilarity	$\sum_{i=1}^{N}\sum_{j=1}^{N}\lvert i-j\rvert.p(i,j)$
7	Energy	$\sum_{i=1}^{N}\sum_{j=1}^{N}p(i,j)^2$
8	Entropy	$-\sum_{i=1}^{N}\sum_{j=1}^{N}p(i,j)\log p(i.j)$
9	Homogeneity 1	$\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{p(i.j)}{1+\lvert i-j\rvert}$
10	Homogeneity 2	$\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{p(i.j)}{1+\lvert i-j\rvert^2}$
11	Maximum Probability	$\max_{i,j} p(i,j)$
12	Sum of squares	$\sum_{i=1}^{N}\sum_{j=1}^{N}(i-\mu)^2 p(i,j)$
13	Sum average	$\sum_{k=2}^{2N} kP_{x+y}(k)$
14	Sum variance	$\sum_{k=2}^{2N}(k-\mu_{x+y})^2 P_{x+y}(k)$
15	Sum entropy	$-\sum_{k=2}^{2N}P_{x+y}(k)\log\left(P_{x+y}(k)\right)$
16	Difference Variance	$\sum_{k=0}^{N-1}(k-\mu_{x-y})^2 P_{x-y}(k)$
17	Difference entropy	$-\sum_{k=0}^{N-1}P_{x-y}(k)\log\left(P_{x-y}(k)\right)$
18	Inverse difference normalized	$\sum_{k=0}^{N-1}\frac{p_{x-y}(k)}{1+\left(\frac{k}{N}\right)}$
19	Inverse difference moment normalized	$\sum_{k=0}^{N-1}\frac{p_{x-y}(k)}{1+\left(\frac{k^2}{N^2}\right)}$
20	Information measures of correlation 1	$\frac{HXY-HXY1}{max(HX,HY)}$
21	Information measures of correlation 2	$\sqrt{1-exp[-2(HXY2-HXY)]}$

Texture analysis using GLCM: The texture-context detail or data is indicated by the matrix of relative incidence Pij with two adjacent pixels segregated based on a distance d with gray levels i & j present in the image. Matrices of reliable frequencies obtained from spatial gray level are symmetric and has angular relationship function among the adjacent pixels inclusive of the range or distance function among them.

Here twenty-one texture features are calculated using GLCM. GLCM distinguishes the image's texture by evaluating how many times the set of pixels with same values occurs and it also evaluates certain spatial link that occurs within an image. This makes the Gray Level Co-occurrence Matrix, after which the statistical estimates from the GLCM are brought out. In our work, twenty-one texture features are calculated and are presented in detail in table III.

In table III, p(i, j) is the normalized co-occurrence matrix, N is the total amount of discrete levels of intensities present in the image, px(i) and py(i) is the marginal row and column probabilities, HX and HY is the entropies of px and py and HXY is the entropy of p(i, j) [9].

From GLCM, we obtain 2 values for each feature. One is minimum value of the feature and another value is the maximum value of the feature. Table IV gives the detail about the mean for minimum and maximum value of various texture features obtained from 10 normal MRI brain image and 10 MRI brain images with tumor and their respective p value which is calculated by using two-tailed test.

If p value of any feature is lesser than 0.05 then the feature is considered to be significant. If the p value is greater than 0.05 then it is considered insignificant. From table IV, we can conclude that autocorrelation, contrast, cluster prominence, cluster shade, sum of square (variance), sum average, sum variance, difference variance and inverse difference moment normalized has p value less than 0.05 for both their minimum and maximum value and considered significant. For dissimilarity, p value is less than 0.05 for its maximum and considered significant. Similarly for minimum value of Information measures of correlation 1, p value is less than 0.05 and considered significant. Apart from these features rest all considered as insignificant. The p value of significant features is highlighted in table IV. The significant features are further given to train a classifier in order to detect Glioma in MRI images.

IV. Conclusions and Future Work

Brain tumor is a crucial issue nowadays. Early diagnosis of brain tumor will give raise to the survival chances of the patients. Due to the rapid increase in the numbers of cases in the past few decades it became difficult to detect brain tumor manually from MRI images as it is a tedious task and depend on the decision of Radiologist or Neurologist. In the present work, we proceeded with filtering images using both Median and Gaussian filter and we choose median filter to remove the noise in MRI, since it gave higher PSNR than Gaussian filter. Then we choose to segment filtered MRI images using watershed algorithm since it gave higher value of performance metrics than K means clustering. Then texture features are extracted from the segmented image and significant features are chosen based on their respective p value. Our future work is to extend our proposed methodology by training a classifier using the significant features obtained in order to detect Glioma in MRI images with high accuracy.

TABLE IV. Mean and P value of texture features for 14 MRI images of Normal Brain and with Tumor.

Name of the features	Mean for Minimum values		P value	Mean for Maximum value		P value
	Normal Brain MRI image	MRI Brain Image with tumor		Normal Brain MRI image	MRI Brain Image with tumor	
Autocorrelation	1.15E+01	2.32E+01	**0.003265552**	1.16E+01	2.35E+01	**0.00272064**
Contrast	5.91E-01	1.67E+00	**0.001811808**	6.81E-01	2.08E+00	**0.000589149**
Correlation	6.14E-01	5.74E-01	0.608201090	6.76E-01	6.76E-01	0.995392850
Cluster Prominence	6.45E+01	4.26E+02	**0.034583695**	7.03E+01	4.85E+02	**0.017096807**
Cluster Shade	1.38E+00	-2.56E+01	**0.008958356**	1.84E+00	-2.10E+01	**0.012876285**
Dissimilarity	3.49E-01	4.51E-01	0.088887560	3.83E-01	5.56E-01	**0.015380962**
Energy	2.95E-01	3.01E-01	0.921817286	3.02E-01	3.17E-01	0.812693194
Entropy	1.85E+00	1.73E+00	0.568840426	1.89E+00	1.81E+00	0.715565565
Homogeneity 1	8.42E-01	8.46E-01	0.860141175	8.53E-01	8.72E-01	0.330746581
Homogeneity 2	8.35E-01	8.34E-01	0.973815223	8.47E-01	8.63E-01	0.420037477
Maximum probability	4.98E-01	4.60E-01	0.55585807	5.05E-01	4.71E-01	0.604641928
Sum of squares: Variance	1.17E+01	2.40E+01	**0.002447759**	1.18E+01	2.43E+01	**0.002298486**
Sum average	6.49E+00	8.88E+00	**0.004993891**	6.50E+00	8.94E+00	**0.004845168**
Sum variance	2.88E+01	6.97E+01	**0.002244285**	2.89E+01	7.08E+01	**0.001827627**
Sum entropy	1.52E+00	1.53E+00	0.985691976	1.54E+00	1.55E+00	0.909219602
Difference variance	5.91E-01	1.67E+00	**0.001811808**	6.81E-01	2.08E+00	**0.000589149**
Difference entropy	7.41E-01	7.16E-01	0.713536477	7.86E-01	8.22E-01	0.622660492
Information measure of correlation1	-3.24E-01	-4.14E-01	**0.028765533**	-2.84E-01	-3.40E-01	0.192255539
Information measure of correlation2	6.72E-01	7.05E-01	0.525269971	7.07E-01	7.56E-01	0.303462499
Inverse difference normalized (INN)	9.60E-01	9.51E-01	0.121271402	9.64E-01	9.60E-01	0.489481848
Inverse difference moment normalized	9.91E-01	9.77E-01	**0.000640327**	9.92E-01	9.81E-01	**0.001962181**

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Data Visualization Tool for AI Orange – A Contextual Study

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***Abstract*—The paper, while giving the outline of the idea, defines the Open-Source Software (OSS) for machine learning and elucidates the denotation of the term OSS, giving a few of the explanations, the distinctive standings used to illustrate it. ORANGE - a current machine learning Open-Source Software investigation with these structures, claims, and updates. Orange is an all-purpose machine learning and data mining and machine learning suite. The paper extra highlights the future of the OSS and accomplishes with a valuation of extensively used OSS related to machine learning.**

***Index Terms*–Free open-source software (FOSS), machine learning, orange.**

I. Introduction

Information mining, additionally called Information Disclosure in Data sets (KDD), in the field of finding novel and conceivably valuable data from a lot of information. Open-source AI, subsequently, can include the utilization of open-source programming in achieving different AI objectives and practices. An organization may utilize AI strategies on information the organization produces concerning marketing projections throughout a specific timeframe to refine that crude information into more useable and more apparent data[1].

For machine specialists, ORANGE gives an adaptable stage to improving new information investigation calculations through Python prearranging. It offers a versatile component-based graphical UI that features visual programming and a high degree of intelligence for data miners. Orange gadgets are basic blocks that can be put together employing visual programming to design unique data exploration applications that fit one's needs. Gadgets convey, pass tokens that incorporate the information, property records, models, and so forth to one another, and frequently permit intelligent determination of information subsets that are gone to different gadgets for additional analysis.[2]

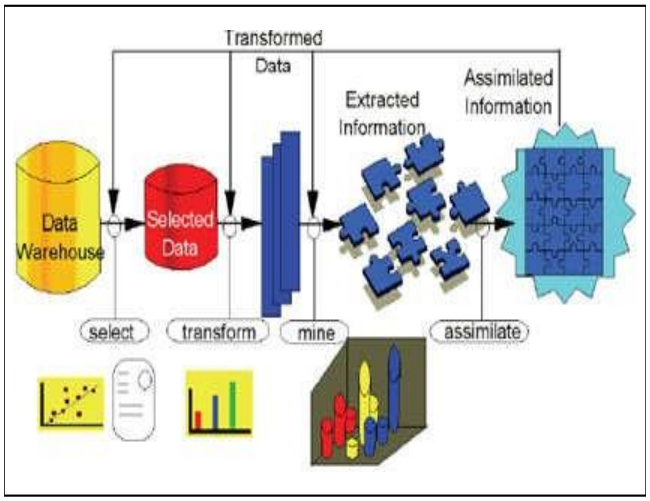

Fig. 1. Machine learning process.

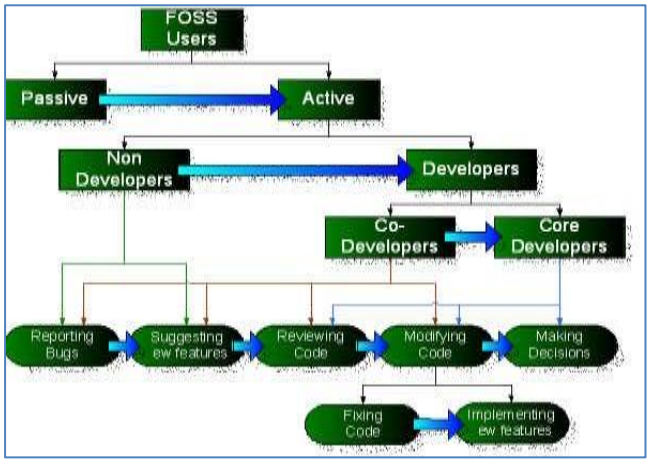

Fig. 2. FOSS Schema.

OSS are PC programs in which the source code is made accessible to the overall population for use and additionally alteration from its unique plan for nothing, for example, open. Open-source programs are regularly made as a communitarian exertion in which software engineers offer the client adaptability of utilization and offer the progressions within the community[9,12].

A certificate standard is given by the Open Source Drive that shows that the source code of a PC program is made accessible for nothing to the overall population. The Reasoning for this development is that a more significant gathering of software engineers not worried about restrictive possession or monetary profit will deliver a more valuable and bug-free item for everybody to utilize. The concept relies on peer review to find and eliminate bugs in the program code [7], and interactions that commercially developed and packaged programs don't use. Software engineers on the Web read it reallocate, and change the source code, driving a catalyst development of the item. The way toward wiping out bugs and improving the product occurs faster rate as the data is shared through the local open-source area[4,6,14].

A. OSS has numerous qualities. The significant ones are:

- It is by and largely obtained openly
- Manufacturer or engineer has no option to guarantee sovereignty on the conveyance or use.
- Source code is available to the client and conveyed with the product.
- No refusal to an individual or to a gathering to get to the source code of the product
- It has the arrangement of adjustments and deductions under the program's unique name.
- Rights of offices joined to the program should not rely upon the program's by and a large piece of a specific programming dispersion.
- Licensed programming can't put a limitation on another programming that is circulated with it.
- Distribution of Permit ought not to be explicit to a product and License should be innovation neutral, etc.
- Data Mining Tools:
- **Orange:** An information mining instrument that is helpful for visual programming and explorative information investigation. It tends to been written in Python. Orange, various parts are known as gadgets. This information mining device upholds macOS, Windows, and Linux.
- **Weka:** Weka is an AI information mining instrument written in Java. It contains Representation and analysis. Weka has an extensive assortment of pre-processing.
- R: R is likewise an information mining instrument and open source. R has been utilized in measurable figuring. It executes a wide assortment of factual and graphical strategies such as direct and nonlinear Information Mining device acts as deciphered language.
- Rapid Miner: A information mining device, It created on an open center model. Primarily Fast excavator utilizes the customer/worker model. It has been performed extraction, change and information preparing tasks information and displaying
- Knime: Knime(Konstanz Data Digger) is an open-source information mining apparatus.
- Data Melt: Data Melt is a structure for logical calculation and multiplatform also, written in Java. It is an open-source information mining tool.

II. Open-Source Machine Learning

Open-source AI can allude to a couple of various things; however, it commonly shows either the utilization of open-source programming in AI or utilizing AI to comprehend open-source programs more readily. Open-source AI can likewise include utilizing AI programming on open source programs to more readily understand the code used to make those programs.[5] The expression "open source" in open source AI alludes to programming created and delivered under some general use or public License. The utilization of open-source AI programming is genuinely primary because of the number of open-source programs that are very viable for mining information. Nonetheless, these projects should be utilized dependably, as there might be laws in specific spaces directing how data can be mined and used. [5,13]

Open-source AI can likewise allude to the utilization of AI programming to get data about another program. AI techniques can be utilized to discover source code and other data about a program, which may bring about legitimate infringement when performed on business programming. Since open-source programs are normally made under a general population permit, AI on such programming should be possible lawfully. [5,10]

III. About Orange

Orange is a segment-based AI and AI programming suite that highlights amicable yet amazing, quick, and adaptable visual programming front-end for explorative information examination and perception and Python ties and libraries for prearranging. It contains a total arrangement of information preprocessing segments, including scoring and sifting, demonstrating, model assessment, and investigation methods. Its graphical UI depends on a cross-stage Qt system.

Orange, AI Productive and Fun is an open-source segment-based AI and AI programming suite. Orange highlights simple to utilize yet impressive and adaptable visual programming front-end for explorative information investigation and perception, and prearranging interface in Python, giving direct admittance to all its force for quick programming of new calculations and creating complex information examination strategies. Being created at the

Bioinformatics Lab at the Workforce of PC and Data Science, College of Ljubljana, Slovenia, along with open source local area, is effectively utilized in research, consolidating bleeding-edge apparatuses and methods continually advancing. Orange backings C4.5, Partner, Retis, and tab-delimited (local Orange) information formats.[3]

IV. Features of Orange

A. Visual Programming and visualization

The information investigation measure is planned through visual programming. Orange recollects utilize decisions, recommend most often used mixes, and insightfully pick which correspondence channels between gadgets to utilize.

Orange is loaded with various perceptions, from dissipating plots, bar outlines, trees to dendrograms, organizations, and warmth maps. In its graphical climate called Orange Canvas, the client places gadgets on a material and interfaces them into a pattern. Every gadget plays out some fundamental capacity.

Fig. 3. Orange canvas outlook1.

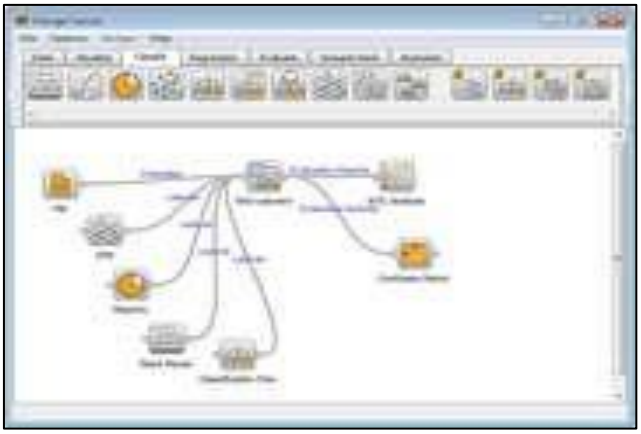

Fig. 4. Orange canvas outlook2.

B. Interaction and Information Examination and Larger Tool Compartment

Fig. 4. Orange Material Outlook2 Activities flawlessly proliferate through information investigation patterns. Determination of information subset in one gadget can naturally trigger differences in the show in the other one. By joining different devices, the information investigation structure can be planned for the client's decision.

More than 100 gadgets are accessible are as yet developing. It additionally covers a large portion of the standard information investigation undertakings. Likewise, specific additional items are accessible, as Bio orange for bioinformatics.

C. Scripting Interface and Extendable

With the prearranging interface in Python, programming new calculations and creating complex information examination methods is unadulterated happiness, utilizing and reusing all force found in visual programming and then some.

Own gadgets, expand prearranging interface can be created, or even own additional independent items can be grown, all consistently coordinating with the remainder of Orange, permitting segments and code reuse.

D. Open Source and Platform Independence

Orange is open source with a dynamic local area. We can openly peruse and get to the source code, expand and reuse it, take part in its turn of events while the local area offers the help, direction, and thoughts.

It runs on Windows, Mac OS X, and a variety of Linux operating systems.[3]

Fig. 5. Screenshot of naive bayesian nomogram.

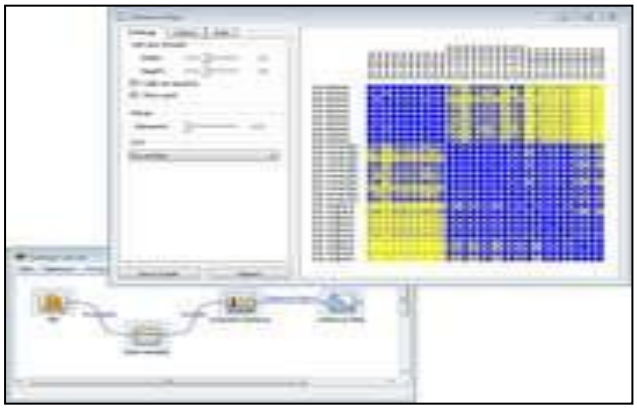

Fig. 6. Screenshot of distance map.

V. ORANGE WIDGETS

Orange Widgets are parts of Orange's visual programming climate. They are coverings around some information investigation code that give graphical UI (GUI). The widgets can peruse information from detailed tab-delimited or comma-isolated records, just as documents in C4.5 organization and Weka's.arrf documents. Gadgets are characterized in a Python record. Widgets are accessible in Orange in the accompanying category.[3,4-6] . They are stated and explained as follows

- Visualize
- Classify
- Regression
- Evaluate
- Associate
- Unsupervised

Orange executes APRIORI calculation (see Agrawal et al., Quick revelation of affiliation governs, a part in Advances in information disclosure and AI, 1996); Orange incorporates an upgraded rendition of the calculation that deals with basic information). [3,11]

While the center Orange gives instruments to assess the importance of characteristics that depict characterized occurrences, a module called Orange .feature .selection provides capacities and coverings that highlight subset selection.[3]

Building gathering classifiers in Orange is straightforward and straightforward. Beginning from students/classifiers that can anticipate probabilities and, if necessary, use model loads, gatherings are coverings that can total expectations from a rundown of built classifiers. These coverings act precisely like other Orange students / classifiers.[3]

Information discretization is a method that takes an informational collection and converts all ceaseless qualities to unmitigated. As such, it discretizes the nonstop ascribes. Orange's center backings three discretization strategies: first utilizing equivalent width stretches (Orange. EquiDistDiscretization), second using equivalent recurrence spans (Orange.EquiNDiscretization), and class-mindful discretization as presented by Fayyad &Irani (AAAI92) that utilizations MDL and entropy to track down the best remove focuses (Orange.EntropyDiscretization). The discretization strategies are conjured by calling a preprocessor mandate orange.Preprocessor_discretize, which takes an informational collection and discretization strategy and returns an informational index with any persistent quality being discretized.[3,6,8]

A. Build Your Student in Orange

Fostering your students in Python makes prototyping of new techniques quick and pleasant. There are various approaches to fabricate students/classifiers in Python. Particular to Orange students is the way how they are conjured and what they return. For instance, say that we have a Student (), which is some student in Orange. The student can be brought in two unique manners:

Student = Student() Classifier = Learner(data)

In the primary line, the student is summoned without the informational collection, and all things considered, it should return an occurrence of the student, to such an extent that later you may say classifier = learner(data) or you may call some approval technique with a student itself (say orngEval.CrossValidation ([learner], information)). In the subsequent line, the student is called with the information and returns a classifier.

Classifiers ought to be called with an information case to order and should return either class esteem (by default), probability of classes, or both:

```
esteem = classifier (case)
esteem = classifier (case, orange.GetValue)
Probabilities = classifier (case, orange.GetProbabilities)
        esteem, probabilities = classifier (case,
        orange.GetBoth)
```

B. New in Orange

- Partial least squares relapse

Fractional least-squares relapse is a relapse procedure that upholds different reaction factors. PLS relapse is well known in territories, such as bioinformatics, chemo measurements, and so forth. The quantity of perceptions is generally not exactly the number of estimated factors and multicollinearity among the indicator factors. In such circumstances, standard relapse procedures would typically come up short. The PLS relapse is currently accessible in Orange.

- Orange 2.5a2 Accessible

Orange 2.5a2 has been transferred to PyPI. It presently incorporates fundamental help for multi-name characterization, some new gadget symbols, and documentation for crate design. Delivery is additionally labeled on Piece container storehouse.

- New Orange Symbols

As new and new gadgets with recent highlights are added to Orange, symbols for them must be drawn. More often than not, those are only some speedy outlines or, in any event, missing out and out. However, presently we are beginning to redraw and bind together with them. A couple of them have effectively been made.

- Earth - Multivariate Versatile Relapse Splines

One of the few augmentations to the setup of Orange is Orange.regression.earth.EarthLearner. It is an Orange interface to the Earth library composed by Stephen Milborrow executing Multivariate versatile relapse splines.

- Orange 2.5: code change

Orange 2.5 brings together Orange's C++ center and Python modules into a solitary module progressive system. To utilize

the new module advanced system, import Orange rather than orange and going with orng* modules.

- Random woods changes to Straightforward tree student of course

Arbitrary woods classifiers presently use Orange.classification.tree.SimpleTreeLearner naturally, which extensively abbreviates their development times.

- Debian bundles support numerous Python forms now

Debian bundles are made for different Python forms. This implies that they work now with both Python 2.6 and 2.7 out of the container, or arrange them physically, with any (upheld) rendition we have introduced on our (Debian-based) framework.

- 3D Perceptions in Orange

A 3D plotting library is intended for new 3D representation as far as the Programming interface to the new Qt plotting library.

The library utilizes OpenGL 2/3: since Khronos expostulated portions of the old OpenGL Programming interface, care has been taken to use just abilities less inclined to disappear in the years to come. All the drawing is finished using shaders; math information is taken care of to design equipment using Vertex Cushions. The library is convenient under OpenGL 2.0; when gear upholds fresher adaptations (3+) [3].

TABLE I. COMPARISON OF TOOLS WITH PARAMETERS [11].

Features/ Parameters of Data Mining tools	**Data Mining Tools**					
	Orange	***Weka***	***R***	***Rapid Miner***	***Knime***	***Data Melt***
Open Source	yes	yes	yes	yes	yes	yes
Data Visualization and Analysis	yes	yes	no	yes	no	yes
Interaction and Data Analysis	yes	yes	no	yes	yes	yes
Large Toolbox	yes	no	no	yes	yes	no
Scripting Interface	yes	yes	yes	no	yes	yes
Platform Independence	yes	yes	yes	yes	no	no

VI. CONCLUSION

State-of-the-art open-source machine learning suites of today have come a long way from where they were only a decade ago. They offer excellent graphical interfaces, focus on usability and interactivity, support extensibility through augmentation of the source code, or (better) through interfaces for add-on modules. They provide flexibility through either visual programming within graphical user interfaces or prototyping by way of scripting languages. Major toolboxes are well documented and use forums or discussion groups for user support and exchange of ideas. Besides friendliness and simplicity of use, Orange's strong points are a large number of different visualizations of data and models, including the intelligent search for good visualizations and support of exploratory data analysis through interaction. The A user can select a subset of examples in visualization, in a model, or with an explicit filter, and pass them to, for instance, a model inducer or another visualization widget that can show them as a significant subset of the data. Orange is weak in classical statistics; although it can compute the data's basic statistical properties, it provides no widgets for statistical testing. The computationally intensive parts of Orange are written in Cþþ. In contrast, the upper layers are developed in Python's scripting language, allowing advanced users to supplement the existing suite with their algorithms or with routines from Python's extensive scientific library.

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Image Dehazing by Using Laplacian Approach with Contrast Adjustment

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***Abstract*—The underwater image processing area has received considerable attention within the last decades showing important achievements. Due to the complex underwater environment, there are problems such as poor light, low contrast, and color degradation. Dehazing method has been specifically developed for the underwater environment.These techniques are capable of extending the range of underwater imaging, improving image contrast and resolution. A dehazing algorithm based on the difference structure preservation prior, which can estimate the optimal transmission map and restore the actual scene. In order to rectify the color distortion, the restoration images were equalized by using the histogram equalization. Experiments show that compared with other underwater image processing methods, this method greatly improves the clarity of the image, enhances the color saturation the image and has a better visual effect. Final enhanced result on synthetic and real under-water images demonstrate the superiority of the proposed method, which out performs nondeep and deep learning methods in both qualitative and quantitative evaluations. Furthermore, we perform an ablation study to show the contributions of each component and carry out application tests to further demonstrate the effectiveness of he proposed method.**

I. INTRODUCTION

Underwater images are hampered by poor contrast, color change, suspended and floating particles. Particularly with cameras mounted on ROV and AUV systems has widespread in civil and military applications. The processing and analysis of underwater images is nontrivial in ocean engineering and many other scientific applications. The quality of underwater images is important in many applications such as inspection of plants; Sea based exploration, search of wrecks up to the exploration of natural sources and geological and biological fields. The broad issue in ocean engineering is acquiring the clear images in underwater environment. Capturing of underwater images is a great challenging task compared to terrestrial images, because of the haze caused by light that is reflected from the surface and is deflected and also diverted by several water particles. Different wave lengths of light cause various degrees of attenuation and the most visible color in the water is blue. Subsequently, with light scattering and deviation of color leads to the contrast loss in the captured images.

Images collected underneath fog, haze, and different weather usually suffer from low distinction, unclear scenes, and huge color errors, that area unit vulnerable to adversely have an effect on the applying of laptop vision algorithms like target detection and linguistics segmentation. Therefore, the strategy of dehazing a single-image directly while not victimisation any a priori data is of nice significance to the sphere of laptop vision. At present, the quality dehazing strategies are often divided into 3 in keeping with completely different principles: first off, image sweetening techniques. These strategies focus primarily on the distinction of the image itself and different data. Secondly, image restoration strategies area unit supported the standard physics models; these strategies area unit primarily through a priori information and physics models to finish the dehazing operation. third neural network-based dehazing strategies primarily use neural networks to finish the haze feature extraction, thereby finishing the dehazing method. Image sweetening may be a technique, accustomed increase the standard of a picture by increasing the intensity levels of the image or components of the image in order that the resultant image ought to be clearer compared to the captured image and thus used for show or any image analysis.

II. EXISTING SYSTEM

The recurrent gradient descent network (RGDN) that serves as an optimizer to deconvolute images. The components of the network are inspired by the key components of gradient descent method and designed accordingly. The proposed RGDN implicitly learns a prior and tunes adaptive parameters through the CNN components of the gradient generator.

A. Problem Definition

- Conventional methods are often sensitive to the parameter settings and may be computationally expensive.
- It is difficult for them to reconstruct realistic high-frequency details due to the lack of prior knowledge of natural images.

III. PROPOSEDSYSTEM

In the proposed system we used to improve the visibility of images, early researchers use the traditional techniques of

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image processing. Based on the learned cross domain relations, the proposed method can remove color distortion by using dehazing method. We proposed a dehazing algorithm based on the difference structure preservation prior, which can estimate the optimal transmission map and restore the actual scene. The method of image contrast enhancement on the basis of the contrast distribution at the boundaries of objects and background on the image is proposed.

A. *Advantages of Proposed System:*

- The image will be clearly visible by using the enhancement technique.
- Accuracy is high.
- The dehazing algorithms in imreducehaze follow five steps:
- Estimate the atmospheric light L using a dark channel prior.
- Estimate the transmission map T.
- Refine the estimated transmission map.
- Restore the image.
- Perform optional contrast enhancement.

IV. ARCHITECTURE

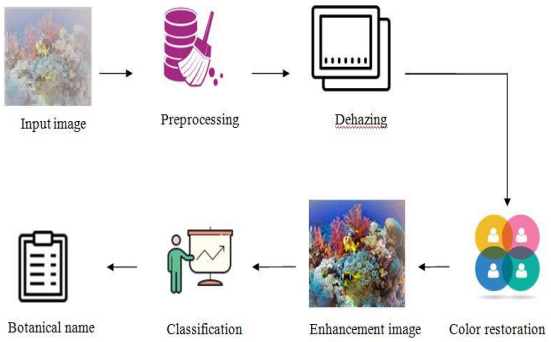

Fig. 1. Architecture.

A. *Preprocessing*

Images are represented as arrays consisting of pixel values.8-bit images have pixel values ranging from 0 to 255.Not all of our images are at the same size we need them to be,so it's important to properly resize an image.so that we can avoid time delay which is due to different size of an input image. Resize the image to a new width and height.To make the image scale proportionally,use 300 as row value.for instance,to make column of an image use 300 as the value and the resize command is denoted as (300x300).

Command to Read image: R=imread(fp);
figure,imshow(R);
Command to Resize image: I=imresize(R,[300 300]);
figure,imshow(I);

B. *Normalization*

Image that there are few pixels having very minimal intensity in any one of the color channel. These pixels are called dark pixels. Dehazing algorithm is used to eliminate some blocky effect. Laplacian method under dehazing algorithm is used to create patches on the fog effect of the image and locate the area using patches in which pixels to be enhanced. Image is utilized for restoration of foggy image so that dehazing is estimated accurately. This method removes the negative frequency of the image,so that we can obtain the same color of the input image as outcome.

To make dark channel:

[image_x image_y channels]=size(I)
p1=padarray(p,[floor(patch_size)/2)floor(patch_size)/2)],'symmetric')

DEHAZING :

It relies upon statistical assumption torecovers the scene information based on the proceeding information from a single image.Dehazing is accomplished through the following steps:

- **Transmission map estimation**-Estimated transmission map from input haze image is roughly good.It contains some blocky effect because transmission is not always constant in a patch.
- **Image restoration**-This method minimizes haze from image without removing important parts such as edged,lines or other detail which is useful for knowing of an image**.**
- **Atmospheric light**-Atmospheric light estimation is calculated by dark channel prior with fixed patch size.

C. *Enhancement & Classification*

It is an actual method that minimizes haze from image without removing important parts such as edges,lines or other details which are useful for the knowing of the image.This is followed by grouping of pixels, where clustering is done to increase the high resolution pixels. At this stage, the image pixels are converted back to RGB color model and pixels highlighted to a certain level.By using the neural network botanical name of the plant is classified with the database created.

Enhancement method:

A=color_estimate(I,J,numBrightestPixels)

D. *Dark Channel Prior*

This technique is actually useful for single image dehazing. It is used to measure the statistics of the outdoor fog free image. Imagine that there are few pixels having very minimal intensity in any one of the color channel. These pixels are called dark pixels. These dark pixels are used to calculate the transmission map. Transmission map is used to eliminate some blocky effect. Single image is utilized for restoration of foggy image so that Transmission map is estimated accurately. Basically, the minimum intensity in such a patch need to have very minimum value.

E. Deep Neural Network (DNN)

Neural networks are typically organized in layers. Layers are made up of a number of interconnected 'nodes' which contain an 'activation function'. Patterns are presented to the network via the 'input layer', which communicates to one or more 'hidden layers' where the actual processing is done via a system of weighted 'connections'. The hidden layers then link to an 'output layer' where the answer is output as shown in the graphic below.

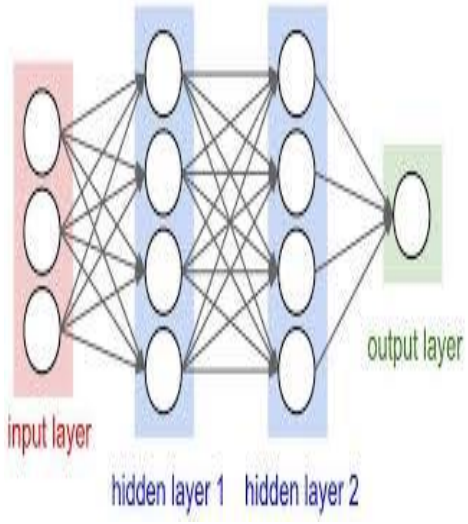

Fig. 2. Neural network.

1) Use of neural networks:

Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer "what if" questions. Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organization: An NN can create its own organization or representation of the information it receives during learning time.
3. Real Time Operation: NN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
4. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage.

2) Train the network:

Once the network weights and biases are initialized, the network is ready for training. The multilayer feed forward network can be trained for function approximation (nonlinear regression) or pattern recognition. The training process requires a set of examples of proper network behavior network inputs p and target outputs t. The process of training a neural network involves tuning the values of the weights and biases of the network to optimize network performance, as defined by the network performance function net. The default performance function for feed forward networks is mean square error mse—the average squared error between the networks outputs and the target outputs t. It is defined as follows:

$$F = mse = \frac{1}{N}\sum_{i=1}^{N}(e_i)^2 = \frac{1}{N}\sum_{i=1}^{N}(t_i - a_i)^2$$

There are two different ways in which training can be implemented: incremental mode and batch mode. In incremental mode, the gradient is computed and the weights are updated after each input is applied to the network. In batch mode, all the inputs in the training set are applied to the network before the weights are updated. This topic describes batch mode training with the train command. Incremental training with the adapt command is discussed in Incremental Training with adapt. For most problems, when using the Neural Network Toolbox™ software, batch training is significantly faster and produces smaller errors than incremental training. For training multilayer feed forward networks, any standard numerical optimization algorithm can be used to optimize the performance function, but there are a few key ones that have shown excellent performance for neural network training. These optimization methods use either the gradient of the network performance with respect to the network weights, or the Jacobian of the network errors with respect to the weights. The gradient and the Jacobian are calculated using a technique called the back propagation algorithm, which involves performing computations backward through the network.

V. Conclusion

The deep neural network based underwater image enhancement network is designed. When the system is trained, it is able to correctly dehaze the images in real time with only a still raw image as input. The results shows that the system is able to generalize and learn to dehaze with images from a location.The method of image contrast enhancement on the basis of the contrast distribution at the boundaries of objects and background of the image is proposed.By using the neural network finally the botonical name of the plant is displayed with the database created.

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Weather Prediction Using Machine Learning

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***Abstract*—The activities of most sectors rely upon the climate. The environment is changing at an exceptional rate these days, which makes the old forecast strategies less powerful. To foresee the climate, a model is proposed, which combines data preparing, sensors, Arduino, GPS,GSM and machine learning to provide real-time weather monitoring and accomplish climate figures through prescient models valuable for individuals to know the climate conditions constantly.**

***Index Terms*—Weather prediction, machine learning, Arduino, GPS, GSM, random forest**

I. Introduction

Weather plays a vital role in people's lives. It is a key factor for agriculture [4]. Through weather monitoring, investigation of the past information and forecasting can be performed to give valuable climate data. Old climate determining strategies depended on noticing an example of occasions, which was likewise called pattern acknowledgment, to beat these troubles, the improved and solid climate expectation techniques are required [3]. So, this is when the modern technology comes into play for prediction.

Machine Learning is a core sub area of incredible form of artificial intelligence which is being used in various industries. Machine learning is an automatic learning of a machine to give profoundly precise prescient or classifier model, or discovering obscure examples in information, via preparing and testing information utilizing certain calculations [2]. Generally, a dataset is first gathered, cleaned and made easy to understand and afterward the dataset is typically parted into a few subsets. These subsets are utilized for preparing and testing of the classifier model. Once these datasets are made, a prescient model or classifier is utilized for preparing information, and afterward the model's prescient precision is determined utilizing the test data.

Machine learning use calculations to consequently display and discover designs in inputted data, with an aim to predict a target output by bringing a relation between the variables. Algorithms like Linear Regression [2], Decision Tree algorithm, KNN algorithm, Random Forest are compared, and the best algorithm is chosen for evaluation and prediction.

Arduino is an instrument which is both equipment and programming which is an open-source registering stage reliant upon a fundamental miniature regulator board, and an IDE for creating programming for the board. Arduino is used to make various undertakings, taking commitments from a grouping of sensors, and controlling a grouping of lights, motors, also, gives real yields. Arduino is used freely, or with programming running on your PC.

II. Related Work (Literature Survey)

A. Weather Prediction Using Normal Equation Method and Linear regression Techniques

One of the significant deterrents that climate determining faces is the inappropriate assumptions from the nature. Climate determining falls under prescient mining which points on the investigation of the information, assessing the data set, and predicts the highlights of mysterious information.

This exploration recommends and proposes a productive and exact climate forecast utilizing linear regression and normal equation model. In this paper it is demonstrated that the gradient method is inadmissible for anticipating dew point, though results delivered by the normal equation technique are profoundly solid[1]. This paper demonstrates the proficiency of the normal equation.

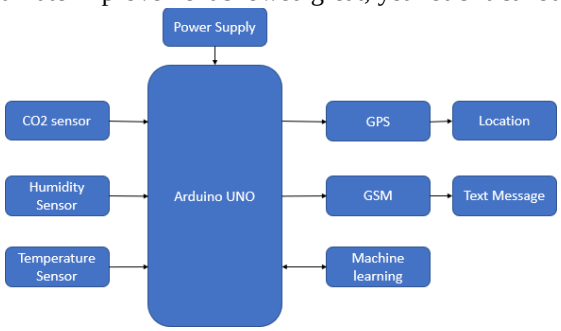
B. Temperature Predictio Using Machine Learning Approaches

The advanced environment deciding methodologies incorporate a mix of computational models, discernment and good data on environment examples and models. Among all environment inputs, temperature precipitations have some level of importance due to its application in agribusiness and industry region. Acclaimed mathematical models for the estimates are MLR, ANN and SVM [2]. By considering the blunders and the relationship coefficient it is inferred that among the proposed approaches MLR is a more definite than ANN and SVM.

C. Use of Genetic Algorithms in Numerical Weather Prediction

Studies show that the actual definition affectability regarding blunders assessing distinctive climate circumstances and conditions proposes that for each climate type or occasion, an alternate arrangement of setups could be more appropriate. This paper explores the utilization of hereditary calculations related to the WRF - Weather Research and Forecast mathematical climate expectation framework to improve the estimate of two significant barometric boundaries: 2-meter

temperature and relative humidity. Genetic algorithm utilized in relative humidity gauge performed great while the ones started for the temperature didn't give huge outcomes. Results reasoned that calculations started to advance the overall stickiness figure performed great in every one of the three cases dissected, while the ones started for the 460-temperature estimate improvement showed great, yet not critical outcomes.



D. Future Weather Prediction Using Genetic Algorithm and FFT for Smart Farming

procedure.

Availability and quality of previous weather data sets is not very good. Despite the high accuracy the time required for the prediction is more because the time required for cleaning and evaluation is more .In order to solve this problem machine learning model random forest is applied to the data for prediction.

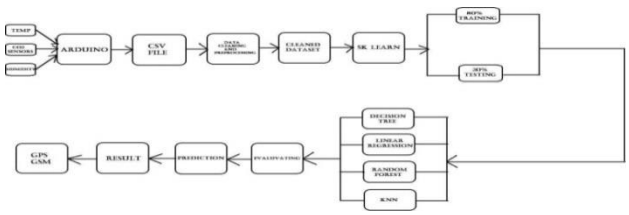


Fig. 1. Framework.

III. PROPOSED SYSTEM

The main target of this model is to obtain a relevant dataset, compare the efficiency of linear regression, random forest, decision, KNN algorithms and to send the predicted result to a concerned authority using GPS and GSM. The attributes in the dataset such as temperature, CO2, moisture is collected in real-time over a specific area. Then the data collected is converted into .csv dataset file which is the pre-processed to make it user friendly.

The below figure is the block diagram of the proposed system:

To assist the farmers with improving the nature of agrarian products and services by reducing speculation cost by recommendation of best appropriate yield as per current or anticipated climate. Additionally, crop harm Alert is given from chronicled information so ranchers can make a suitable move. The conjecture of the climate occasions helps for appropriate arranging of ranch utilizing Genetic calculation and FFT approach. It will help in settling on different choices identified with crop examples and water the board. It would significantly assist with improving efficiency of yields.

A. Data Collection

Fig. 2. Block diagram.

IV. METHODOLOGY

V. PROBLEM STATETMENT

As far as estimating, since there are numerous elements that influence climate transforms, it is trying to anticipate the climate precisely. Gathering past information and applying information mining methods to anticipate climate is a complex

Created a dataset with attributes such as temperature, CO2, moisture, prediction, events. The attributes temperature, co2, moisture have been collected in real- time over a specific area. For the collection of these attributes' sensors have been used. The sensors are configured with the Arduino. The values which has been obtained is logged into a .csv file using Tera Term software.

A. Data Pre-Processing

Datasets, immense and little, go with a collection of issues-invalid fields, missing and additional characteristics, and characteristics that in exceptional corresponding to the one we need. To convey it to a helpful or coordinated construction, we need to clean the data, and make it arranged to use.

The below figure shows the events in the dataset after the dataset has been preprocessed and cleaned:

Fig. 3. Weather events in a dataset.

B. Applying Machine Learning Algorithms to the Dataset

Once the data is cleaned, in this module that cleaned data can be used as an input to our Machine learning algorithms. Libraries like NumPy, pandas, Matplotlib. pyplot, and Scikit-learn has been used. The dataset is split into training data (80 percent) and testing data (20 percent) for the algorithms.

We have used the below four algorithms to compare: i. Linear Regression ii. Decision Tree algorithm iii.KNN algorithm

VI. RANDOM FOREST

A. Evaluating the Algorithms

Using the Scikit- learn library the accuracy of the algorithms is obtained. It is noted that the accuracy of the Linear regression is 20%, Decision Tree algorithm is 78%, KNN algorithm is 73% and Random forest is at 82%.

TABLE I. COMPARISON OF DIFFERENT ALGORITHMS.

S.No	Algorithm	Accuracy
1	Linear Regression	0.2001
2	Decision Tree	0.7830
3	KNN	0.7311
4	Random Forest	0.8254

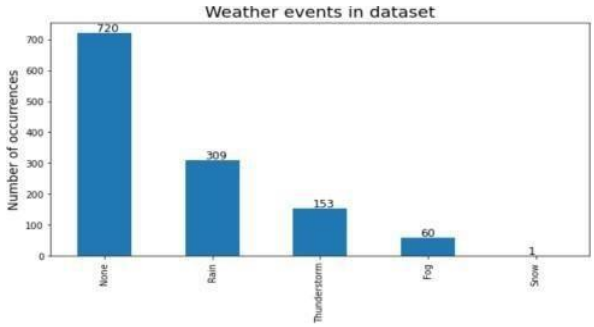
B. Prediction

Since the Random Forest has the highest accuracy, this modal has been used for the weather prediction. Thunderstorm, Rain, Snow and Fog can be predicted.

C. Integration of GPS and GSM

The predicted results are configured to the Arduino and the GPS and GSM has been integrated with the Arduino UNO. With the assistance of GPS, the area of user location where the information is to be analyzed is obtained. And with GSM a message of the location and the temperature prediction is sent to the concerned authority.

VII. Conclusion and Future Scope



The target of this work is to build up an ease, solid, and proficient climate gauging application utilizing the machine learning models in Python on Arduino utilizing GPS and GSM.

In the future scope, the model will be extended for various other inputs and most importantly the aim is to Increase the accuracy of the predicted value and with help of studying about movement of the jet stream and the way it affects the climatic conditions, along with nearby pressure factor variations help in improvement of the prediction.

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Improved Navigation and Positioning Using Machine Learning

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***Abstract*—The main aim is to improve the navigation structure. The Google Maps application currently on the Playstore doesn't have any option to to view any bumper or pothole location on the road. The aim is achieved by making a database, that stores the data of the location along with the data of smartphone's Inertial Measurement Unit (IMU) sensors, and this data, using the Artificial Intelligence (AI) algorithm is used to mark a position on the maps to show the uncertainty which is present at that location. Tests are done on the Matlab filter model and real- time data extraction from sensors and feeding to the database. The results show that our database is giving stable outputs with an efficacy of 92% to detect the uncertainty, hence improving and adding a feature to the navigation and positioning.**

Index Terms–

I. INTRODUCTION

The Main focus of the project is to improve the navigation system of roads in India by having a detailed and updated information of the irregularities present on the road to the user.

The project aims to detect the potholes, bumpers and other irregularities on the road which can lead to problems for the user by degrading the road safety which also damages the vehicle in the long run.

The project provides timely updates of the road quality to the local road maintenance authorities which was prior done manually and hence reduces the man power and the time consumption caused to undertake certain checks.

The project is easily affordable for the public as major functioning of the project can be completed using a smartphone which is used by the public daily.

No external circuitry is used as most of the data collection is completed on cloud based servers which updates in real-time. Some of the earlier work on this concept have been done which are more on based on the hardware and filters approach. Our project brings a strict software based approach which uses algorithms for decision making and Simulink logic model for filtering the data for the database.

Currently, any navigation and positioning application on any platform does not feature the presentation of condition of the roads. The cloud database that is made by us, shows the real time updates on the road incline.

This project is a truly innovative concept that uses Artificial Intelligence (AI) for better navigation and positioning. The more the past data stored on the database from the past users, the better it will be able to detect the uncertainties information. Road safety is the major concern for all the travelers and sometimes it become nightmare for the travelers while

travelling on very uncertain roads.

Our project is to enhance the detection of road quality maintenance which will indirectly enhance the quality of roads, which will finally improve road safety.

Application based on our database will also help in better accuracy in the navigation and positioning of a user on the map.

This database is also used to keep a check on the road quality, and it is used for comparing the current data to the past data on the database to get better navigation.

In the present scenario, most of the apps for helping in better navigation and positioning doesn't display enough data for the road inclination. This can risk people's lives and hence decrease road safety. Even the most used application for navigation that is Google Maps does not have the feature to show any bumpers or potholes on the map. Our project brings a new Artificial Intelligence (AI) based approach to get this information of the inclination of the road. The Artificial Intelligence (AI) algorithm is used to make assumptions based on past data.

The problem of Navigation and Positioning is solved by detecting the real- time incline of the road. This incline is detected by Inertial Measurement Unit (IMU) sensors present on the smartphone which contain accelerometers and gyroscopes. These sensors are used to make a 3D mapped data of the road according to the subsection.

The raw data from the sensors is passed onto the Simulink model for filtering out the dampness caused by the vehicle suspension systems. The Global Positioning System (GPS) data is also be extracted from the Global Positioning System (GPS) sensor in terms of latitude and longitude. Then this filtered data along with the Global Positioning System (GPS) data is stored on the database [3].

The old data is the data from the database which already has the information of the road incline and its position on the road. During the working of this project, this old data is compared to the new data that we are getting from the sensors currently. Then, our Artificial Intelligence (AI) algorithm decides the information for the incline of the road. This decision output is then saved for future decision enhancement. The more the data, the better the decision.

A. Literature Survey

The literature survey is based mostly on the integration part between the hardware and software parts of navigation and positioning systems.

Kichun Jo, Real-Time Road-Slope Estimation Based on Integration of Onboard Sensors With GPS Using an IMMPDA Filter, Integration of the 3D mapped data and the older data saved on database [6].

Jingbin Liu, Accelerometer assisted robust wireless signal positioning based on a hidden Markov model, Accelerometer assisted robust wireless signal positioning based on a hidden Markov model [7].

Miaoxin Ji, Vehicle dynamic model-based integrated navigation system for land vehicles, Structuring the Positioning data to the 3D mapped road information and Kalman filter [8].

V.M. Vasyliev, Integration of inertial and satellite navigation systems with using corrective circuits and filtering, Improving the accuracy and reliability of positioning systems [9].

The Objective is to create a database which contains the 3D incline map of a road, subsection wise according to the location and further to use this database to perform described applications.

II. METHODOLOGY

The raw data will be extracted from the IMU sensors present in the smartphone. IMU sensor is integrated by a three-axis accelerometer sensor and a three-axis gyroscope sensor. The main data for our project comes from the Z axis which represents the vertical trajectory i.e. the height of the car at the specific time. Y axis represents the forward trajectory when a car is on road and X axis represents the lane of the road on which the car is currently present. The Z axis data is fed to our Simulink Model for filtering the dampness caused by the suspensions present on the vehicle.

The Simulink model uses an Integrated Inverse K Square filter with a feedback loop to decrease the dampness error caused in the sensor's data.

At the same time, the Global Positioning System (GPS) sensor present in the smartphone is used to get the real-time latitude and longitude updates from the smartphone. The data output from the Simulink model which is Z-axis data of the accelerometer, the vector addition of the X-axis and Y-axis of

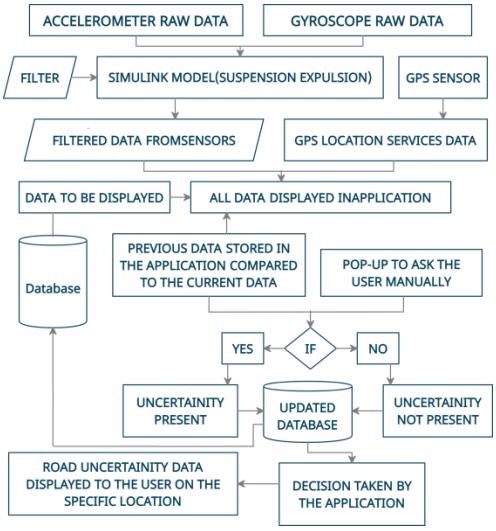


Fig. 1. System architecture.

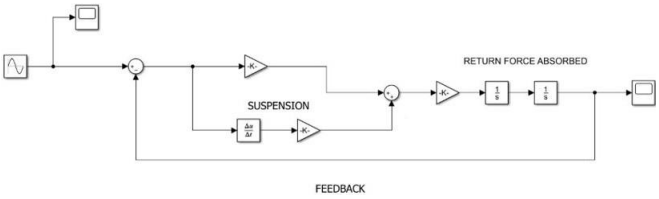


Fig. 2. Simulink model.

the gyroscope and the Global Positioning System (GPS) data are all saved to a database along with the decision made by our Artificial Intelligence (AI) Algorithm. Its important to note that this project will only start working during a second use as the first time it gathers the data. During working of the project, i.e. the second time, the current latitude and longitude data are compared to the old first use data and hence the correct location of the road incline information can presented to the user for accident avoidance [5].

A. Hardware

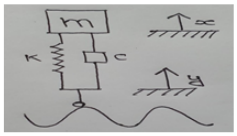
The Inertial Measurement Unit (IMU) sensor name used in the smartphone that is used in the test cases is ICM 4x6xx. It has an integrated three-axis accelerometer and three- axis gyroscope with an additional three-axis magnetometer. It also has Global Positioning System (GPS) sensor which has a resolution of 0.483 m. Combination of these sensors are enough to perform some test cases. Presence of these sensors are necessary for the project to work.

The prime data for our project comes from the Z-axis which represents the vertical trajectory i.e. the height of the car at the specific time. Assuming the smartphone is in the vehicle and the top part of the phone is facing the front of car, Y- axis represents the advancing trajectory when a car is on road and X-axis represents the lane of the road on which the car is currently moving. The Z-axis data is fed to our Simulink

Algorithm Model for filtering the dampness caused by the suspensions present on the vehicle [2].

The mathematical equation used in our Simulink model has a mass of the average of the currently commercial vehicles present. Hence variable M is subject to change in future. This equation adds dampness to a moving object, similar to the suspensions which also add dampness to the moving vehicle and makes the ride smooth. Hence, we will be using the inverse of this model to remove to dampness.

$$x = \frac{1}{m}\{k\{y - x\} + c\{\dot{y} - \dot{x}\}\}$$



x = output
m = mass
k = spring constant
y = original curve of the road
x = output curve from gyroscope and accelerometer
$\dot{y}$ = change in output curve of the road
$\dot{x}$ = change in output curve from gyroscope and accelerometer
c = constant

Fig. 3. Mathematical equation.

Here the difference of Y and X represents the change in z axis raw data extracted directly from the tires and the difference of Y bar and X bar represents the change in z axis data which is fed to our Simulink model. The difference between the two is the result of the dampness caused by the vehicle suspensions [1].

There are different type of suspension present on different kind of vehicles. Each suspension is designed according to weight and maximum speed of the vehicle. Suspension is present to decrease the spontaneous changes on the road called jerks experienced by the users.

Due to the suspensions, the vehicle barely follows the trajectory of the road. The dampness caused by these suspensions are enough to add errors to our road. Hence we are using the Simulink model to decrease the dampness.

As we can see in the figure The test case for our dampness reduction algorithm. The ripples created by the suspension of the vehicle is reduced to a cutting edge pothole.

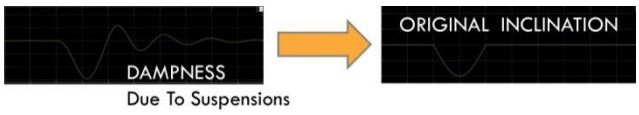


Fig. 4. Dampness reduction algorithm.

Without using the algorithm, the sensors will detect multiple potholes and bumpers which will give multiple errors to the Artificial Intelligence (AI) algorithm and the whole system will crash. This will increase the data to be stored on the cloud database rapidly which will ultimately increase the total budget of the project.

B. Software

This is the Android application we have developed for our major. We have me made it using Flutter framework that uses dart programming language. It extracts the gyroscope and accelerometer data from the smartphone and sends it to the Simulink model for filtering the data and then to the cloud database.

It also extracts the Global Positioning System (GPS) data and feeds it to the Google Maps API system for location and positioning in real-time on the maps.

The old data on the database will be compared to the new data coming to the cloud to show the user a proper information of the road condition ahead.

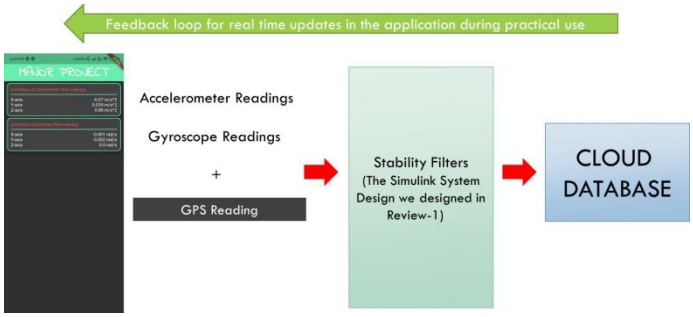


Fig. 5. Application methodology.

The feedback loop will be used to accomplish this comparison.

Google Maps API is an application programming interface that uses google cloud based servers to distribute the google maps data or to use it. The API key is used to use the Google Maps.

The Google Maps API is used in the code to get the latitude and longitude data from Global Positioning System (GPS) sensors.

Cloud computing is used to store, modify, view or use the data stored on an online storage called cloud.

This project uses online Microsoft Excel database to store the data and to feed it when the AI algorithm requests for it to make assumptions. [4].

For this project the best suitable algorithm will be K-NN Algorithm.

Both classification and regression problems can be solved using this algorithm. All the old cases are stored and the new ones are classified by taking a its k neighbors' majority vote. The class or classes with which it has the most in common among its k nearest neighbours, the case is then assigned to those class.

In Our project, k neighbors will be the data stored earlier. A decision class will be made using these k neighbors for the application, to conclude a proper decision.

Each new case added to the database, will make decision made by the algorithm better. The more the data for the specific location, the better its outcome of detecting the uncertainty.

III. Experimental Setup

For this project an experimental setup according to both hardware and software along with their integration is made. For the hardware, the smartphone model used is Redmi K20 Pro With ICM 4x6xx sensor which is a 3-axis accelerometer,

gyroscope and magnetometer.

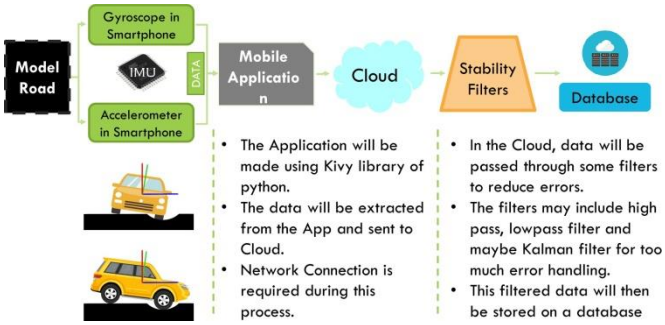


Fig. 6. Working model.

For the software part, the raw data from these sensors is showed on the application and feed to the Simulink model for filtering. The data from the model is stored on the data base and fed further to the AI Algorithm for the assumptions on the road incline that can be sowed to the user in future.

IV. Results and Discussions

The results show that our database is giving stable outputs with an efficacy of 78 - 92 percent to detect the uncertainty, hence improving and adding a feature to the navigation and positioning.

A. *Test Cases*

Fig. 7. Simulink test case 1.

1. *Test Case 1*: This is the test case for single bumper on the road as crest. As we can see our Simulink model is successful in decreasing the dampness caused by the suspensions.
2. *Test Case 2*: This is the test case for single pothole on the road as trough. As we can see our Simulink model is successful in reducing the dampness caused by the suspensions.
3. *Test Case 3*: This is the test case for series of bumpers and potholes on the road as crests and troughs. As we can see our Simulink model is successful in decreasing the oscillations caused by the suspensions.

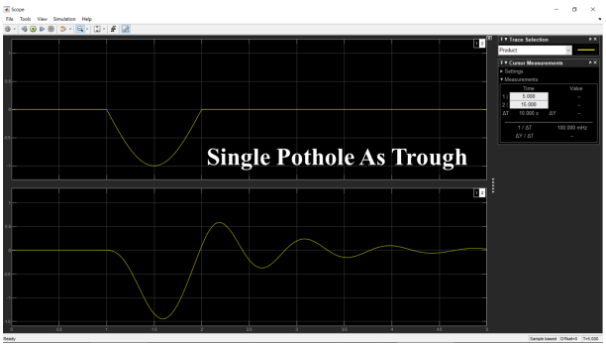


Fig. 8. Simulink test case 2.

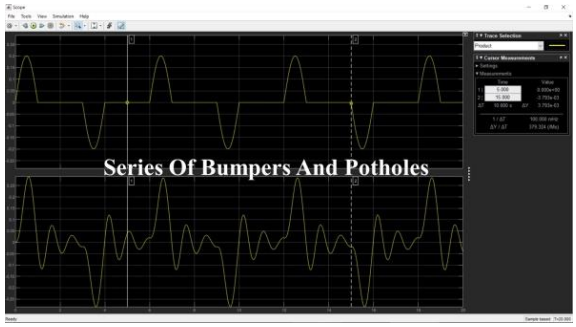


Fig. 9. Simulink test case 3.

4. *Test Case 4:* This is the test case for series of sharp bumpers and *potholes* on the road as crests and troughs. As we can see our Simulink algorithm is successful in decreasing the oscillations caused by the suspensions.
5. *Test Case 5:* This is the test case for continuous bumpers and potholes on the road as crests and troughs more like a sine wave. As we can see our Simulink model is successful in decreasing the oscillations caused by the suspensions.
6. *Database Test Case:* The data stored on the data base will be showed here.

The decision made by our Artificial Intelligence (AI) Algorithm will also be shown here.

Below is the small sample of data taken on 100 m road.

The Algorithm is successfully detecting the uncertainties on the road and mapping it to the specified location.

B. *Discussions*

The range of 78 - 92 in the result is present, because we tested it 4 times on the same road of 100m. As we have discussed, the more the past data our Artificial Intelligence (AI) model have, the better the output of the algorithm. The First test case output is to add the data to the database first so it will not be taken into account while measuring the data. The 2nd, 3rd and 4th test cases have assumption percentages of 78.63, 84.28 and 92.39 respectively. Hence we can see that the decision made by the AI algorithm is drastically improving with the increase in data.

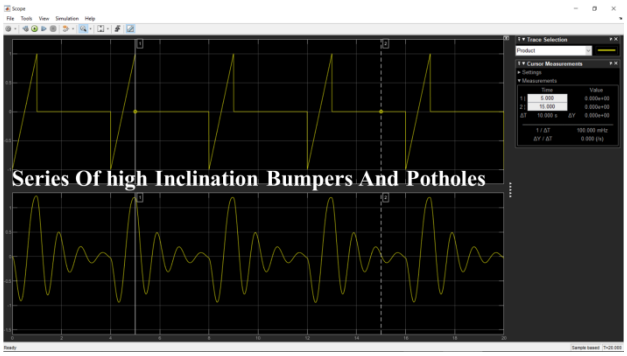


Fig. 10. Simulink test case 4.

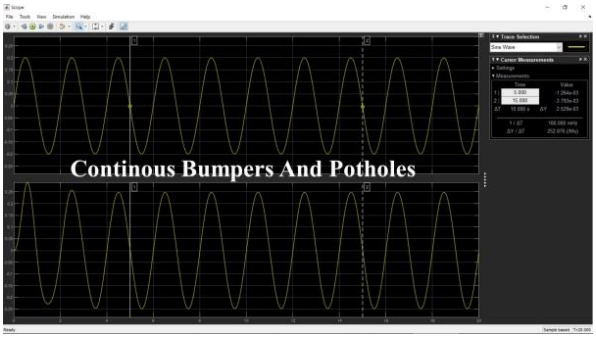


Fig. 11. Simulink test case 5.

Latitude	Longitude	Accelerometer Data	Gyroscope Data	Conclusion
21.929674	83.355588	-0.003	-0.094	
21.872887	83.379044	0.8044	0.1034	
21.8161	83.4025	-0.021	-0.056	
21.759313	83.425956	0.022	0.008	
21.702526	83.449412	1.32	1.76	Bumper Detected
21.645739	83.472868	0.002	0.103	
21.588952	83.496324	0.003	0.203	
21.532165	83.51978	-1.0021	-1.0045	Pothole Detected
21.475378	83.543236	0.0045	0.005	

Fig. 12. Database test cases.

C. *Limitations*

The real-time database update can only work if the user's smartphone is connected to a stable network always.

Our Simulink design is made by using a constant average of vehicles' weight and if the weight of the user's vehicle differ too much from this average, the filters might give unstable outputs.

The extensive utilization of the Global Positioning System (GPS) sensors, accelerometer sensor and gyroscope sensors present in the smartphone might increase the battery drain.

Current Global Positioning System (GPS) sensors used in smartphones have a minimum average resolution of a meter which may lead to our database have a maximum error of a meter in locating the uncertainties on the road.

Its important to note that this project will only start working during a second use as the first time it gathers the data.

The data set for the final results can not be visually determined because it has very high amount of 8 dimensional data (3 from accelerometer, 3 from gyroscope and 2 from Global Positioning System (GPS)).

V. Conclusion

Hence it is concluded that our project was successful in developing the 3D map of the road by using just accelerometer and gyroscope sensor on the smartphone and this mapped data was stored in the database. The Artificial Intelligence (AI) Algorithm is successful in making the decisions about the information of the road.

The Future Enhancement involves designing a more interactive android application for this project that can be spread to mass community. This application could have a map that shows the data of the road inclination using our database and give real time updates on that data when a vehicle passes over it. This will help tourist to get better navigational support when they explore the place. This will also help to get better quality of roads because the concerned authorities will get timely update from our database

Acknowledgment

I would like to express my deepest gratitude to my guide, Dr. P. Eswaran his valuable guidance, consistent encouragement, personal caring, timely help and providing me with an excellent atmosphere for doing research. All through the work, in spite of his busy schedule, he has extended cheerful and cordial support to me for completing this research work.

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Faculty Attendance Monitoring System Using Facial Recognition

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***Abstract*—Face recognition is a method of verifying or confirming an individual's identity using their face. The applications of facial recognition technology are plenty and they have great market demand. One of the applications is for attendance monitoring. Due to the ongoing pandemic, using a fingerprint scanner for attendance monitoring would be a health risk since the virus can spread through surface contact. This risk can be eliminated by using a face recognition attendance monitoring system which will be contact-free. We aim to develop a seamless faculty attendance monitoring system using facial recognition technology.**

***Index Terms*—Face recognition, artificial intelligence, tkinter, mailgun.**

I. Introduction

In recent years, face recognition technology has developed rapidly. Face recognition technology has many applications in the field of monitoring, public safety, civil economy, and entertainment. For a task as sophisticated as face recognition, accuracy plays a crucial role as the effectiveness of the product depends on it. Also, the need for such technologies has been more than ever in today's date due to the alarming rates at which the covid-19 virus is spreading.

With the number of reported cases being at an all-time high in recent weeks, the need for systems which can accomplish certain tasks without the need for people to gather around physically is more than ever. This attendance monitoring system aims to fulfil the very same purpose, wherein faculty members of the institution can log their attendance whilst maintaining the social distancing norms, without putting anyone at risk by ensuring that there is not surface contact.

In the advent of these pandemic times, several institutions and corporations alike are bringing changes to the way of going about their regular dealings. As these situations are beyond our control, we must look for ways to improvise, adapt and overcome any adversities that might come along to ensure everyone's safety whilst tending to our daily obligations.

Therefore, putting in place a facial recognition-based attendance monitoring system is a need of the hour and a step in the right direction.

II. Literature Survey

The problem statement is that given a still image or a video, one or more people in the captured region must be identified using a stored database of faces available. The dawn of facial recognition was in the 1960's. Following which there has been much research in this field and people have tried different techniques, algorithms and concentrated on different features for extraction.

Hao Yang et al., in their research journal Face Recognition Attendance System Based on Real-Time Video Processing, IEEE 2020, wrote about the methods of face recognition and also about the database which can be used to store the attendance information. The main face recognition methods being geometric feature method, subspace analysis, neural network method and support vector machine method. To check the sign in accuracy rate they investigated two colleges A and B in a province. They then conducted experiments in those colleges based on the application of face recognition attendance system accuracy and selected 200 college students. They found out from the experiment's results that after using the face recognition system, the skipping rate of the two universities was significantly lower than that of the other group of universities where there was normal roll number calling. Therefore, they concluded that the recognition attendance system can effectively increase the attendance rate of university classrooms and is highly effective in preventing leaves.

W. Zhao et al., in their research highlighted some of the issues related to facial recognition. They realized that the surroundings play an important role in recognizing faces and also the significance of features such as hair. It is also observed that the upper area of the face is more important in terms of face recognition when compared to the lower area.
They also pointed out that several studies have shown that the nose plays an insignificant role, but a distinct nose shape could be more important than the mouth or the hair.

The role of aesthetic attributes such as beauty and attractiveness were also studied. The more attractive the faces are, the better is their recognition rate. Coming to distinctiveness, studies show that distinctive faces are better retained and are recognized more accurately and faster than the normal faces.

In the face recognition systems, detection of faces in the image is the first step. In the feature extraction step, the features that are to be fed into the face classification system are obtained.

Based on the classification systems type, the features can be local features, or facial features.

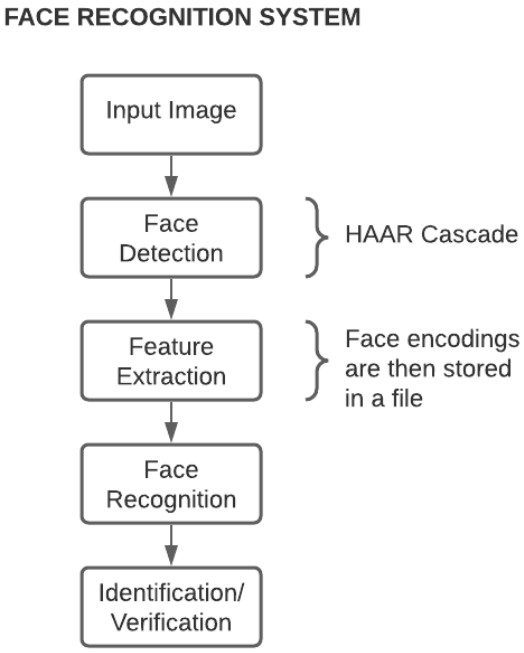
In 1999, W. Zhao, Sarnoff Corporation mentioned that the

Face detection is declared a success when the rough location of the face is determined correctly. It is noticed that when there is inaccurate face location then there is a degradation in the recognition performance.

With the results, studies and observations of various research, our Faculty Attendance Monitoring System is designed, and additional features are integrated.

III. Methodology

For the design of the Face Recognition Based Faculty Attendance Monitoring system the HAAR cascade classifier was used.



In the input image phase, the faculty stands in front of the attendance system. In the face detection phase, the faces present in the frame are detected and a bounding box is constructed around the location of the face.

After the face detection step, the image of the face undergoes feature extraction. The input is the image of the face and the output is a vector representing the important features of the face. This output vector is known as the as a face embedding vector.

The faces which are similar will have similar embedding. Hence the vectors for these images will be very close in the vector space.

For every face, there is its face embedding stored in a file with the .pickle extension. To the algorithm, the face is an array of RGB values.

Arr([-0.34163776, 0.05098191, -0.03425048,
0.45678347, -0.12966095, 0.04867411,
. 0.12511892, -0.08418588,
0.2254715])

Each of the numbers represent an orthogonal component. When two faces are being compared, it is these values which are being compared along with a tolerance limit kept for them.

A Boolean array is obtained. Based on the number of true values in the Boolean array we determine how accurately a face matches with the face in the database.

In the face recognition phase, the encodings of the image are obtained. It is then compared with the existing encodings which we have been stored and the identification and verification is done.

IV. Results and Discussion

Overall design of the developed Attendance System

The faculty approaches the device and stands in front of the camera. Once the face is recognized, the name of the faculty along with the time and day of their presence is marked and pushed to a file on the Raspberry Pi.

For a smooth and fast user experience and a good GUI (Graphical User Interface) Python's Tkinter library was used. Once the faculty comes up to the attendance system, they will be greeted with a welcome screen and the Pi camera will be ready to detect the face of the faculty. A screen grab of this user interface is shown in Fig. 1. Once the recognition is complete, the Tkinter user interface will show an acknowledgment (Fig. 3) and hence the faculty will get to know that their attendance has been registered for the day.

An email API solution called Mailgun is used. Using Mailgun Email was integrated into the application. When the attendance is complete for a particular day, the application automatically triggers and email. This email is sent to the person in charge, and it contains the file with the details of all the names of the faculty who are present along with the date and the time of their presence.

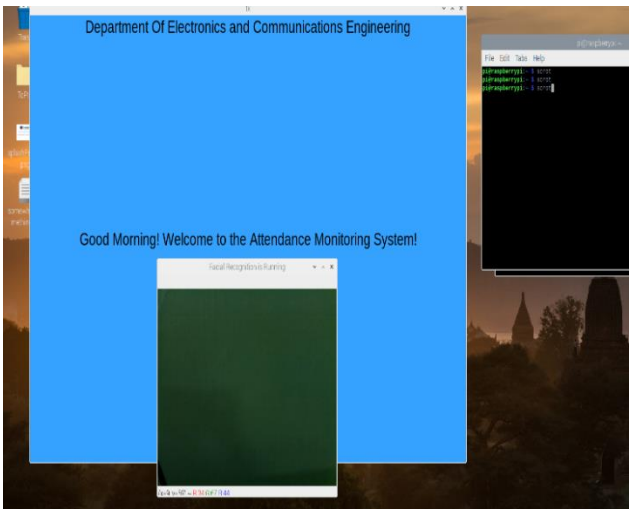


Fig. 1. Welcome screen.

The above figure shows the welcome screen which will be displayed to the faculties on the monitor which will be present right above the camera.

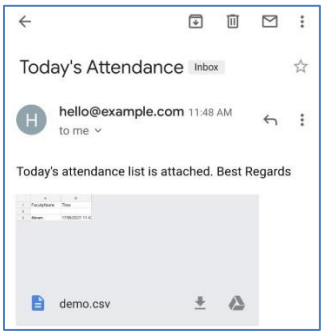


Fig. 2. Email with attendance information attached.

The above email is received from a sandboxed domain. Sandboxed domains are restricted and are for authorized recipients only. A custom domain can be registered on the Mailgun portal based on the institution's requirements.

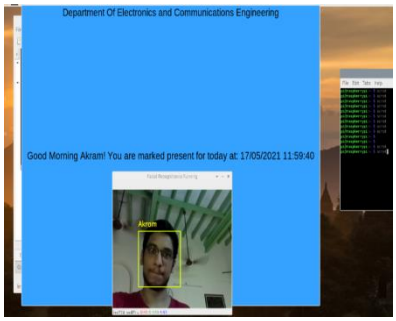


Fig. 3. Acknowledgment of Presence.

In the above figure the individual is recognized and their name along with date and time is stored in the attendance file on the Raspberry pi.

Fig. 4. Finished product design

The above figure shows the complete product including a light mounted on top of the structure to ensure that the faces are well lit and can be recognized seamlessly.

V. Conclusion and Future Works

The Face recognition attendance monitoring system is designed to help seamlessly monitor faculty attendance. Our product is designed to be a contact-free low-cost solution for faculty attendance monitoring.

This can be further developed by integrating it with a mobile application or an online website. This application can contain profiles for each of the faculty so that they can login and monitor their current attendance. The application can also be improved with a feature to make requests for leaves and for submitting feedback. Further improvements and features such as a home page for the faculty to post content for internal communications can also be developed.

Face recognition is a powerful technology. With the introduction of credit card sized computers, high quality cameras, 5G and the Internet of Things (IOT), the possibilities for what face recognition can be used for becomes infinite. The scope for the expansion of this technology is very wide and can alter almost all walks of life.

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Implementing Smart Farming Based on Iot Using Machine Learning

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***Abstract*–Detection of pests inside the paddy fields is a first-rate challenge inside the area of agriculture. Therefore powerful measures have to be developed to combat the infestation while minimizing the usage of pesticides. The strategies of photo evaluation are considerably carried out to agricultural science, and it gives maximum protection to crops, that can in the long run result in higher crop control and production. Monitoring of pests infestation is based on manpower, however computerized monitoring has been advancing to be able to decrease human efforts and mistakes.**

This observe extends the implementation of different image processing strategies to hit upon and extract insect pests by setting up an automatic detection and extraction system for estimating pest densities in paddy fields.Plant leaf for the detection of disease is considered which shows the disease symptoms. Then depending upon the diseases, the respective medicine can be given to the crops through a automated prototype.

***Index Terms*–Segmentation, HSV (Hue, Saturation, Value), K-mean Clustering.**

I. Introduction

A. Image Pre-Processing:

Image pre-processing can significantly boom the reliability of an optical inspection. Several filter operations which intensify or lessen positive image details permit an easier or quicker evaluation. Users are able to optimize a camera picture with only a few clicks.

Pre-processing is a commonplace call for operations with pictures at the lowest degree of abstraction — each input and output are intensity pics. These iconic snap shots are of the same type because the authentic facts captured via the sensor, with an intensity picture normally represented through a matrix of picture characteristic values (brightness's). The purpose of pre-processing is an development of the photograph records that suppresses unwilling distortions or enhances a few photograph features important for similarly processing, although geometric differences of pictures (e.g. Rotation, scaling, translation) are categorized amongst pre-processing techniques right here in view that comparable strategies are used.

B. Image Enhancement

Image enhancement is examination and control of a digitized picture, to enhance quality utilizing numerical tasks by utilizing any type of sign preparing for which info is a picture; the yield of picture handling can be a picture or boundaries recognized by the picture. Assuming you take exacting importance of picture handling, its only doing some activity or cycle on picture. This cycle is needed to get better subtleties of image(in clinical application) or clean awful image(like individuals clean their terrible selfie, concealing imprints in picture and so forth) or changing over a high contrast picture into shading picture or concealing information inside picture (stignography use in safeguard) and some more. So picture processing incorporates sifting a picture, upgrade of a picture, colorisation of picture and some more. Different strategies accessible like channel, improvement methods and so forth to get subtleties of picture. The aggregate investigation of above things is called image enhancement.

II. Proposed Methodology:

Our methodology involves 3 steps namely Preprocessing, Extraction (segmentation), Post processing where as for stimulation we are using matlab to stimulate the above mentioned steps. We have used Image Processing Tools and also Computer Vision to implement various algorithms to extract Leaf .

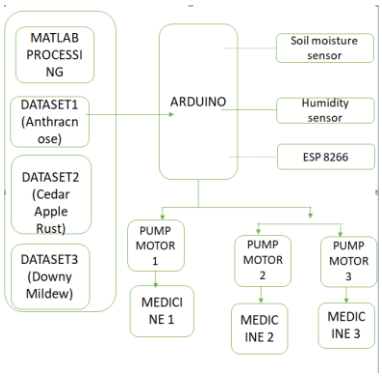

Fig. 1. Block diagram.

Fig. 2. Plant leaf images.

A. *Gray Scale Image:*

To store a solitary shading pixel of a RGB shading picture we will require 8*3 = 24 pieces (8 digit for each shading segment), yet when we convert a RGB picture to grayscale picture, just 8 bit is needed to store a solitary pixel of the picture. So we will require 33 % less memory to store grayscale picture than to store a RGB picture. Gray scale pictures are easier to work. Since they are single layered where as RGB has 3 layers which makes it complex.

Fig. 3. Adjusted gray image.

B. *RGB to HSV Conversion*

Not at all like RGB, HSV disconnects luma, or the image power, from chroma or the concealing information. This is significant in various applications. For example, if you need to do histogram evening out of a concealing picture, you probably need to do that simply on the power portion, and let the concealing fragments be. Else you will get outstandingly unusual tones.

In PC vision you consistently need to disconnect concealing portions from power for various reasons, similar to solidarity to lighting changes, or dispensing with shadows.

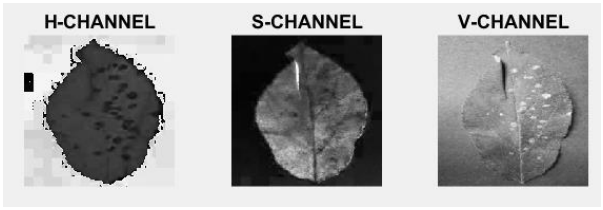

Fig. 4. (a) H-Channel, (b) S-Channel, (c) V-Channel.

C. *Filter:*

Median filter is not a linear virtual filtering, it is generally used to reduce noise from a picture. Similarly noise reduction is an pre-processing step to improve the consequences of later processing. Median filtering may be very extensively utilized in digital photograph processing because, beneath sure conditions, it preserves edges while casting off noise

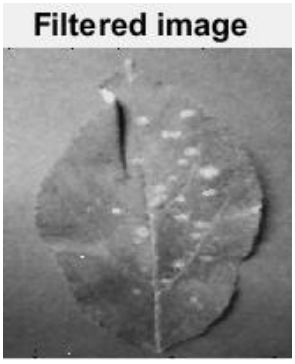

Fig. 5. Filtered image.

D. *Edge Based Segmentation*

Picture segmentation is a extensive and checking out interplay of photograph getting ready. Photo segmentation technique is utilized to phase a picture into sizable elements having comparative highlights and houses. The essential factor of segmentation is improvement as an instance addressing an image into tremendous and successfully analyzable manner. it's miles important preliminary phase in photo investigation. The goal of this is to separate a image into some sections/quantities having comparable highlights or developments. the threshold detection strategies are very tons developed strategies of picture preparing all by myself. it's miles trusted the short distinction in pressure esteem in a picture in light of the fact that a solitary strength esteem would not deliver excellent statistics approximately edges.

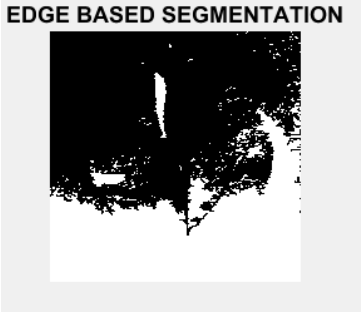

Fig. 6. Edge based segmentation.

E. *Dilated Image:*

Dilation is a alternate that creates a picture that may be a similar form as the first, however is an exchange length. And the resulting photo is known as the dilated photograph. Dilation that makes a larger photo is called an growth, that makes a extra modest picture is referred to as a reduction and

stretches or shrinks is knows as original photo. here, we're the use of dilated image due to the fact , Dilation extends the photograph pixels for instance it's miles utilized for extending a element A by means of making use of organizing issue B. It provides pixels to protest limits. The estimation of the yield pixel is the most excessive estimation of the multitude of pixels within the vicinity. A pixel is set to at least one if any of the adjoining pixels have the really worth.

Fig. 7. Dilated image.

III. SEGMENTATION

Segmentation is the choice of which points of light (pixels) in a picture are important for an article that is of interest (like an individual) or some portion of the less fascinating foundation (like sky or structures). At the point when rehashed commonly, this choice will frame a diagram limit that encompasses an item, permitting the watcher outwardly to isolate it from the foundation and remember it.

To bunch pixels into objects, the low level division measure depends on viewable prompts. Pixels that are close by to one another and share a similar shading or design or delicate slope of splendor are assembled into a solitary article. However, in the event that the shading or example or slope changes essentially between two pixels, this infers the pixels are not piece of a similar item. This low level cycle happens in the essential, auxiliary, and tertiary visual cortex at the back of the human cerebrum.

IV. SVM (MACHINE LEARNING ALGORITHM USED)

Backing Vector Machines (SVM's) are coordinated learning models with related learning computations that breakdown data used for request and backslide assessment. Given a lot of planning models, each put aside are having a spot on both arrangements, a SVM getting ready estimation manufacture a model with new advisers for one characterization**.** A SVM is a representation of the models as centers in space. Just as performing straight portrayal, SVM's can adequately play out a non-direct request using what is known as the standard trick, Certainly arranging their commitment to high dimentional part spaces.

V. HARDWARE

A. Moisture Sensor

There are different soil moisture sensors available on the market, and they work on different principles. there's a resistive sensor:

It consists of two electrodes and it depends on the resistance of the soil between the electrodes: the wetter the soil, the more conductive it is (the less resistance it has). Those aren't quite reliable, and they're often very cheap to produce and quick to degrade and go kaputt.A little better and a little bit more expensive are capacitive sensors: they measure capacitance of the soil and don't have exposed electrodes that can oxidize and degrade over time.Those two are the most common, the cheapest ways to measure moisture in the soil. Once you move to the more serious business (like running a plantation), you get to play with things like tensiometers that measure water tension in a soil by applying partial vacuum to the head of the device and measuring how much water can be sucked out of the soil and if you feel really hardcore, you can employ some crazy technology to measure neutron scattering in the soil.

B. L298N Motor Driver Module:

The L298 is a 5v logic powered set of gate and 8 transistors that can handle 46V at 4A. The full bridge mode and dual half bridge modes require some external logic where a zero is less than 1.5V and a one is less than the logic supply. It is a weird package called a "Power Multiwatt 15" which looks a bit like a TO-220 on steroids.

C. Transformers:

A step down Transformer is basically used to step down the voltage from high to low rating. Usually the step down transformers are used in SubStations to step down voltage to a shielded value , every material/ Apparatus operate at specific current level so to get that appropriate level for the safe level we step down the voltage from high rating to low rating through distribution Transformers.

D. Temperature lm35:

An LM35 is a voltage source whose output voltage vary accordingly with the celsius temperature. LM35 is an integrated circuit, three-terminal analog temperature sensor. Electrical Resistance has basically no meaning as a specification or property for this device

VI. HARDWARE

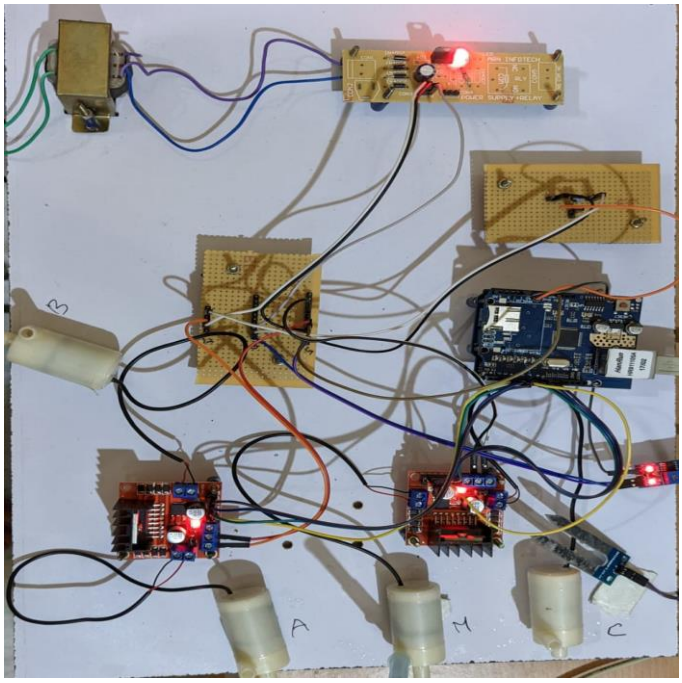

Fig. 8. Hardware.

VII. CONCLUSION

We can detect disease in plants by implementing smart farming based on iot using machine learning.

Through which required medicines is being given to the diseased plants. This not only reduces manual efforts but also reduces the chances of errors. It also minimize usage of pesticides, Lowers the budget, decreases water usage. It ensures better farming method and to get maximum yield with less resources using Communication technology we can monitor live field condition to take corrective action.

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Performance Analysis of TSTW FD-NOMA Cooperative Communication with SIC for 5G Wireless Systems and Beyond

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***Abstract*–Non orthogonal multiple access (NOMA) is the key multiple access technique proposed for the future generation wireless networks which can overcome the problems of spectral loss, latency and overhead in the existing fourth generation multiple access technology called orthogonal frequency division multiple access (OFDMA). Cooperative diversity is one of the fruitful wireless techniques in which nodes are sharing the resources in spatial domain to reduce the effect of multipath fading, improve throughput and ensure quality of service. Half duplex (HD) cooperative communication consumes more phases to accomplish downlink and uplink processes when compared to full duplex (FD) cooperative communication. Hence, in this paper three step two way (TSTW) relaying based FD cooperative communication with NOMA is proposed to achieve good spectral efficiency, larger capacity and better coverage even at the edge of a cell in order to achieve the goals of 5G and beyond wireless technologies. The cooperative relay uses amplify-and-forward (AF) and NOMA uses successive interference cancellation (SIC). This paper compares the performance of NOMA and OFDMA in cooperative and non-cooperative mode in terms of outage probability and channel capacity. This paper shows the proposed TSTW FD-NOMA cooperative communication outperforms the HD-NOMA cooperative communication.**

***Index Terms*–Non-Orthogonal Multiple Access, orthogonal frequency division multiplexing, three way two step, successive interference cancellation, full duplex cooperative communication**

I. INTRODUCTION

The first generation (1G) system involved Frequency Division Multiple Access (FDMA) technique in which each user has been allotted with a small part of the allocated spectrum all the time. Table 1 show the multiple access schemes and the key elements to facilitate multiple accesses used in 2G (GSM), 3G (WCDMA/HSPA), 4G Long Term Evolution (LTE), LTE-Advanced, 5G New Radio and beyond 5G wireless technologies. 2G wireless standards used Time Division Multiple Access (TDMA), in which each user has allowed to use the entire allocated spectrum for a small time span, normally in milliseconds. In the third generation wireless Code Division Multiple Access (CDMA), each user can access the entire spectrum at all times with uniquely spread code sequence. 2G and 3G system mainly relies on transmission power control (TPC) for link adaptation. In the fourth generation Long Term Evolution (LTE) and LTE-Advanced orthogonal frequency division multiplexing (OFDM) is used as a waveform candidate with OFDMA. 5G and beyond wireless technologies changes the trend of orthogonal multiplexing in to NOMA in power and code domain. 4G system uses adaptive modulation and coding (AMC) where as 5G system uses the combination of AMC and TPC.

TABLE I. EVOLUTION OF CELLULAR MULTIPLE ACCESS TECHNIQUES AND KEY ELEMENTS USED IN WIRELESS TECHNOLOGY

Key elements	2G	3G	4G	5G and beyond
Multiple access technique	Non-orthogonal TDMA	Non-orthogonal CDMA	Orthogonal OFDMA	NOMA with SIC
Multiplexing domain	Time	Code	Orthogonal carriers	Power and code
Front End system	Single antenna	Single Antenna	MIMO	MIMO
Waveform	Single Carrier	Single Carrier	Multi Carrier (OFDM)	Multi carrier
Link Adaptation	TPC	TPC	AMC	AMC + TPC

In the last two decades, exponential growth of wireless technologies and massively connected devices in various applications like Internet of Things, Voice over IP, Video conferencing, etc., cause deficiency in spectral resources and demand the high speed data and mobile traffic without compromising the spectral efficiency. Due to this, effective spectrum utilization is becoming an important concern in designing next generation wireless system without affecting its quality of service (QoS).[1] Non-orthogonal multiple access (NOMA) has been identified as a promising radio access technology (RAT) to improve spectral efficiency of the fifth generation (5G) wireless networks. NOMA allows the evolved base station node (e-Node B) to transmit information at same

time, using same carrier frequency, and code but with variable power levels depending on channel state information (CSI). The distribution of power levels in the same bandwidth depends on the distance between e-Node B and the receiving user equipment (UE). The receiving UEs are permitted to receive the superposition signal from transmitter with different levels of power and then to detect its intended information through SIC technique.

Multipath fading is an important impact which occurs during the wireless propagation of signals and affects the QoS. It can be mitigated through the use of cooperative diversity technique which shares antennas of intermediate UEs spatially located between source and destination UE to relay the information. Amplify-and-Forward (AF) relaying technique and decode-and-forward (DF) relaying techniques are the significant relaying strategies used for user cooperation in many researches for the last two decades. The important design considerations of next generation cooperative network are to attain high system throughput, low latency, high reliable, high secured and high system capacity which essentially depend on the spectral efficiency of the system. Conventional HD one way relaying strategy cannot satisfy these design specifications since they require two time slot to transmit one frame. It causes degradation in system capacity and spectral efficiency by a factor of two as well. Then to improve the spectral efficiency loss and system capacity, pioneering groups of wireless technology have moved the cooperative communication research into a new paradigm shift towards full duplex mode where transmission and reception takes place through same time and frequency.

Hence this paper focuses in the design and simulation of TSTW based FD-NOMA cooperative communication to support the wireless research arena. The rest of this paper is organized as follows. Section 2 deals with the studies of various literature and motivation for doing this research. In section 3, the methodology of TSTW based FD-NOMA cooperative communication along with its performance metric parameters is explained with substantiated mathematical expressions and figures. Experimental setup is described in section-4. The performance of the proposed technique is evaluated and the results are discussed in section 5. Section 6 provides the concluding remarks and the scope for the future extension of the research.

II. Literature Review and Motivation

Orthogonal multiple access depends on various modulations such as Orthogonal Frequency Division Multiplexing (OFDM), pulse shaping based modulations such as Filter Bank Multi Carrier (FBMC) & Generalized Frequency Division Multiplexing (GFDM) and sub-band filtering based modulations such as Universal Filtered Multi Carrier (UFMC) & Filtered OFDM (f-OFDM). NOMA can be achieved in various methods like power domain NOMA, code domain NOMA techniques such as low density spreading & sparse coding and multiple domain NOMA techniques such as Pattern Division Multiple Access (PDMA) & Lattice Partition Multiple Access (LPMA).

The capacity and cell-edge throughput of the downlink can be increased through NOMA. In the literature [2], authors have designed NOMA based multi antenna system with successive interference cancellation (SIC) and interference rejection combining (IRC) to achieve gain in capacity and spectral efficiency. They showed that NOMA with fractional transmission power allocation (FTPA) and tree-search based transmission power allocation (TTPA) overall cell throughput gain of 30% and 35% over OFDMA. The performance of NOMA with TTPA outperforms NOMA with FTPA. NOMA can serve multiple users at the same time, same frequency and with same code, but with different power levels, which provides a significant spectral efficiency gain over traditional orthogonal multiple access (OMA) practised [3].

In the literature [4], to combat with multipath fading, low-complexity cooperative diversity with AF and DF relaying protocols is proposed. It allows a pair of UEs to fully exploit spatial diversity in the channel. For fixed low data rates AF and DF based cooperative communication offer 1.5dB optimal power savings while compared to non-cooperative communication. Outage behavior and average information rate of cooperative network in AF and DF relaying mode is evaluated. This literature laid down an important milestone in the evolution of HD one way relaying cooperative communication. FD cooperative communication schemes such as two way relaying, TSTW relaying strategies are introduced in [5]. Also it has been proven that the spectral efficiency of HD cooperative network is doubled and greater than that of FD cooperative network through the use of HD relaying protocols.

The authors of the literature [6] have implemented the cooperative communication with better channel conditions in NOMA using two phases, i.e. direct transmission phase and cooperative phase. The practical challenges and issues of implementing cooperative NOMA are exemplified. The key features and the engineering feasibility of NOMA cooperative communication with AF and DF relaying schemes is explained in the literature [7] with different configurations. Uplink, downlink and composite architectures for OMA and NOMA based cooperative communication system are depicted. It reveals that the power utilization of NOMA is 30% greater than OMA. Multiple relay with unicast and multicast cooperative NOMA is introduced in [8] with fixed and dynamic power allocation. Best user selection (BUS) is employed in high signal to noise ratio (SNR) regime of the cooperative NOMA to reduce the outage probability and to increase the diversity order. BUS scheme utilizes the diversity order and increases it asymptotically as the number of multicast UEs is increased.

Performance analysis of traditional cooperative relaying systems (CRS) is compared with the NOMA-based CRS in the presence of Rician fading channel in [9]. The comparative studies presented in the literature says that the achievable rate is approximated efficiently using Gauss-Chebyshev Integration which makes the NOMA-CRS to perform well when compared to traditional CRS. The paper [10] considers the optimal power allocation between the nearest UEs and the

farthest UEs in NOMA-CRS in the global energy efficiency aspect and improves the QoS. The optimal decoding solution is obtained by decomposing the original non-convex optimization problem into a bi-layer optimization problem.

Cooperative NOMA is designed with successive user relaying in the paper [11]. Optimization of power split factors is introduced in this research article and it improves the fairness of outage performance between the near and far UEs remarkably. The process of successive interference cancellation is studied from this literature. NOMA CRS with energy harvesting UEs adopting AF and DF relaying strategies along with maximal ratio combining is portrays in the research article [12]. The system model consists of one source nodes with fixed multiple antenna relays and two destination nodes. Relay nodes switches between AF and DF relaying protocols based on the target signal-to-interference-noise ratio (SINR). It also investigates scenario of un-trusted relaying with precisely derived logical expressions for the average secrecy rate. The literatures [13, 14] analyses the bit error rate of cooperative NOMA systems with channel state information. Virtual FD cooperative NOMA is implemented in [15] using two HD relaying UEs between the base station and the destination UE. The research articles [16, 17] discussed the scheduling policies and spectrum aggregation to support NOMA system implementations.

Recently, the idea of NOMA has attracted the academicians and researchers in cooperative relaying systems to enhance the spectral efficiency to achieve higher diversity gain. Different forms of cooperative NOMA have been proposed in the various literatures referred in this paper. The implementation of real FD cooperative NOMA with performance analysis is not yet in the current research. Hence, this paper is presented and dedicated to improvise the current research in NOMA Cooperative wireless network and to make it in to real time implementation in 5G and beyond wireless services.

III. Proposed Methodology

Let us assume a center excited cell environment in which the evolved base station node (e-Node B) is located at the center of the cell. Further, there are two user equipments UE_1 and UE_2 are located inside the footprint of the cell in such a way that UE_1 is located at a small distance from the e-Node B and UE_2 is located at a large distance from the e-Node B as compared to UE_1. Fig. 1 represents the direct communication without cooperation and compares the spectrum of OFDMA and NOMA for the same cellular environment. Generally, in NOMA scheme, UE_1 detects the signal of UE_2 and subtracts the signal of UE_2 from the combination and then detects the signal for UE_1. The farthest user equipment UE_2 detects its corresponding signal since the signal for UE_1 is not reachable at the location of UE_2.

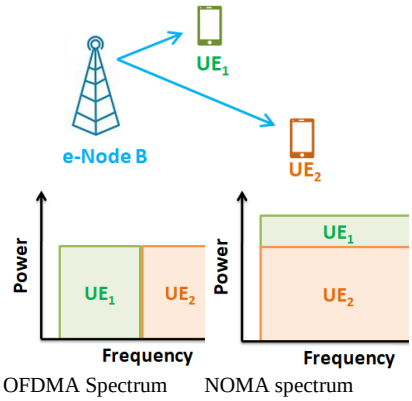

Fig. 1. Illustration of non-cooperative communication and spectral comparison between OFDMA & NOMA.

NOMA achieves appreciable spectral efficiency when compared to OFDMA due to the usage of same wideband frequency spectrum by the multiple users. NOMA offers lower latency due to the simultaneous transmission and reception at all the time rather than dedicated scheduled time slot. By exploiting the flexible power control algorithms in NOMA better QoS can be provided to all the users. It helps in increasing cell-edge throughput and better user experience at cell-edges.[1,7]

Let us consider a TSTW based FD-NOMA cooperative communication system model which consists of evolved base station node (e-Node B) with relaying user equipment (UE_R) near to it and the destination user equipment (UE_D) far to it as shown in the Fig. 2.

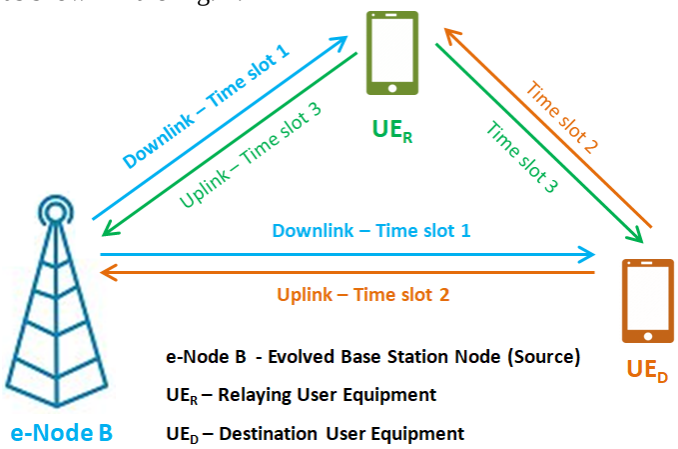

Fig. 2. System model for TSTW FD-NOMA cooperative communication with single relay.

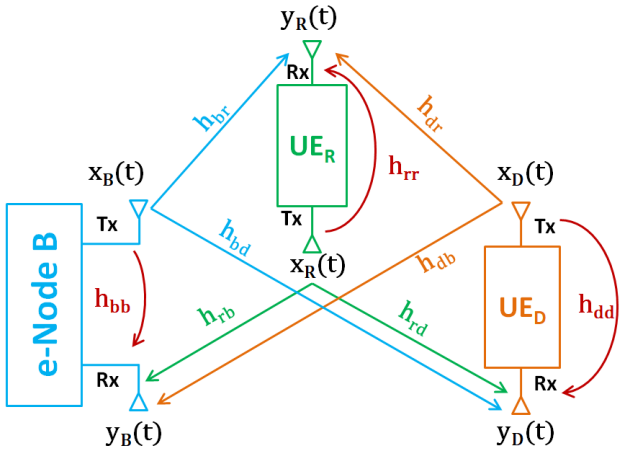

Fig. 3. Illustration of signal flow and channel coefficients between various nodes of TSTW FD-NOMA cooperative system.

Figure 3 illustrates the signal flow and channel coefficients between various nodes of TSTW FD-NOMA cooperative system. In this figure the terms $x_B(t)$, $x_R(t)$ and $x_D(t)$ are the signals transmitted by e-Node B, UE_R and UE_D whereas the terms $y_B(t)$, $y_R(t)$ and $y_D(t)$ are the signals transmitted by e-Node B, UE_R and UE_D correspondingly. The communication channel between any two nodes is assumed to experience an independent Rayleigh multipath fading. The channel coefficient between two nodes i and j is denoted by

$$h_{ij} = \lambda_{ij} \left(d_{ij}\right)^{-\frac{\alpha}{2}} \tag{1}$$

Where α is the path loss component, d_{ij} is the distance between node i and node j and λ_{ij} is the multipath fading coefficient. The variables i and j are denoted by any one of the values in the sets {b,r,d}. The channel coefficients between nodes are known as follows. h_{br} denotes the channel coefficient between e-Node B and relay node UE_R. h_{bd} denotes the channel coefficient between e-Node B and destination node UE_D. h_{rd} denotes the channel coefficient between relay node UE_R and destination node UE_D. The channel coefficients h_{br}, h_{bd} and h_{rd} are relevant to half duplex cooperative communication. In full duplex cooperative communication, the phenomenon h_{bb}, $h_{rr}$and h_{dd} are the self interference channel coefficients correspondingly which is trade-off by SIC.

Table 2 shows the time slots required for completing the uplink and downlink processes of HD-NOMA Cooperative system and TSTW FD- NOMA Cooperative system. HD NOMA cooperative wireless system takes 4 phases to complete the transmission and reception process of all nodes where as the proposed TSTW FD- NOMA cooperative wireless system requires 3 time phases. In this table the term DL refers to downlink, the term UL refers to uplink, the term Tx refers to transmission and the term Rx refers to reception.

TABLE II. TIME SLOT REQUIRED BY ALL NODES FOR TRANSMISSION AND RECEPTION IN HD-NOMA AND FD-NOMA BASED COOPERATIVE SYSTEM

	Node	Time Slot			
		t_1	t_2	t_3	t_4
HD NOMA	e-Node B	DL-Tx $x_B(t_1)$	Idle	UL-Rx $y_B(t_3)$	UL-Rx $y_B(t_4)$
	UE_R	DL-Rx $y_R(t_1)$	Tx $x_R(t_2)$ ~ $x_d(t1)$	Rx $y_R(t_3)$	UL-Tx $x_R(t_4)$ ~ $x_b(t_3)$
	UE_D	DL-Rx $y_D(t_1)$	Rx $y_D(t_2)$	UL-Tx $x_D(t_3)$	Idle
TSTW FD-NOMA	e-Node B	DL-Tx $x_B(t_1)$	UL-Rx $y_B(t_2)$	UL-Rx $y_B(t_3)$	
	UE_R	DL-Rx $y_R(t_1)$	Rx $y_R(t_2)$	UL-Tx $x_R(t_3)$ $\{x_d(t_1), x_b(t_2)\}$	
	UE_D	DL-Rx $y_D(t_1)$	UL-Tx $x_D(t_2)$	Rx $y_D(t_3)$	

In TSTW FD-NOMA cooperative communication, during the first phase, e-Node B broadcasts a superimposed NOMA waveform to E_R and which is given by

$$x_B(t_1) = \sqrt{a_R P_B}\, x_r(t_1) + \sqrt{a_D P_B}\, x_d(t_1) \tag{2}$$

In the expression (2), $x_r(t_1)$ and $x_d(t_1)$ are the components of the signal transmitted by e-Node B corresponding to UE_R and UE_D

$$E\left[\left|x_r(t_1)\right|^2\right] = E\left[\left|x_d(t_1)\right|^2\right] = 1 \tag{3}$$

P_B is the total power transmitted by the e-Node B. a_R and a_D are the power split factors of the signal components $x_r(t_1)$ and $x_d(t_1)$, correspondingly. The power split factors should satisfy the criteria $a_R + a_D = 1$ and $a_R < a_D$, since UE_R is near to e-Node B when compared to UE_D. Hence, the expression (2) can be re-written as

$$x_B(t_1) = \sqrt{a_R P_B}\, x_r(t_1) + \sqrt{\left(1 - a_R\right) P_B}\, x_d(t_1) \tag{4}$$

At this phase the UE_R receives two components $x_r(t_1)$ &$x_d(t_1)$ and UE_D receives the component $x_d(t_1)$, which can be represented by

$$y_R(t_1) = h_{br}\sqrt{a_R P_B}\, x_r(t_1) + h_{br}\sqrt{a_D P_B}\, x_d(t_1) + w_r(t_1) \tag{5}$$

$$y_D(t_1) = h_{br}\sqrt{a_D P_B}\, x_d(t_1) + w_d(t_1) \tag{6}$$

In the equations (5) & (6), the terms $w_r(t_1) \sim \mathcal{CN}(0,\sigma^2)$ and $w_d(t_1) \sim \mathcal{CN}(0,\sigma^2)$ are referring to white noises present in UE_R and UE_D with zero mean and variance σ^2.

During the second phase UE_D transmits the signal which is represented as follows

$$x_D(t_2) = \sqrt{P_D}\, x_b(t_2) \tag{7}$$

In the expression (2), $x_b(t_2)$ is the uplink signal transmitted by UE_D to e-Node B and P_D is the transmission power of the UE_D. During this phase e-Node B receives the uplink signal and UE_R receives the signal which can be written as

$$y_B(t_2) = h_{bd}\sqrt{P_D}\, x_b(t_2) + w_b(t_2) \tag{8}$$

$$y_R(t_2) = h_{rd}\sqrt{P_D}\, x_b(t_2) + w_r(t_2) \tag{9}$$

In the equations (8) & (9), the terms $w_b(t_2) \sim \mathcal{CN}(0,\sigma^2)$ and $w_r(t_2) \sim \mathcal{CN}(0,\sigma^2)$ are referring to white noises present in e-Node B and UE_R with zero mean and variance σ^2.

During the third phase the relay decodes $x_d(t_1)$ from the e-Node B at time t_1 and $x_b(t_2)$ from the UE_D at time t_2. Then the relay forwards the combination of these signal along with its own information $x_b(t_3)$ to e-Node B using AF relaying strategy. The amplification factor of AF relaying protocol for the proposed scheme is given by

$$\beta = \sqrt{\frac{a_D P_B}{|h_{SR}|^2 a_R P_B + 2\sigma^2}} \tag{10}$$

The signal broadcasted by the relay to e-Node B and UE_D is given by

$$x_R(t_3) = \beta\sqrt{P_R}\, x_d(t_1) + \beta\sqrt{P_R}\, x_b(t_2) + \beta\sqrt{P_R}\, x_b(t_3) \tag{11}$$

In equation (11), the term P_R refers to the transmission power of the relay user equipment. During this phase, the signals received by e-Node B and UE_D are given by

$$y_B(t_3) = h_{br}\beta\sqrt{P_R}\, x_d(t_1) + h_{br}\beta\sqrt{P_R}\, x_b(t_2) + h_{br}\beta\sqrt{P_R}\, x_b(t_3) + w_b(t_3) \tag{12}$$

$$y_D(t_3) = h_{rd}\beta\sqrt{P_R}\, x_d(t_1) + h_{rd}\beta\sqrt{P_R}\, x_b(t_2) + h_{rd}\beta\sqrt{P_R}\, x_b(t_3) + w_d(t_3) \tag{13}$$

In the equations (12) & (13), the terms $w_b(t_3) \sim \mathcal{CN}(0,\sigma^2)$ and $w_d(t_3) \sim \mathcal{CN}(0,\sigma^2)$ are referring to white noises present in e-Node B and UE_D with zero mean and variance σ^2. In the third phase the UE_D decodes the information $x_d(t_1)$ by combining the signals using maximal ratio combining method. The signal component $x_b(t_2)$ is cancelled using SIC at the destination user equipment.

A. Signal To Interference Noise Ratios

Signal-to-interference-noise ratio is an important QoS metric which is used to theoretically determine the upper bound of the channel capacity. It is defined by the ratio between the signal power and the combination of interference and noise power. The SINR of the relaying user equipment is given by

$$\gamma_R = \frac{a_D P_B |h_{br}|^2}{a_R P_B |h_{br}|^2 + \sigma^2} \tag{14}$$

The SINR of the destination user equipment at the end of all up-link and downlink processes happened after three phases is given by

$$\gamma_D = \frac{\beta P_R |h_{rd}|^2 + a_D P_B |h_{bd}|^2}{a_R P_B |h_{bd}|^2 + \beta P_R |h_{rd}|^2 + \sigma^2} \tag{15}$$

B. Outage Behavior

Wireless communication system service condition in which user equipment is completely deprived of service from e-Node B is called as outage. Outage probability is the probability that an outage event will occur within a specified observation time period and is a significant measure of the quality of the transmission. In a multipath Rayleigh fading radio channel, it is likely that a transmitted signal will suffer deep fades that can lead a complete loss of the signal or outage of the signal. Outage event is said to occur when the received data rate goes below a certain threshold level. Let T_R and T_D be the threshold rate in accordance with QoS requirement of UE_R

and UE_D respectively. For each data stream, it is defined that the outage event occurs when the achievable rate is smaller than the corresponding target rate. The outage event occurs in the half duplex NOMA cooperative communication, if UE_R fails to decode $x_R(n)$ from $y_B(n)$ and UE_D fails to decode $x_D(n)$ from $y_R(n)$ and $y_B(n)$. Let the outage probability of the relay be $p(O_R)$ and the outage probability of the destination user equipment be $p(O_D)$.

The outage probability of UE_R is given by

$$p(O_R) = 1 - p\left[\log_2(1-\gamma_R) > T_R\right]$$

$$p(O_R) = 1 - \exp\left[\frac{\left(1-2^{T_R}\right)\sigma^2}{\left(1-a_R 2^{T_R}\right)P_B\lambda_{br}}\right] \quad (16)$$

The outage probability of UE_D is given by

$$p(O_D) = 1 - p\left[\log_2(1-\gamma_R) > T_R\right] p\left[\log_2(1-\gamma_D) > T_D\right]$$

$$p(O_D) = 1 - \exp\left[\frac{\left(1-2^{T_R}\right)\sigma^2}{\left(1-a_R 2^{T_R}\right)P_B\lambda_{br}} + \frac{\left(1-2^{T_D}\right)\sigma^2}{\left(1-a_D 2^{T_D}\right)P_B\lambda_{rd}}\right] \quad (17)$$

The outage probability is also a factor which depends on power and distance. Outage event of UE_D occurs when the SINR of destination user equipment at the edge of the cell is less than the threshold (γ_{th}) acceptable power level. The received power of any wireless equipment decays in accordance with the distance from its access point. The outage probability of UE_D with respect to power and distance is given by

$$p(O_D) = 1 - p\left[\gamma_D > \gamma_{th}\right] \quad (18)$$

C. Capacity

The capacity of non-cooperative NOMA direct transmission link [3] between the e-Node B and UE_D is given by

$$C_{NC} = B_T \log\left[1 + |h_{bd}|^2 \, SNR\right] \quad (19)$$

In the equation (19), the term B_T refers to the transmission bandwidth and the term SNR refers to signal to noise ratio of the link. The capacity of cooperative NOMA with AF relaying scheme is given by

$$C_C = B_T \log\left[1 + |h_{rd}|^2 \gamma_R + f\left(|h_{br}|^2 \gamma_R, |h_{rd}|^2 \gamma_D\right)\right] \quad (20)$$

In the equation (20), the function f(u,v) is given by

$$f(u,v) \approx \frac{uv}{u+v+1} \quad (21)$$

D. Optimal Power Allocation

The optimal power split factor is attained based on satisfying the following condition

$$\arg \max_{0 \le a_R \le 0.5, 0 \le a_D \le 0.5} \{C_C\}$$

IV. Experimental Setup

This paper deals with the significant area of multiple access techniques in wireless technology which meets the requirements of 5G and beyond cellular communication. This section briefs the experimental setup with discussions on the results obtained through MATLAB simulations. The table (3) shows the details about execution environment.

TABLE III. SIMULATION ENVIRONMENT

Tools	Types	Version
Simulation Software	MATLAB	R 2019a (64 bit)
Operating System	Windows	10 Professional (64 bit)
Processor	Intel Core i5	core i5 3470 (3.60GHz)
RAM	LPX	DDR4 (16Gb)

The table 4 shows the simulation parameters for NOMA and OFDMA in both the cooperative and non-cooperative mode.

TABLE IV. SIMULATION PARAMETERS

OFDMA	NOMA
• OFDM symbol with 1024 subcarriers • 25% cyclic prefix • 16-QAM mapping	Optimal Power split factors For cooperative case $\arg \max_{0 \le a_R \le 0.5, 0 \le a_D \le 0.5} \{C_C\}$ For non-cooperative case $\arg \max_{0 \le a_R \le 0.5, 0 \le a_D \le 0.5} \{C_{NC}\}$
• Sub 6GHz carrier frequency with 200MHz bandwidth • SINR {-15dB, 15dB} for outage behavior and capacity analysis • Channel variance is set to unity	

V. Results and Discussion

The outage behavior of cooperative NOMA is compared with non-cooperative NOMA, cooperative OFDMA and non-cooperative OFDMA as shown in Fig. 4. The outage probability reduces as the SINR increases for all the cases. Also it is observed that the non-cooperative NOMA outperforms the non-cooperative OFDMA but almost proportionally. Both multiple access techniques (OFDMA and NOMA) with cooperative mode provide a better outage behavior when compared to the multiple access techniques without cooperation. FD-NOMA Cooperative system reduces the chances of outage behavior to a maximum of 29% when compared to non-cooperative NOMA at 15dB.

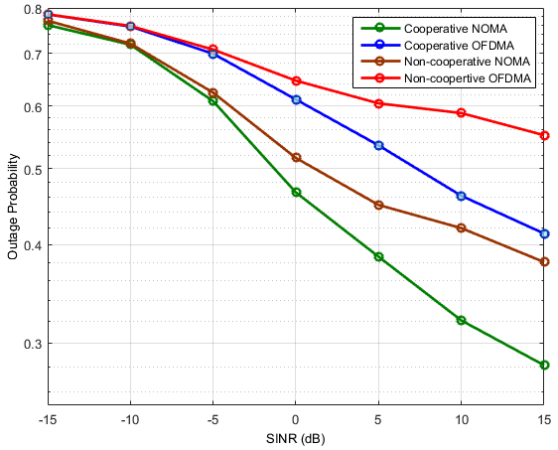

Fig. 4: Outage behaviour of NOMA and OFDMA in Cooperative and Non-Cooperative mode

A scenario is considered where e-Node B is located in the centre of the cell, i.e. at the coordinate (30m, 30m). The outage behaviour of UE_D is analyzed by considering the SINR level of UE_D as $\gamma_D = 30\text{dB}$ and varying the position of the destination on every 1m. The position of the relay is considered in such a way that the combination of e-Node B, UE_R and UE_D forms an equilateral triangle in the triangular geometrical space.

In the literature [1], the outage probabilities of Non-cooperative NOMA and Non-cooperative OMA for two user system (one far user and one near user) are compared for a cell radius of 700m with an SNR of 40dB. An outage probability of 0.12 is achieved at 30m radius with power allocation factors of $\frac{4}{5}$ and $\frac{1}{5}$ for far and near users respectively. In this paper, from the Fig. 5 it is revealed that the outage probability of 0.14 is achieved at 30m radius, i.e. at the coordinate (21m, 21m) from centered e-Node B with SINR of 30dB along with optimal power allocation factors. The plot depicted in Fig. 5 clearly shows that the outage probability of cooperative NOMA is very better when compared to non-cooperative NOMA over the given area, since the cooperative NOMA achieves the transmit diversity gain as much as possible.

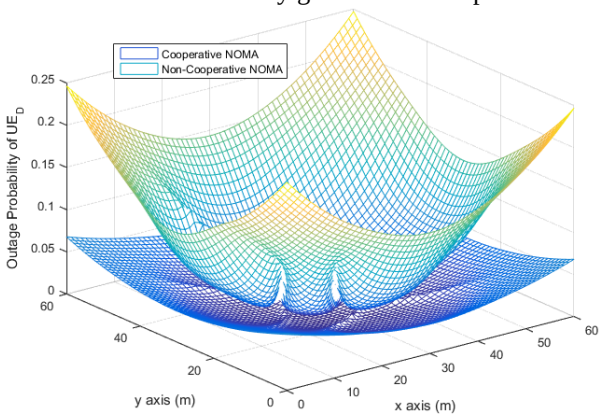

Fig. 5: Outage behavior of cooperative NOMA and non-cooperative NOMA in 60mX60m area

From the Fig. 6 it is understood that with sub 6GHz spectrum, it is possible to achieve channel capacity from 0.8Gbps to 33Gbps with a 200MHz of bandwidth from the variation in SINR from -15dB to 15dB while using FD-cooperative NOMA.

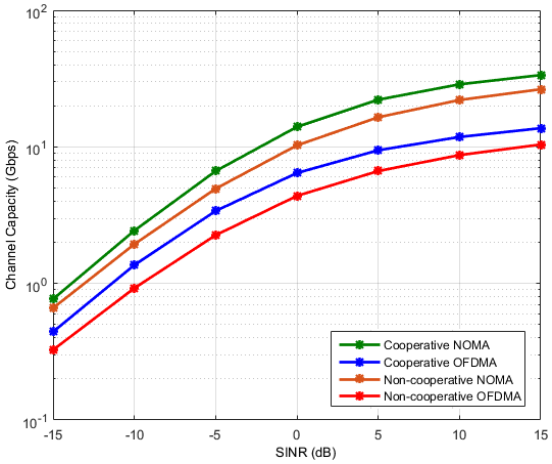

Fig. 6: Capacity analysis of NOMA and OFDMA in Cooperative and Non-Cooperative mode

VI. Conclusion

The requirement of the next generation wireless communication technology such as high achievable data rate, good coverage, and massive connections laid the motivation of this research. The outage behavior analysis with respect to SINR showed that FD-NOMA cooperative communication is the profitable technique to reduce the chances of outage event as well. The outage behavior analysis with respect to the distance proves that cooperative NOMA is better than the Non-cooperative NOMA in the footprint of the centre excited cell. The capacity analysis have also proven that the proposed FD-NOMA cooperative communication will provide the higher channel capacity as much as possible to satisfy the higher data rate goal. With the various results presented in this paper, it hopes to provide a roadmap for the deployment of next generation wireless communication for various applications like Internet of everything in healthcare, vehicular communication

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Detecting Brand Level Extremist Reviewers and Obstructing False Promotion

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***Abstract*–Opinion spammers have become more influential in recent days. In the current situation, under pandemic conditions direct shopping has got reduced to a greater extent. This gives way for a greater number of people opting for online shopping as their safest way for buying their needs. This is used by opinion spammers to influence buyers to buy their products. We propose a supervised model that detects the extremist reviewer for a particular brand who intends to promote the sale of that brand. A Decision tree classifier is used to classify the extremist reviewers of a particular brand. People post extreme positive reviews for all products under a single brand to promote it - such users who influence the user sentiments are detected and prevented from submitting further reviews and promote that brand.**

***Index Terms*–Extremist reviewers, opinion spammers, decision tree, extreme positive, user sentiment.**

I. INTRODUCTION

In online marketplaces, reviews and ratings play a major role in determining the future sale of the products and it also affects the brand reputation. When a brand and its product are posted with many positive reviews and ratings, the buyers who wish to buy those products would be more likely to buy without any hesitation. Similarly, when a product of any brand has got many negative reviews and poor ratings, then any customer of the shopping site would try to avoid buying those products. Thus, the reviews and ratings influence the user sentiments and change the reputation of any product and its brand. It affects both the brand manufactures and also the customers who spend their money to buy a product and end up buying a faulty product based on the fake reviews posted by other users.

Every consumer buys a product after viewing the reviews given by the previous customers. Many studies have shown that reviews play a major role in impacting the brand reputation in the market [13], [14]. To prevent this opinion spam, Amazon India had introduced a policy of limiting the number of reviews posted for a product in a day [10].

Few people will provide genuine reviews after buying and using the product. Whereas few people review a product for other reasons – to promote a brand or demote any other brand. The manufactures of any brand might be involved in promoting their brand by employing few people to post reviews in favor of their brand. Studies prove that the brand owners will be involved in promoting their own brand rather than demoting other brands because the competitors will be indefinite and numerous and employing people for posting reviews against them would be tedious and practically impossible. The latter would require more resources and time. Comparatively promoting their own brand is much easier than trying to demote the competitive brands, because they will be well aware of the products of the brand that they wish to promote. The brand owners would guide them with all the details they would require to promote their products by posting extreme positive reviews. But when they decide to demote the competitor's brand, finding all brand and product information would be more tedious and the resource required would be more when compared to employing people to promote their own brands. This paper deals with the extreme positive reviews posted for promoting any particular brand.

We use a regression tree-based classifier to classify the reviews as extreme or moderate reviews. A product will be given a rating from 1 to 5 stars, where 1 is considered as an extreme negative review for the product and 5 is the extreme positive review for any product. The extreme reviews tend to influence other buyers more when compared to other ratings which include 2,3,4. They are considered to be moderate reviews.

We propose a supervised model to detect extremist reviewers of a particular brand based on the star ratings given by each customer. The detection is done using the decision tree classification technique. The decision here is to classify whether the review is extreme or moderate and then the extreme rating is further classified as extreme positive and extreme negative.

II. PROBLEM DESCRIPTION

When a manufacturer or the marketing personnel of any brand decides to promote their brand's online sale, they might employ few people to post extreme positive reviews for all the products under their brand. The customer who is planning to buy a product will be influenced to a greater extent by viewing many positive reviews with extreme ratings of those products. Even if the product has any faults or failures the extreme

positive reviews posted by the fake reviewers will overshadow all its defects and will force any user to buy it.

For reputed brands, this might not be a problem because the number of customers for a well-known promising brand will be more and the real reviews posted for the products of genuine brands will be more than the employed reviewers and their reviews. So, the sale or reputation of reputed brands cannot be spoiled by extreme reviewers.

The real problem would be for an upcoming brand with great quality – they will not be provided with the recognition they would deserve or a brand with poor products would gain more orders and the end customers would receive products with faults or failures. Thus, opinion spam plays a major role in the upcoming brands' sales and progress.

III. Background and Related Works

There are many studies and many approaches for detecting fake reviews in the online review system. Previous studies prove that reviews and ratings prove to affect user sentiments to a phenomenal effect. Studies show that most of the users buy a product after viewing the reviews and ratings, and when they find the reviews to be useful.

Various marketing studies show that product reviews are the key factor in determining the quality of a product and it is also essential for maintaining the reputation of any brand in the online business. Previous work [15] has shown that 10-15% of the reviews are as same as the previous reviews and an early fake review can influence the overall rating of the product.

Studies are done on the fake reviews, reviewers, and also reviewer groups and many classification algorithms are employed for classifying the dataset and detecting fake reviews at the product level and few studies have been done at the brand level. V. Gupta, A. Aggarwal and T. Chakraborty [1] had done a pioneering effort in detecting extremist reviewers at the brand level and they attempted to identify groups involved in posting extreme reviews at the brand level

They collected the review history of users from their Amazon profiles. They preprocessed all the datasets by using case-folding followed by careful stemming to clearly distinguish all the products belonging to all brands. They used frequent itemset mining based on a recursive elimination algorithm for identifying candidate groups. They used various classification techniques and used various features for classification. It includes average rating, average upvotes, average sentiment, review count, and many other features.[4] S. Dhawan, S. C. R. Gangireddy, S. Kumar, and T. Chakraborty extended reviewer graph to detect temporary group of users who work together to spam.

However, the previous work does not deal with how to handle the extreme reviewers once detected. Here we concentrate on extreme reviewers of each brand, if they are characterized as an extremist reviewer of a particular brand the reviewing ability of the user for that particular brand will be disabled by using (username, userid) attributes.

IV. Proposed Approach

Our approach to solving the problem of extremist reviewers who tend to dominate the reviews with extremism and change the overall sentiments of the users will be comprised of two steps. The first step would be detecting the extremist reviewers of the brand and the second step would be to prevent the reviewer from posting further reviews and ratings for the brand.

A. Detecting Extremist Reviewers

The users of any shopping site would view all the products of all the brands. They would search for the product they would want to buy. Similar products can be chosen from various brands available. The cost would vary according to the brand and its qualities. Any user would wish to buy a product with the best quality at an affordable price. Beyond their expectations, the review and rating given for a product would also determine which brand products to be bought. When a user finds the same product of different brands with almost the same cost, then deciding factor would be the reviews given by the previous customer.

We classify any customer to be an extremist reviewer when he posts reviews for almost all the products under a particular brand with extreme ratings.

B. What is an Extreme Review?

In the real world, even when the products meet all the user's expectations the probability of getting a 5-star rating is not always 100%. Only a very few customers would give a full rating if they liked the product very much, whereas the majority of the users would opt to give a moderate rating - 2,3,4. This is the reason why none of the products on any website would have the average rating to be full 5-star. The average rating for most-liked products will vary between 4 and 4.9 stars. This pave way for the influencers to post extreme positive ratings with 5-star to all the products of a particular brand and influence the users to buy their brand products. Such reviews are termed extreme reviews. The users who post such 5-star extreme positive for all the products of a particular brand are termed, extremist reviewers. The main aim of such users would be to just influence the user sentiments to buy their brand products. If those products of that brand are not worth the money spent by any customer, that would result in unhappy customers for the shopping site. Thus, opinion spamming affects the reputation of the website as well.

C. Decision Tree Classification

Decision trees are used in data mining to create a model which predicts the value of a target based on the values of several independent variables as input. We use the CART decision tree methodology to classify the reviews.

Classification trees are used where the target variable is categorical and the tree is used to identify the "class" within which the target variable would likely fall. Regression trees are used where the target variable is continuous and the tree is used to predict its value.

Fig. 1:. User 'xxx' had submitted extreme positive rating for all products of the brand Global Appliances.

The CART algorithm is structured as series of questions, the answer will determine the following question. This would form a tree structure where the ends are terminal nodes which indicates there are no more questions.

Here the questions to be followed for classification would be whether the review rating is extreme or moderate. And the next question would be if the rating is extreme, whether it would be extreme positive or extreme negative.

The CART algorithm uses Gini Impurity – a measure of how often a randomly chosen element of a set would be incorrectly labeled if it was randomly labeled according to the distribution of labels in the subset.

Mathematically Gini Impurity can be written as follows,

$$I_{Gini} = 1 - \sum_{i=1}^{j} p_i^2$$

Where j is the number of classes present in the node and p is the distribution of the class in the node.

And the other point to be considered would be if the reviewer has reviewed all or almost all of the products under a particular brand. Since we are trying to detect and prevent opinion spam of promoting their own product, the reviewers who had reviewed all the products with extreme positive ratings under a particular brand is considered to be the extremist reviewer corresponding to that particular brand.

The key factors of the proposed approach are as follows:

1. Once employed for promoting a brand, the reviewer's job would be to post reviews for all the products under the corresponding brand.
2. The reviewers would be cautious in finding every product of the brand and post an extreme positive review for all products.
3. Deciding to buy any product after viewing a star rating is much easier and more efficient when compared to viewing and reading review content. Reviews might be lengthy, making it difficult for the user to decide whether to buy the product or not.

D. Detecting Extremist Reviewers

Here the attributes used for classifying the extreme reviewers are as follows:

- Brand name
- Product name
- Product id
- Username
- User id
- Review
- Rating

The users with their user id will be able to log in to the shopping website, view all brands and products under each brand. When the user wishes to buy a product, the user will view the ratings and reviews corresponding to that product, if any. Based on the reviews the user decides to buy the product. After buying the product the user might provide ratings based on their use and help to the users.

As per our classification, when a user provides extreme ratings for all the products under a particular brand then the user intends to promote the brand and its products. In our system, we detect the extremist reviewer using the decision tree algorithm. For every brand, a list of products under the brand and the corresponding reviewers for every product under that brand are displayed. From that list, extremist reviewers for that brand can be classified and displayed to the website administrator for further actions.

Fig 2. Alert message after the user Xxx is blocked to submit a review for the Global Appliances brand

E. Blocking Extremist Reviewers

After being classified as an extremist reviewer for a particular brand, the administrator can opt to block the particular user from submitting more extreme reviews for that brand. For the first time, the extremist reviewer is not blocked from the entire website, he is just provided with a warning but preventing him from submitting extreme ratings for that particular brand.

For instance, consider a user Xxx, and an upcoming brand 'Global Appliances' with the following brands – Refrigerators, Washing Machines, Microwave Oven, Air Conditioners, Water Purifiers, Dishwasher.

If the brand owners or the marketing personnel decides to promote the online sale of products of their brand, they might employ people to submit high positive ratings and reviews to influence the opinion of the other users to buy their brand products.

If Xxx is one of the employed users to promote the brand Global Appliances, Xxx would submit an extreme positive rating for all the products under the Global Appliances brand.

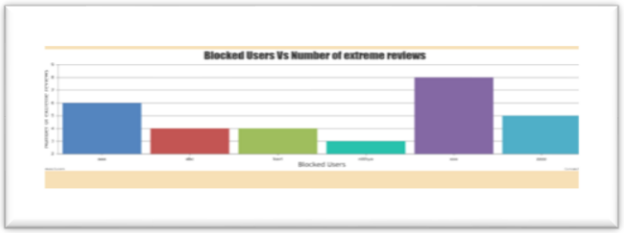

Fig 3. Graph showing the blocked users vs the number of extreme reviews posted by them.

The proposed system would detect the user Xxx to be an extremist reviewer for the particular brand. Fig. 1 displays the list of all products under Global Appliances for which user Xxx had submitted extreme positive rating. As per classification since Xxx had submitted extreme positive 5-star rating for all the products under a single brand, he would be classified as an extremist reviewer for that particular brand.

The administrator will have the option to block the user Xxx from providing another extreme review for the products of the brand. When the user attempts to post a rating for any of the products under the same brand, an alert message is displayed "You are classified as an extremist reviewer for this brand and you are not permitted to post any review for this brand products." Even though the user rating and review options are disabled for that brand's products, the user will be permitted to buy further. Only the recommending and reviewing options for that brand will be disabled, buying and paying facilities will still be available for that particular user

Hence not affecting the users' shopping experience, only the rating abilities are blocked if the user is classified as an extremist reviewer. If the user has genuinely posted positive reviews for the products but is classified as an extremist reviewer the user will not be stopped from purchasing further, instead, he will just not be permitted to post reviews, which is not going to be a major hindrance for any user. The next step in blocking the extremist reviewer would be if the user continues to post extreme positive reviews for other brands and get classified as an extremist reviewer for a second brand, the administrator can block the user logging in from the entire website. In the given instance, the user Xxx is classified as an extremist reviewer for the brand “Global Home Appliances”.

Now the user Xxx will not be allowed to post reviews and ratings for the products under that brand. When the user Xxx attempts to post a review and rating for any product of that brand, an alert message would be displayed and his rating ability would have been disabled. Now the user is not hindered from buying any products or viewing any other brand products.

We present a bar-chart in Fig. 3 with the extremist reviewers and the number of extreme reviews submitted by the users for better understanding. Based on the number of products under each brand and the extreme reviews for products the graph varies. Users who had submitted positive ratings for brands with fewer products have less rise in their graph whereas users who had submitted extreme positive ratings for brand with larger number of products will have greater rise in their graph.

F. Future Work

As a future work, after the users are blocked from posting extreme reviews for that particular brand the reviewer might again submit extreme reviews for any another brand intending to promote the second brand. As a future work the reviewer who had been already blocked from submitting ratings and trying to submit extreme positive ratings for another brand are to be detected and blocked from the website.

V. Conclusion

In this paper, we deal with opinion spammers who intend to promote the sale of products of a particular brand. We detect the extremist reviewers concerning a particular brand using decision tree classification techniques. The supervised model identifies extremist reviewers corresponding to a brand and after detecting the extremist reviewers, we disable the review options of the brand for that particular reviewer. This prevents the reviewer from influencing the sentiments of the buyers and preventing them from determining the popularity and reputation of the brand. The supervised model would detect and block extremist reviewers and thus reduce the influencing reviews enforced on the end-users to buy any products.

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Analysis of SURF Algorithm in Copy Move Forgery Detection

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***Abstract*–Copy - move image forgery detection (CMFD) is one in which the fraudulent is detect from the genuine digital image which is changed to make it look in some other way different from the original image. Availability of various improvisation and techniques in trend, that aids in image editing which paves way for image forgery. In turn the originality of the image is lost. In some scenarios where images may have influential power and be treated as proofs, for example, judicial proofs in court, news and insurance claim proofs. Digital computers that make use of algorithm in processing and obtaining details from digital image is known as Digital image processing. Implementing SURF algorithm, the images are analyzed for forgery where image is forged is saturated either with one or more functionalities like rotation, wrapping blur, hue and saturation color change, etc. SURF algorithm analyzes the images and obtain details in order to detect the originality of the image. Steps in this system includes 1. Feature extraction, 2. Feature description and 3. Feature Matching. Upon application of SURF algorithm on the images, matching is carried out with the extracted feature points to detect forgery.**

***Index Terms*–CMFD, feature, SURF and tampered.**

I. INTRODUCTION

Digital images in the modern world, has meaningful values various domains including forensic, medical, legal proofs etc. These images used as proofs or that has the power to change the real time situation, need to be genuine and free of tampering. In trend of editing and tampering images using various techniques and software, it is important to detect the image originality.

Availability of many ways in CMFD with different points taken into consideration. Generally, the most often operations done in image tampering includes removing any object from the image or placing a new object similar to the situation of the image so that the other object is hidden. Here, CMFD is performed by analyzing with Speeded Up Robust Feature (SURF) algorithm.

Copy move image tampering is one of the often-used techniques to pelt or manipulate the data of the captured image. Some portion of the image or some other similar object is pasted on another part of image. Suggestions on available methods to detect this type of forgery among few methods are highlighted in, but all the methods have not been covered in the survey. Since the invention of photography, individuals and organizations have often sought ways to manipulate and modify images to deceive the viewer. While originally a fairly difficult task requiring many hours of work by a professional technician, with the dawn of digital photography it is made possible and fairly trivial for anyone to easily modify images, and even easier to achieve professional looking results. This has resulted in wide reaching social issues.

Many methods exist in detecting forgery within digital images; however, it is problematic to discover which are the well-organized and practical ways to implement and run. Whilst one algorithm may have a good detection rate, it could also have a large rate of false positives. In addition, runtime is a least required feature that reflects to the efficiency and overall usability of an algorithm, but tends to only be mentioned academically as opposed to in real world terms.

II. RELATED WORKS

Copy-move method being very commonly used method for tampering digital images. Key point-based detection is recognized as effective in copy-move forgery detection (CMFD). An efficient CMFD method via clustering SIFT key points and searching the similar neighborhoods to locate tampered regions. In the proposed method, the key points are clustered based on scale and color, grouped into several smaller clusters and matched separately, which reduce the high time complexity caused in matching caused by the high dimensionality of SIFT. [1] Images being key marks in many scenarios, forensic analysis of image has become important to find the authenticity of them. A novel motion blur-based image forgery detection method, which includes three steps, convolutional neural network (CNN), kernels-based image tamper and a consistency propagation to detect forgery and localize.[2]

Differential excitation component (DEC) of Weber Law descriptor with the gray level co-occurrence matrix (GLCM) extracts texture feature extraction for CMFD. [5]

III. System Architecture

This system aims in detecting copy move forged digital images. Initial phase includes the collection of digital images and the input is given to the system. In which the input includes both the Original (Genuine) image and the tampered image.

Then the images are preprocessed where the images are processed for removal of noise and other unwanted details from it. Further to the images are enhanced with image resizing and image contrast adjust to obtain detailed data from the image pixels. These RGB images are then converted to Gray images for convenient and easy processing.

These images are then subjected to SURF algorithm where the feature points are extracted from each image and key point descriptors are chosen for respective images. Finally, the obtained feature key points are matched. When the matching percent is greater forgery is detected and vice versa.

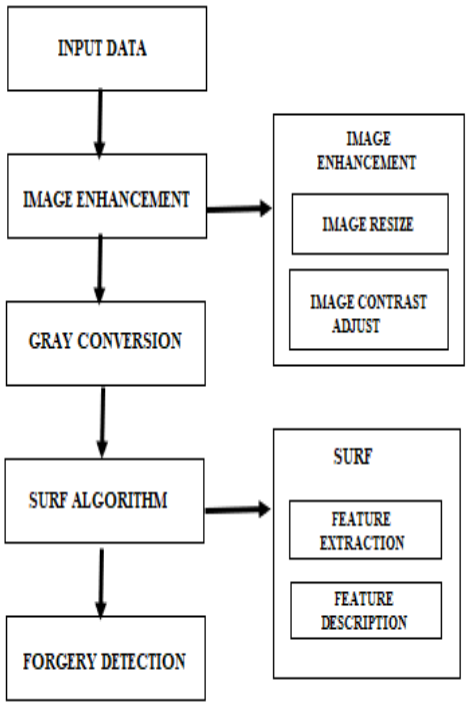

Fig. 1. Architecture diagram of the system.

The above Fig. 1, represents the working flow of the system in the analysis of SURF algorithm in detecting Copy move forgery.

IV. Methodology

A. Data Collection

Data collection is the approach to assemble and analyze to get information from all possible available sources to properly the obtain all available data that is required to process the system.

Fig. 2. Original input image.

Fig. 3. Tampered input image.

The above figures, Fig. 2 and Fig. 3 represents the Original Image and the Tampered images that is being passed as the input to the detection system. The data collected must be relevant to which is the system out is aimed to be. More the images relevant to the ideology of the system processing, more the accurate and efficient output is obtained.

B. Data Pre – Processing

Any data being collected may be subjected to various unwanted corruptions and alterations due to the environment which may disturb the data present in them. To obtain a clear set of data from the input used, they are subjected to pre-processing technique. It includes removal of various noises on the image using filters. Different types are filters are available in removing noises where the suitable one is used according to the data source. The clarity of the input data source determines the outcome of the system.

C. Image Enhancement

Image Enhancement is carried out to improve the quality of the image used in processing. Images can be enhanced in size, color, spatial representation etc. Here, in our system, image enhancement is done by image resizing and image contrast adjustment.

1) Image Resize:

Image resize involves the process of changing the size of the pixel from its actual size. Image Resize may involve two types, either pixel size is increased to enlarge the image or

pixel size is reduced to diminish the image. This further aids in obtaining detailed data from the image.

2) Image Contrast Adjustment:

Image contrast adjustment involves the process of varying the intensity of the image where the image contains various colors. With adjusting the contrast of the image, the color of the image may get changed. Data may be missed in case if the image has any darkened region or very light area. So, the image is adjusted such that there is no loss of information.

D. Gray Conversion

Gray scale represents monochromatic representation. The processing of RGB values in the image may involve huge computational complexity as they are represented in a three-dimensional spatial form. RGB is the combination of values along the Red, Green and Blue color intensity.

Fig. 4. Gray conversion of original input image.

Fig. 5. Gray conversion of tampered input image.

Whereas, the gray image is the single value i.e., can be represented in one dimensional form. The image is represented in Gray by simply varying the intensity of the brightness on the scale of black to white. Resultant image contains only Gray or no shade in it.

E. Feature Matching Using Surf

SURF algorithm generally works in 3 phases where the features are extracted from the space to represent them in the new space, secondly finds the feature descriptor and finally feature matching.

1) Feature Extraction:

Feature Extraction involves the process of obtaining the key points k in the pixel range, simply evaluating the distance between the nearby key points. Here evaluation is done with respect to the ratio of the closest distance of one key point to the second closest one. There may also be possibility of false key point generation with same distances. The strongest key points are chosen for further process.

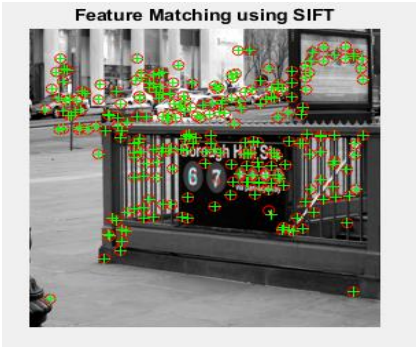

Fig. 6. Feature point extraction using surf.

2) Keypoint Descriptor:

The Localization region obtained in the initial phase using the Hessian Matrix is then subjected to orientation assignment and further these are brought into 4X4 square blocks. These are represented in vector form. Further these define the key points extracted in pixels to detect matching points. Here various measures are used to improve the robustness in the system.

3) Keypoint Matching:

Key points between two images are matched by identifying their nearest neighbors. But in some cases, the second closest match may be very near to the first. It may happen due to noise or some other reasons. In that case, ratio of closest-distance to second-closest distance is taken.

F. Forgery Detection

The capability of our proposed method against the extremely smooth copy-move forgery gives an example where the copy-move forgery only involves smooth regions. Generation of extremely smooth copy-move forgeries, continuously smooth the copy-move regions using Gaussian filters. Finally, we obtain a set of copy-move images with variances of the copied regions gradually changing from higher value to lower value.

The image is successfully detected as a forgery when the F-pixel is bigger than 0. As can be seen, our method is able to detect the forgery with high localization accuracy even when the variance of the copied region is about 1, in which case the copy-move areas are extremely smooth.

V. CONCLUSION

In this paper, the proposed fast and effective key point-based copy-move forgery detection and localization technique play a vital role in CMFD. By carefully studying the key point

extraction algorithm (SURF), it is demonstrated the possibility to generate a sufficient number of key points in small regions as well, by lowering the contrast threshold and resizing the image. Then this typical feature point extracting and matching made the task more easier and speeder in any critical matching problems. By fully exploiting the robustness properties of the SURF algorithm and the color information of each key point, our proposed technique achieves performs well and forgery is detected.

VI. Future Enhancement

All the methods have been suggested to draw strengths from different transforms to make them robust against post processing and to reduce the number of features to compare. However, as yet no method achieved 100% robustness against post processing operations. Also, selection of features poses problem. If it's taken too small smooth surfaced area and if taken too large, some forged areas go undetected.

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