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2nd Online International Conference Riset-2020

on

Industry 4.0 Generation 18th - 19th September, 2020



Organized by



Yogananda College of Engineering & Technology (YCET), Jammu in collaboration with Department of Electronics, University of Jammu, IETE Jammu Sub Centre of University of Jammu, and IIT Bombay

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2nd International Conference

RISET-2020 on Industry 4.0

Research and Innovations in Science, Engineering & Technology, 2020

ON
18TH & 19TH SEPTEMBER, 2020

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2nd Online International Conference Riset-2020
on
Industry 4.0 Generation

Organizes by

**YOGANANDA COLLEGE OF ENGINEERING AND TECHNOLOGY,
JAMMU**

On 18th-19th September, 2020

*In Technical collaboration with
IIT Bombay (Spoken Tutorial)
Department of Electronics, University of Jammu
IETE, Jammu Centre*

PROGRAMME

DAY – I 18th September, 2020

A. Technical Sessions

10.00 AM - 06.00 PM

| | | | |
|---------------|---------------------------------|--|--|
| 10:00-11:00AM | Inaugural Function | | |
| 11:00-12 Noon | Address by | Dr. Arun Prakash Arangaon, University of Manchester, U.K. | Paper on “Opportunities around Graphene & its Technology” |
| 12:00-1:00 PM | Address by | Prof. R. K. Shyamasundar, IIT Bombay, Mumbai | Paper on “Machine Learning” |
| BREAK | | | |
| 2:00-3:00 PM | Address by | Prof. Adrian Hopgood, University of Portsmouth, U.K. | Paper on “Practical AI using Complimentary Techniques |
| 3:00-5:00 PM | Paper Presentation Session 1 | Convenor of Session Prof. Sanjeev Kumar Gupta, HoD, GCET. | CIVIL |
| 3:00-5:00 PM | Paper Presentation Session 2 | Convenor of Session Dr. Bipin Kumar Rai, HoD, ABES, Ghaziabad Co-convenor Er. Vijay Sharma Honb Secretary, IETE JSC | ELECTRICAL/E&C |
| 5:00-6:00 PM | Project Idea Demonstration | Er. Rajnish Magotra, HoD Civil Department , YCET | (CIVIL/MECHANICAL) |
| 5:00-6:00 PM | Project Idea Demonstration | Er. Yuvraj Singh, Assistant Professor (Electronics Engineering) ,YCET | (CSE/IT/ELECTRICAL/E&C) |

B. INAUGURATION FUNCTION 10.00 AM - 11.00 AM

| | | | |
|------------|--|---------------------------------|--|
| 10.00 A.M. | Welcome all the dignitaries | Er. Rajnish Magotra | Rapporteur |
| 10.05 A.M. | Lighting of Lamps | By Students and Faculty of YCET | YCET |
| 10.10 A.M. | Saraswati Vandana | Recorded Video | Students of YCET, Jammu |
| 10.15 A.M. | Welcome Speech | Er. Vidhi S Singh Jamwal | Chairman, Jamwal Group |
| 10.20 A.M. | Introduction Speech | Prof. A.K. Srivastava | Director, YCET & Convener, Riset-20 |
| 10.25 A.M. | Speech of Special Guest | Prof. Al-Dabass | Professor Emeritus, NTU, U.K. |
| 10.30 A.M. | Speech by Special Guest | Dr. Mesfin Belachew | Senior Strategic Advisor, Digital |
| 10.35 A.M. | Release of Riset-20 Proceedings | | |
| 10.40 A.M. | Address by | Prof. Praveen Kumar Lehana | H.O.D. and Convener, Department of Electronics, University of Jammu |
| 10.45 A.M. | Address by | Prof. Pawanesh Abrol | Chairman, Institution of Electronics & Telecommunication Engineers, Jammu Sub Centre |
| 10.50 A.M. | Speech by Chief Guest | Prof. Manoj Kumar Dhar | Vice Chancellor, University of Jammu. |
| 11.00 A.M. | Vote of Thanks | Er. Dinesh Gupta | Organising Secretary, Riset-20 |
| 11.05 A.M. | National Anthem | | |

DAY – 2 19th September, 2020

C. TECHNICAL SESSIONS

10.00 AM - 05.00 PM

| | | | |
|----------------|-------------------------------------|---|--|
| 10:00-11:00 AM | Address by | Prof. Vivek Borkar, IIT Bombay, Mumbai | Paper on “Getting around in a networked world” |
| 11:00-12:00 PM | Paper Presentation Session 3 | Convener of Session, Er. Sanjeev Gupta, GCET | Mechanical |
| 11:00-12:00 PM | Paper Presentation Session 4 | Convener of Session, Dr. Richa Bhargava, ICFAI Business School, Gurgaon | CSE |
| 12:00-1:00 PM | Address by | Dr. Balakrishna Ananthoju, U.K.: | Paper on “Defect Enhanced SERS from Graphene-Gold” |
| | | Lunch Break | |
| 2:00-3:00 PM | Address by | Prof. J.V. Aghav, College of Engg., Pune | Paper on “Machine Learning Applications” |
| 3:00-4:00 PM | Address by | Dr. Rakesh Kumar, U.K | Invited Paper on “Generation of Sensors” |
| 4:00-5:00 PM | Project Idea Demonstration | Er. Kuldip Sharma, HoD, Mechanical Department, YCET, Jammu | (CIVIL/MECHANICAL) |
| 4:00-5:00 PM | Project Idea Demonstration | Er. B. R. Verma, Chief Coordinator, YCET, Jammu | (CSE/IT/ELECTRICAL/E&C) |



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|  Akshit Kumar Student Member ISF | Student Member | Mr. Akshit Kumar |
|  | Student Member | Ms. Amisheeka Anand |



MESSAGE

Prof. Manoj K. Dhar, FNASc, FNAAS
Vice Chancellor
University of Jammu, Jammu

I am pleased to know that 2nd International Conference Riset-2020 is being hosted by Yogananda College of Engineering & Technology, Jammu, in collaboration with IIT Bombay, Department of Electronics, University of Jammu, and IETE Jammu Centre. In spite of several constraints posed by COVID19, the efforts of the organizers are really praiseworthy as conducting the online activities of this stature are not an easy job. The theme of the conference "Industry 4.0 Generation" seems to be chosen judiciously, because of its relevance in today's technological era.

It is expected that the Fourth Industrial Generation will use 'digital Reality' to change conventional business practices, consumer behavior, operation decisions, and product precision. It will also change the employment environment requiring excellence of skill and level of knowledge. I am sure that the conference would offer excellent platform for discussion, exchange of views, ideas, and share information on the subjects of technological relevance.

I extended my warm greetings to the participating delegates, the organizers, and faculty members of Yogananda College of Engineering & Technology, (J&K) for organizing this Conference and wish the Conference a grand success.

With Best Regards

Prof. Manoj K. Dhar



MESSAGE

**Prof. Adrian Hopgood,
University of Portsmouth, U.K.**

I am looking forward to my participation in the 2nd International Conference Riset-2020 on Industry 4.0 Generation. It will be an honor to present my keynote talk on Practical AI using Complementary Techniques. Although there is currently a great deal of interest in machine learning from large data sets, I will argue that there are several other important AI techniques that can be used to complement it. I look forward to meeting you and I hope that you will find the conference enjoyable and informative.

Best regards

Prof. Adrian Hopgood



MESSAGE

Er. Vidhi S. Singh
Chairman, YCET

It gives me immense pride to have an International Conference being organised by our Institute.

YCET has always been ahead when it comes to quality enhancement programs and following best teaching practices for incessant improvements.

This is yet another endeavor by YCET in collaboration with Spoken Tutorial (IIT Bombay), Department of Electronics (University of Jammu) and IETE (Jammu Centre) as Riset 2020 on Industry 4.0 Gen.

I hope this proves to be a great opportunity for all to connect with expertise from education community and influential academicians from national and international institutes through their comprehensive range of presentations and will also bring out many thought provoking strategies on the traditional and advanced innovations in the fields of Science, Engineering & Technology with Industry 4.0.

We are looking forward to have you on September 18th & 19th to make Riset 2020 a grand success.

"I convey my very best wishes for an effective, successful and productive Conference."

With Best Regards

Er. Vidhi S. Singh



Prof. (Dr.) A. K. Srivastava
Director, YCET, Jammu

MESSAGE

It gives me immense pleasure that Computer Science & Engineering Department of Yogananda College of Engineering and Technology in collaboration with IIT Bombay, Department of Electronics, University of Jammu and Institution of Electronics & Telecommunication Engineers, Jammu is organizing online 2nd International Conference “Research & Innovations in Science & Technology Riset-20 on the theme of Industry 4.0 Generation” on 18th and 19th September, 20.

The theme of the conference is quite relevant in the present time. The term Industry 4.0 stands for the 4th industrial revolution which is defined as a new level of organization and control over the entire value chain of the life cycle of products: it is geared towards increasingly individualized customer requirement. Industry 4.0 is still visionary, but a real concept which includes Internet of Things (IOT), Machine Learning (ML), Industrial Internet, Smart Manufacturing, Block Chain Method, Artificial Intelligence (AI), Cyber Security, Intelligent Systems, Autonomous Robots, Data Science and Cloud Based Manufacturing etc.

A large number of research papers from Asia, Europe and rest part of the world have been received and after peer review of papers, selected papers will be presented during parallel session on various streams of the conference and published in UGC approved IJSTA journal.

In this technical conference latest research papers in theoretical and practical technological advances will be discussed. It will provide a forum where researchers can present recent research results, describe emerging technology and new research problems and directions related to Industry 4.0 Generation pillars.

To meet the challenges posed by COVID-19 and minimize the impact of pandemic on academic activities the idea of two days online 2nd International

Conference RISE-20 on Industry 4.0 Generation was conceived for sharing the research work and best practices of Industry 4.0 revolution for capacity building of all researchers across the world.

I hope that the conference proceedings will be a valuable resource in the professional, research and educational activities whether you are a student, academic, researcher, or a practicing professional.

Finally, I would like to express my sincere thanks to the plenary speakers, authors, session chairs, member of the program committee, reviewers and organizing committee who made this conference grand success.

My best wishes for the successful organization of the International Conference.

With Best Regards

Prof. (Dr.) A. K. Srivastava



Shyama Iyer
National Coordinator- Training
IITB-ST

MESSAGE

“TIT Bombay – Spoken Tutorial (IITB-ST) Project wishes the very best for Yogananda College of Engineering & Technology (YCET) organizes 2nd International Conference Riset-2020 in Sept '20. The IITB-ST teaching and learning program has been associated with YCET since 2018. In close and enthusiastic collaboration, the IT/Software course e-tutors have been offered and 1000s of students and teachers have mastered the particular course successfully in remote. In the summer during COVID lockdown phases YCET was able to deploy large Moodle software FDP nationwide. We cherish the continued participation of YCET in the much needed endeavor of spreading IT Competence digitally everywhere.”

With Best Regards

Shyama Iyer



MESSAGE

Dr. Sameru Sharma
Principal, GCET Jammu & Dean Faculty of Engineering
University of Jammu

It gives me immense pleasure to learn that Yogananda College of Engineering & Technology, Jammu affiliated to University of Jammu is organizing 2nd International Conference Riset-2020 on "Industry 4.0 Generation" in collaboration with IIT Bombay (Spoken Tutorial), Department of Electronics, University of Jammu and IETE Jammu on September 18-19, 2020. This International Conference would serve as a common platform among academicians, researchers, entrepreneurs and industry professionals from all over the world to share & exchange their innovative ideas and collaborate to ensure that the academia & the industry go hand in hand for adapting to the ever evolving technological landscape. I am glad to know that galaxy of intellectuals and experts from various parts of the country and abroad are presenting their research paper in the field of engineering and technology in this conference. I hope all students, faculty and stake holders from academic institutions and industry shall take advantage of this event. I wish this conference all the success.

With Best Regards

Dr. Sameru Sharma



MESSAGE

**Prof. Parveen K. Lehana, PhD IITB, FIETE, MISTE, MIAPT
Ex. Chairman IETE, Vice President VigyanParishad
HOD, Department of Electronics
University of Jammu, Jammu**

I am extremely happy to know that Yogananda College of Engineering & Technology, Jammu is organizing 2nd online International Conference Riset-20. I am sure that the conduct of this conference in collaboration with IETE, Jammu Sub Centre and Department of Electronics, University of Jammu will certainly enhance the visibility of the event for betterment of these institutions.

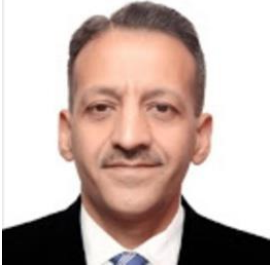
The development index of any country depends upon the infra-structure, availability of resources, and technical collaborations with experienced technocrats. Theme of the conference "Industry 4.0 Generation" justifies the telescopic vision of the organizers. Interaction of the academia and technocrats would surely result in fruitful conclusions for establishing strong standards of ergonomic product design protocols for better safety and reliability.

In my point of view, technology takes different shapes depending upon the Yuga. For example, during Satyuga, the extremely fast communication is possible via Maanas Putra (Naarad). In Tretaa, the communication capabilities are also transferred to the animal world. In Dwaapar, human like Sanjay attains the power of distant communication and during Kalyuga, even the stones (Si, Ge, etc.) also become capable of long range communication.

I wish to put on record my best wishes for the smooth conduct of the event!

With Best Regards

Prof. Parveen K. Lehana



MESSAGE

Pawanesh Abrol, PhD (CS), FIETE, FIE, MISTE, MCSI
Chairman IETE Jammu, Vice President, Vigyan Parishad
Professor, Department of Computer Science & IT
Director, Reasi Campus
University of Jammu, Jammu

It is a matter of great joy that Yogananda College of Engineering & Technology, Jammu (YCET) is organizing 2nd online International Conference Riset-20 in collaboration with Institution of Electronics and Telecommunication Engineers (IETE), Jammu sub Centre.

Industry 4.0 is an industrial transformation with increasing dependency on interconnectivity, automation, and real time data adapting new innovative technologies like big data, autonomous robots, cloud, IoT, machine learning, virtual reality, 3D printing, augmented reality etc. Integration of these technologies has enabled generation of highly efficient processes to produce higher-quality goods at reduced costs. This has indeed generated vast avenues of learning and wider scope of job prospects in information technology and other allied streams.

I am sure that the research scholars, students and the faculty members shall be immensely benefitted by the academic interactions and deliberations during the conference.

I congratulate the organizers for taking this initiative and wish a very enriching and joyful experience during the conference.

With Best Regards

Pawanesh Abrol



MESSAGE

Mesfin Belachew (PhD)
Senior Strategic Advisor, Ministry of Innovation & Technology
Collaborator at HiLCoE School of Computer Science & Technology
Addis Ababa, Ethiopia

I want to forward my appreciation to Yogananda College of Engineering & Technology (YCET) on organizing Riset-2020, the 2nd international conference on industry 4.0. The topic discussed in this proceeding will have a great contribution to the area which explores relatively new technologies like internet of things, artificial intelligence, big data analytics, cloud based manufacturing, cyber security, etc. just to list some. Researchers in the area have produce scientific knowledge and experience on how we humans can create value from the technologies before they become as disruptive.

The papers of the Riset-2020 will be published on the International Journal of Scientific and Technical Advancements (IJSTA) which is one of the best visited and refereed journals by the researchers and practitioners in the sector. The list of published papers is quite impressive in terms of topic coverage and quality of research works.

May I take this opportunity to convey my very best wishes for an effective, successful and productive conference followed by producing quality papers published in this proceeding.

With Best Regards

Dr. Mesfin Belachew



MESSAGE

Prof. David Al-Dabass
School of Computing & Information
Nottingham Trent University, U.K

We are delighted to welcome our colleagues from Asia, Europe and the rest of the world to this 2nd International Conference on Riset-2020 on Industry 4.0 Generation, held at Yogananda College of Engineering & Technology, Jammu. It follows in the footsteps of last successful event, which represented the 1st International Conference on Riset-2015, held at Yogananda College of Engineering & Technology, Jammu.

The conference program committee has organized an exciting and balanced program comprising presentations from distinguished experts in the field, and important and wide-ranging contributions on state-of-the-art research that provide new insights into the latest innovations in the field of Industry 4.0 Generation.

Being the 2nd international conference, we are hopeful that its outstanding technical content contributed by leading researchers in the field from Asia, Europe and worldwide will ensure its continued success. The conference themes and topics included: Internet of Things (IOT), Machine Learning (ML), Artificial Intelligence (AI), Data Science, Cloud Computing, Block Chain Method, Autonomous Robots, Intelligent Systems, Cyber Security etc.

The conference is technically collaborated by IIT, Bombay, Department of Electronics, Jammu and Institution of Electronics & Communication Engineers, Jammu.

The conference proved to be popular and received submissions far in excess of expectation from many countries. The conference program committee had a very challenging task of choosing high quality submissions. Each paper was peer reviewed by several independent referees of the program committee and, based on the recommendation of the reviewers 45 papers were finally accepted for

publication. The papers offer stimulating insights into emerging techniques and their applications in a wider variety of fields within science and technologies in the broadest sense of their meaning.

We would like to express our sincere thanks to the plenary speakers, authors, session chairs, members of the program committee and additional reviewers who made this conference such an outstanding success.

Finally, we hope that you will find the conference to be a valuable resource in your professional, research, and educational activities whether you are a student, academic, researcher, or a practicing professional. Enjoy!

Best regards

Prof. David Al-Dabass

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| 6 | IJSTA_V6N3_RX08_Y20 | Stabilization of Clayey Soil with Polyethylene Terephthalate Plastic Waste Powder | Shivam Sawhney Gurprit Singh Bath | shivamsawhney98@gmail.com | 29-36 |
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| 13 | IJSTA_V6N3_RX25_Y20 | Blockchain Technology: Functioning and Implications | Vivek Mahajan Dinesh Gupta Purva Paroch | purva03mahajan@gmail.com | 63-64 |
| 14 | IJSTA_V6N3_RX28_Y20 | Design and Fabrication of Paper Cutting Machine using Geneva Mechanism | Jaspreet Singh Arjun Singh Tanish Kumar Sharma | arjunsingh.ycet@gmail.com | 65-70 |
| 15 | IJSTA_V6N3_RX32_Y20 | Effectiveness and Efficiency of Unit Testing for Object-Oriented Programs | Pratap Singh Patwal Anoop Kumar Srivastva | pratappatwal@gmail.com | 71-78 |
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| 28 | IJSTA_V6N3_RX49_Y20 | Image Enhancement and Classification Techniques for Motion Blurred Dermatological Images | Chaahat Naveen Kumar Gondhi Parveen Kumar Lehana | chaahatgupta249@gmail.com | 141-146 |

The application of technology in Customer Relationship Management (CRM)

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Abstract— Customer relationship management (CRM) evolved from information technology is concerned with focussing, managing and retaining of customers in an organisation. It is a amalgamation of people, process and technology. Successful implementation of CRM can have competitive advantage but it requires business process engineering. Implementation of CRM can help organisations in gaining profit by managing and retaining customers. It is concerned with collecting, storing and analyzing data containing information about customers so as to enhance internal and external business relationships. This research paper focuses on discussing theoretical aspects of technological development for their use in the context of CRM. The paper is concerned about the importance of integrating technology with CRM.

Keywords— Application, Customers, Organisation, Technology.

I. INTRODUCTION

With the advent of technology and globalisation there has been mass production. The number of products available to consumers has accelerated. However, the relationship of shopkeeper and customers has drastically changed. Customers have lost their loyalty as there are various options available for a particular product. In order to establish good relationship between customers many organisations are using technology oriented processes which is known as Customer relationship management (CRM). CRM helps in understanding Consumer behaviour in order to retain them for longer period which will directly increase the organisations profitability. CRM technology applications link front office (e.g. sales, marketing and customer service) and back office (e.g. financial, operations, logistics and human resources) functions with the company's customer "touch points" [1]. A company's touch points can include the Internet, e-mail, sales, direct mail, telemarketing operations, call centres, advertising, fax, pagers, stores, and kiosks [2]. CRM integrates touch points around a common view of the customer [3]. Various software vendors example Microsoft Dynamics, Oracle, Sugar CRM, SAP, PeopleSoft, etc. are competing to bring best in class CRM applications to organizations.

II. OBJECTIVE

The objective of conducting this research is to :

- Establish link between CRM and Technology
- Identify the use of CRM in business so that new customers are formed and old are retained.
- Examine the recent trends of CRM.

III. RESEARCH METHODOLOGY:-

This paper is based upon secondary research. Various journals and books were consulted in order to study the benefits and recent trends of customer relationship management.

IV. EVOLUTION OF CRM

In the late 1980's Spread sheet and database became to be used for maintaining the record of the customer. Grouping of customers were done on the basis of their buying pattern . Then came contact management software but still most of the work was done manually. In 1990's companies were ready to make huge investment in technology to retain, maintain and form new customers .which led to CRM architecture. Due to advancement in recent enterprise software technology CRM is widely been accepted by organisation to maintain existing customer and focus on new customer. An outgrowth of sales force automation (SFA) tools, CRM is often referred to in the literature as one-to-one marketing [4].SFA uses software that is concerned with processing of orders ,managing of contact, sharing of information, tracking of orders , forecast of sales, inventory management etc. The major concern of SFA tool is to concentrate only on sales and less on administration. While CRM is a sophisticated application that focuses on retaining consumers, winning on new customers and predicting purchasing pattern of customers so that long run profitability is maintained. CRM is relationship management. It has become a reality due to accelerating competition among business houses, advancement in technology and internet.

V. BENEFITS OF CRM

Customer Relationship Management (CRM) is beneficial to companies because of following reasons:-

- Provides products and excellent services to customers.
- Improvement in efficiency by providing online service to customers.
- Forecast products based on previous sale.
- Stores all important information of their customers and makes available to all information as when required due to cloud. All the information is stored in cloud therefore with internet connection accessibility of any information is possible from any device at any time.

VI. CRM AND TECHNOLOGY

People, Process and Technology is required to build relationship between organisation and customers. Technology affects the product. Various technology applications are used for Customer Relationship Management. There are three main types of CRM applications and these are as follows:-

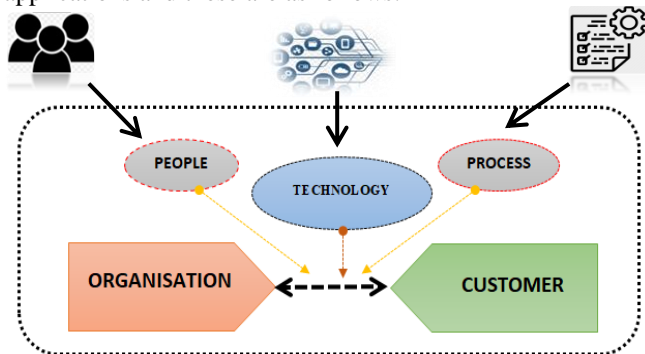


Fig. 1. Framework for Organisation-Customer relationship.

A. Operational CRM

Is the software that helps the organisation in establishing sales and marketing interaction with their customers. It is concerned with sales, marketing and service automation so that organisations are able to handle these various activities in better and flexible manner. Such core activities are as follows:

- Marketing Automation: - It is related to automating the process concerned with marketing activities. Here Customers specific information is collected stored and is used by the marketers to design and develop various Customer-oriented communication strategies.
- Sales force Automation: - The CRM targets not only existing customers but also focus on new customers. It helps in generating leads so that these leads can qualify as new prospects.
- Service Automation: - It is concerned with managing various in-tangible services of organisations. Like easy and quick access of

information related to customers for developing various future strategies keeping in view the needs and demands of their specific target customers.

B. Analytical CRM

It deals with analysing the behaviour of customers. Marketing tools for example data-mining is used for drawing out required data about consumers. Like their buying habits, profitable and unprofitable customers from the target audience.

C. Collaborative CRM

It integrates various departments like sales, marketing, finance and production. It shares the information of the customer among the departments for better understanding of customers. For example, the feedback of products could be shared with marketing and production department so that analysis can be performed in this aspect to provide products to customers.

VII. TECHNOLOGICAL TOOLS

Technology is changing rapidly and is extensively been used in every field. CRM and technology are well integrated. There are various technological tools used in CRM and these are:-

A. Electronic Point of Sale (EPOS)

Retail scanner provides correct and timely information as and when required. With the advancement of technology the scanner provides data not only related to rates of product, inventory level and margin but also delivers information related to purchasing habits, lifestyle, demographic and socio-economic characteristics of consumers.

B. Sales Force Automation

It helps in shortening the cycle of sales and accelerates the productivity of sales. Sales force Automation (SFA) is a software app that manages sales. The main modules of SFA are Contact Management, Lead Management, Account Management, Task Management, Pipe Line Management, Tracking customer preferences etc. For example contact management software helps to track communication with customers while task management helps create reminders to be given on different date. Pipeline management software tracks leads from first stage to closed sale.

C. Customer Service Helpdesk

Software is available to store detailed information about the customer. The inquiries and suggestions are transferred to the appropriate employees so that better service is provided to the customers. With the help of internet the organization can easily communicate with their internal as well as external customers and further helps customers to learn more about the product.

D. Call Centres

With the help of call centres, calls between customers and organisations take place. With the help of host software the automatic generation of the record of incoming and outgoing call is transferred to the organisation. This system is widely used in service sectors like banking, hospitality and telecom sector.

VIII. RECENT TRENDS IN CRM

Following are the emerging trends in CRM

A. Cloud-based CRM

Cloud based CRM software are been preferred. Cloud CRM provides access to the centralised data from the system at anytime from anywhere.

B. Integrating Data from Multiple Channels

The CRM solution providers are working on moving social media data to more safe communication channel. They are also exploring how they can link unstructured data coming from multiple channels such as Email, mobile smartphones, Social media, Product feedback survey and various customer touch points.

C. Social CRM

The customers are into the practice of reading reviews, recommendations, and judging the product or service before deciding to purchase. The businesses are keen to employ social CRM tools in their CRM software as the social media can bring an insight of customer preferences and behaviour.

D. Tool for Environment–Scanning

With the rise of sophisticated CRMs and core tech tools, sales and marketing teams can get information from the environment and use the same for formulating the strategy for future.

E. Voice and Conversational UI will start integrating with CRM

The growth of voice assistant usage and supporting hardware will likely come into play in marketing and operational processes, which means we may soon see some voice and conversational UI as part of CRMs.

providing better customer services and creates loyal customer. It provides an insight into all the activities going on in an organisation.

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IX. CONCLUSION

This paper makes an effort to present an insight into successful implementation of customer relationship management so that organization can make new customers and retain the old ones. Customer relationship management is a complex process because it raises the host of challenging business issues that lie at the interface of all over the business. The implementation of CRM help the organization to gain an advantage over its competitors. It is inevitable to every business organization. It helps in efficient functioning of organisation by reducing unnecessary burden of employees. CRM software helps in

Flood Detection and Avoidance System using IoT

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Abstract- Flooding is typically brought on by an increased quantity of water during a water system, sort of a lake or a river overflowing. Occasionally a dam fractures, abruptly releasing a huge quantity of water. The result is that an enormous amount of the water travels into soil, hence flooding the region. Flood predictions need real time data analysis like: speed of change within the river stage on a true time basis, which can help to indicate the seriousness and immediacy of this flood threat. Understanding of the shape of storm generating the moisture, like length, intensity and a true extent, which is effective for locating potential seriousness of the flood. In this particular system we are using a Arduino Uno interfaced with four different sensors, named as ultrasonic sensor for measuring the water levels, float sensor for detecting full water, flow sensor for knowing speed of water and humidity sensor. This combination of sensors are used to predict flood and alert respective authorities with the help of IoT and sound an instant alarm in the adjacent villages to instantly transmit information about possible floods. These sensors provide information over the IoT using Wi-Fi module. On detection of the conditions of flooding, the system predicts the quantity of your time it might fancy arrive a specific area and alerts the villages or the areas that would be suffering from it.

Keywords- Alarm, Flooding, IoT, Sensors.

I. PAPER DESCRIPTION

As we all know that in India we are facing floods almost every year in different parts of our country and there is tragic loss of life as well as property.

Some of the loss can be avoided. This paper focuses on how the loss could be minimized and the threats of flood could be detected timely and all the necessary measures could be taken to reduce the loss. This paper also focuses on growing technology like IoT and its application in our paper. It shows how a small, portable and inexpensive equipment could monitor the real time data on site using respective sensors and shows it on display as well as on website designed specifically and also sounds an alert.

II. INTRODUCTION

‘Flood Detection and Avoidance System using IoT’ is a smart system developed which will be calculating various natural factors on real time basis to predict a flood, so that we can prepare ourselves for attention, to minimize the damage which can be caused by flood. Natural disasters sort

of a flood are often devastating, resulting in damage to public belongings and loss of living beings. To reduce the consequences of the flood the smart system uses numerous natural factors to detect the incoming flood. This smart system has Wi-Fi connectivity, thus the data collected can be easily accessed from anywhere across globe just by having basic internet connection. To sense a flood the smart system measures various natural factors on site like humidity, temperature, water level and water flow. To collect real time data of the above mentioned natural factors, the smart system consists of four different sensors which will be collecting the data for every single parameter. To detect the changes in humidity and temperature, the smart system is equipped with a DHT11 Digital Temperature Humidity Sensor. The water level is usually kept under observation by a float sensor, which works by opening and shutting circuits which are its dry contacts, as water levels rise and fall. The float sensor basically rests in the closed position, which means that the circuit is incomplete and no electricity is passing through the wires yet. Once the water level starts dropping below a predetermined point, the circuit completes itself and sends electricity through the complete circuit to sound an alarm. To keep an eye over the

flow of the water the smart system is equipped with flow sensor, it consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed varies with change in rate of flow, and hence the rate of flow of water is depicted in litre per hour. Also, to monitor the rise in water level the system is equipped with HC-SR04 Ultrasonic Range Finder Distance Sensor, it works on the principle of SONAR and is designed to measure the distance using ultrasonic waves to determine the distance of water level from the sensor. All these sensors are connected to a common base that is Arduino UNO which store and process the data.

III. BLOCK DIAGRAM

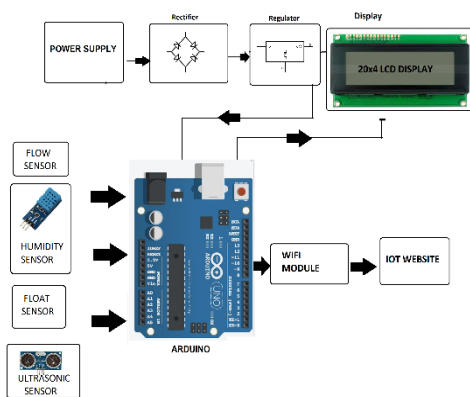


Fig 1: Block Diagram

IV. HARDWARE COMPONENTS

Hardware components used for this projects are flow sensor, float sensor, ultrasonic sensor, humidity sensor, WIFI module, LCD display, Arduino UNO board, power adapter and microcontroller. All these components collectively gather the data and updates it on display and on IoT server.

A. Microcontroller

In this project the microcontroller used is ATmega328 which is an eight bit microcontroller. It can handle the data sized up to eight bits. It consumes low power and is highly efficient.

B. Sensors

In our project we are using four sensors who will collect the real time data and provide for analysis. They are as follows:

C. Temperature and Humidity

This sensor is DHT11 and is used to calculate the temperature of the site at which it is fitted and also calculate the humidity in the atmosphere of the site.

D. Ultrasonic Module

This sensor emits short and high frequency sound pulses after regular intervals. If they strike at an object, then they are reflected back as echo signals to the sensors by which the distance of water level is measured. It is particularly HC-SR04 Ultrasonic Range Finder Distance Sensor.

E. Flow Sensor

The flow sensor is fitted to check the flow of water on the site on bases of litre per hour.

F. Float Sensor

This sensor observes the water level, it works by opening and closing circuits which are dry contacts. It sends the alarm when the water level rises.

G. WI-FI Module

ESP8266 Wi-Fi Module is an integrated TCP/IP protocol stacked with an independent SOC and with that it can give any microcontroller access to our Wi-Fi network.

H. Arduino UNO

The Arduino Uno may be a microcontroller board supported the ATmega328. It has 14 digital input/output pins (of which 6 are often used as PWM outputs), 6 analog inputs, a 16 MHz quartz oscillator , a USB connection, an influence jack, an ICSP header, and a reset button. Also, 32 KB of flash memory for storing our code.

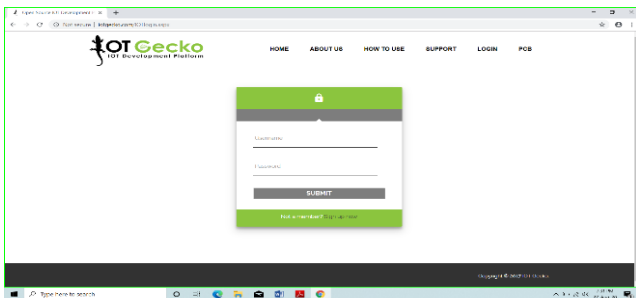
I. LCD

LCD is connected to show all the data collected by the respective sensors. The LCD used in this project is an alphanumeric and is 20x4.Each character is built by 5x8 pixel box.

V. SOFTWARE COMPONENTS

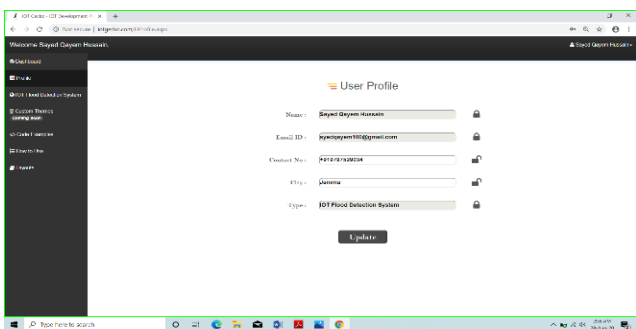
There are not many software requirements like hardware, only a few things are required such as Arduino, program for Arduino, website for data base. Arduino software is easily available on internet with the latest stable version and can be downloaded easily. Now the program for Arduino is major concern because without programming there will be no results. Therefore, we developed a program with respect to our credentials and stored it in the Arduino Uno board which possess a flash memory of 32KB only to store program. Also, the website is developed where user has to login using login id and password and after logging in he will find a dashboard from where he can view the profile and also access the data collected by our project at site.

VI. SNAPSHOT of WEBSITE



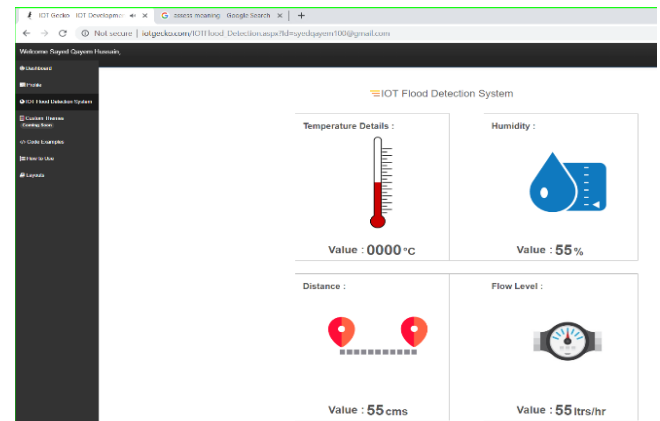
Website: Login page

Above snapshot is the website login page through which the user can enter his login id and password and have access to the facilities provided by the website.



Website: User Profile

In the above snapshot the user profile can be seen in which user's credentials are shown and also the dashboard on left side to access many other options.



Website: Real time data at website

In the above snapshot the real time data collected at the site is sent to the server and is displayed on the website.

VII. IMPLEMENTATION AND RESULTS



Fig 2: Hardware Implementation

In the above figure the hardware implementation of our project can be seen and here our site is considered as a mug full of water



Fig 3: LCD displaying data

In the above figure we can see the real time data collected by sensors being displayed on LCD.

VIII. WORKING

This project is based on a real time analysis and is based on Arduino and IoT. The components used are highly specific for this project. The working of the project can be described as follows:

- Initially the power is supplied to the rectifier circuit (power adapter) which provides the desired power output to all the components.
- The Arduino starts running its pre stored program.
- Simultaneously, all the components connected on PCB start working as they are interconnected to one another and also to Arduino.
- When the program runs it makes all the sensors to take a real time reading.
- The temperature and humidity sensor (DHT11) measures the real time humidity and temperature of the site.
- The flow sensor measures the rate of flow of water in litre/minute.
- Float sensor moves up and down due to buoyancy and measures the rise or fall level of water. A reed switch in the stem is activated by a magnet in sensor, and outputs the detection signal.
- Ultrasonic sensor emits short and high frequency sound pulses at regular intervals. If they strike an object, then the sound pulses are reflected back as echo signals to the sensor, which itself calculates the distance to the target based on the time span between emitting the signal and receiving the echo. Here the reference point is water level.
- As the project is IoT based and it needs to be connected to the internet, for that purpose we have the Wi-Fi sensor which also requires a connection from a local router and the SSID of the router must be set as 'iot' and the password be set as 'project1234', this is because the same is mentioned in the preloaded program.
- When it is connected to the Wi-Fi it starts displaying the real time data collected by all sensors on the LCD.
- This data is sent to a website <http://iotgecko.com>. By logging in into this website using an id and password, same as in preloaded program we can access the real time data from anywhere in the world.
- To initiate alert, we must include the parameters of river, dam or pond into the program i.e. up to what extent the rise in level is safe and what level is an

alarming level. When such parameters appear on real time data the alarm is automatically buzzed.

IX. APPLICATIONS

- To monitor the real time parameters such as humidity, temperature, rate of flow of water, rise or fall in water level.
- The data collected can also be used for long term data analysis.
- It also sends the real time analysis to IoT from where multiple users can view the live data.
- It sends out an alarm, when the real time data matches with the preloaded warning data.
- The equipment can be attached on dams, river basin and bridges, making it portable and easy to handle.
- The timely operation of flood control structures, (e.g. gates, temporary flood defences) prevents inundation of property and land.
- It offers pre-event maintenance operations to ensure free channel conveyance which includes installation of flood resilience measures such as sandbags, property flood barriers.

X. CONCLUSION

Flood warning is that the provision of an advance warning of conditions that are likely to cause flooding of property and a possible risk to life. The first purpose of flood warning is to save lots of life by providing people support and emergency services, and also ample time to organize for floods. The secondary purpose is to scale back the consequences of injury of flood (Bihar, 2020). The advantages associated with flood forecasting and warning are inextricably linked with the effectiveness of the warning dissemination programmes and thus the activities of the overall public and supporting agencies (both voluntary and official). The entire benefits are often defined as 'the reduction in losses (tangible and intangible) resulting from the availability of a warning as compared to things before the operation of the warning system'. Tangible losses are the worth of the damage arising as a consequence of the physical contact of floodwater with property (direct losses), and thus the losses which are consequent upon direct flood damage (indirect losses). Flood warning systems can provide a reduction in direct losses through:

- the timely operation of control structures (e.g. gates, temporary flood defences) preventing inundation of property and land;
- pre-event maintenance operations to make sure free channel conveyance;
- the installation of flood resilience measures (e.g. sandbags, property flood barriers);
- the evacuation of individuals to somewhere above the flood level or out of the flood plain.

Intangible losses include loss of life and injury, and thus the damage caused to human health and long-term well-being. Such losses are extremely difficult to quantify in economic terms, but are important considerations when evaluating the benefits of any flood management scheme, particularly flood warning where significant impacts are often made through facilitation of timely evacuation of these in danger.

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Improvement Of Clayey Soil Using Plastic Strips

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Abstract--Expansive soils are type of soils whose volume changes with the changes in water content. They swell and shrink that is serious hazard to structures built over them. Expansive soils cover almost one-sixth of the total area of our country. These soils show extreme stages of consistency, from very hard to very soft when saturated. In this study an attempt was made to stabilize and reinforced expansive soils with strips of waste plastic bottle. Stabilizing expansive clay soil with waste bottles of plastic simultaneously solves the challenges for disposal of plastic waste that's of great concern for most developing countries. For this Experimental study we conclude use of plastic waste in soil gives favorable result suggest that soil reinforced with plastic waste reduced swelling, improvement shear strength of soil and also resolve ground improvement problem in geotechnical engineering.

Keywords--Clay Soils, Expansive Soils, Plastic Strips, Soil Stabilization, Sustainable Society.

I. INTRODUCTION

Expansive soils are type of soils on addition of water show a significant change in volume. When exposed to excess water and shrink in hot weather conditions undergo expansion due presence of clay minerals. Due to shrinkage cracks of polygonal pattern in dry season these soils can be easily identified in the field. The changing behavior of expansive soils affects on stability of building built over these soils causing a serious hazard. Soil stabilization is required before construction on expansive soils, to reduce their swelling and improve mechanical capacities. Soil stabilization is technique improving the chemical and Physical parameters of soil up to a suitable extent where soil can show significant results in bearing capacity and shear strength ^[1] it is required to improve the soil's unqualified characteristics such as permeability, seepage and consolidation potential and increase shear strength. Soil stabilization goes way up to encourage usage of unstable soil and also reducing the uneconomical weak soil replacement process. Different ways have been developed previously to stabilize soil with low bearing capacity, low shear strength and unstable soils. Some of ways are cement stabilization, chemical stabilization, and bituminous stabilization ^[2] Researchers have also introduced soil stabilization by using different waste material for reinforcing soil. Using plastics for stabilization purpose simultaneously resolve issue related to disposal of plastic waste. Plastic bottles as reinforcing materials for improvement of soil properties is presented in this paper. The experimental study was performed in lab, results achieved are presented here.

II MATERIALS AND METHODS

MATERIALS

There were two materials used for the study. A representative type soil and rectangular PET bottle strips. Waste plastics were cleaned properly after collection and cut out into three different sized strips, using scissors.

Table 1: Strip size

| Strips | Width(mm) | Length(mm) |
|--------|-----------|------------|
| 1 | 5 | 7.5 |
| 2 | 10 | 15 |
| 3 | 15 | 20 |

MATERIAL CHARACTERISATION The characterization of the soil sample taken for this study included atterberg limit, specific gravity and particle size distribution. Top remove impurities and unwanted particles of sample soil was sieved. Once sample preparation was done, to study particle size distribution, sieve analysis ^[3] and hydrometer analysis ^[4] were conducted. Atterberg limits of soil were determined by performing atterberg limit test ^[5]. Specific gravity test ^[6] of soil sample was carried out using specific gravity beaker and vacuum pump.

III MATERIAL MIXING METHODS AND PROPORTIONS

The plastic strips which are expected to reinforce soil were added in three different percentages (0.5%, 1%, 2%) by mass of the soil.

Table 2 Shows the treatment level.

| Strip size(mm) | Treatment levels (%) |
|----------------|----------------------|
| 5*7.5 | 0.5 |
| | 1 |
| | 2 |
| 10*15 | 0.5 |
| | 1 |
| | 2 |
| 15*20 | 0.5 |

| | |
|--|---|
| | 1 |
| | 2 |

METHODS OF TESTING AND SOIL PROPERTIES

Once the characterization of both the materials was complete, the plastic bottle strips were added to soil sample in treatment levels described in table 2.

To behavior of soil with addition of plastic bottle strips for soil stabilization, following test were conducted in lab

- Free swelling test
- Standard proctor test for soil compaction
- Direct shear test

IV RESULTS AND DISCUSSIONS

CHARACTERIZATION OF SOIL

The soil sample was characterized according to specific gravity, atterberg limit and particle size distribution. The results showed that soil was fine grained clay soil with specific gravity 2.78 as well as liquid limit 93.3% plastic limit 27.5% and plasticity index is 65.8% i.e difference between L.L and P.L.

TESTING OF REINFORCED SOIL PROPERTIES

STANDARD PROCTOR COMPACTION TEST RESULTS

Effect on soil properties with addition plastic into soil was checked in terms of soil's improvement during compaction by standard proctor test. This soil stabilization was expressed in the change in the optimum moisture content (OMC) and maximum dry density (MDD). This test was done as per [17]. The summary of test result is given in table 3. The reason for decrement of OMC might be because of zero absorption capacity of plastic strips. Therefore soils can be compacted to its maximum dry density at lower addition of water, which is a good result from improvement point of view.

TABLE 3: Standard Proctor Test for Compaction Results

| Strip size | Treatment level (%) | MDD(KN/m) | OMC (%) |
|------------|---------------------|-----------|---------|
| None | 0 | 12.82 | 42 |
| 5*7.5 | 0.5 | 11.97 | 34.4 |
| | 1 | 12.56 | 32.5 |
| | 2 | 12.8 | 29 |
| 10*15 | 0.5 | 12.38 | 36 |
| | 1 | 12.12 | 35 |
| | 2 | 11.92 | 34 |
| 15*20 | 0.5 | 12.22 | 36 |
| | 1 | 12.25 | 35.14 |
| | 2 | 12.18 | 35 |

TABLE 4: Free Swell Test Results

| Strip size(mm) | Treatment level (%) | Swelling (%) |
|----------------|---------------------|--------------|
| None | 0% | 160 |
| 5*7.5 | 0.5 | 136.3 |
| | 1 | 126.3 |
| | 2 | 123.5 |
| 10*15 | 0.5 | 134 |
| | 1 | 121 |
| | 2 | 116 |
| 15*20 | 0.5 | 135 |
| | 1 | 127.5 |
| | 2 | 117.5 |

Direct Shear Test Results

It was possible to conclude from the results of test that the arrangement of plastic strip from plastic in soil affects the shear capacity of reinforced soil. This test was carried as per [9]. If shear plane is parallel to surface of the strip, the shear resistance will Improved and the capacity of soil will reduce. But other arrangements of strips in soil will improve the shear capacity. But it was very difficult to arrange large strips on direct shear machine. The shear capacity from the test is shown in terms of shear strength parameters, cohesion(C) and angle of friction (ϕ). Both improvement and fall of shear capacity were observed for C and ϕ . The cohesion intercept and angle of internal friction of unreinforced soil was recorded to be 49.75Kpa and 5.690 respectively. The small value of friction angle is attributed to the cohesion of soil. The largest value of C and ϕ for reinforced soil was obtained as 8.980 and 62.67Kpa which was 57% and 27% improvement respectively. However, increasing the plastic size for same content increases both the friction angle and cohesion.

V CONCLUSION

Now days use of plastic products increasing very rapidly and plastic waste generated from these product increasing day by day. Thus using plastic bottle for soil stabilization produce better results. After various laboratory test conducted on soil reinforced with plastic wastes shows increase in shear resistance and also reduction in swelling of clayey soil. Use of plastic waste for soil also results in reduction of several environmental issues that lead to the foundation of sustainable society.

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Double Sequence And Double Series Via Four Dimensional Bounded Regular Matrices

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Abstract—In this paper we establish some wide-ranging spaces of double difference sequence spaces defined by a new definition of convergence of a double sequence and a double series via sequence of Orlicz functions and a four dimensional bounded regular matrices $A = (a_{mnkl})$ over n -normed spaces. We have encompassed some topological and algebraic properties of these sequence spaces.

Keywords— Double sequence, Orlicz function, regularity of 4-dimensional infinite matrices, Silverman-Toeplitz theorem for double sequence and double series.

I. INTRODUCTION

In [13], Hardy introduced the concept of regular convergence for double sequences. Some important work on double sequences is also found by Bromwich [3]. Later on, it was studied by various authors, e.g. Moricz [17], Moricz and Rhoades [18], Basarir and Sonalcan [4], Mursaleen and Mohiuddine [20, 21] and many others. Mursaleen [22] has defined and characterized the notion of almost strong regularity of four dimensional matrices and applied these matrices to establish a core theorem (also see [23]). Altay and Basar [1] have recently introduced the double sequence spaces BS, BS(t), CSp, CSbp, CSr and BV consisting of all double series whose sequence of partial sums are in the spaces Mu, Mu(t), Cp, Cbp, Cr and Lu, respectively. Basar and Sever [5] extended the well known space q from single sequence to double sequences, denoted by Lq , and established its interesting properties. The authors of [24] defined some convex and paranormed sequences spaces and presented some interesting characterization. Most recently, Mohiuddine and Alotaibi [25] introduced some new double sequences spaces for σ -convergence of double sequences and invariant mean, and also determined some inclusion results for these spaces. For more details on these concepts, one can be referred to [6, 26, 32].

A double sequence $x = (x_{kl})$ is said to be bounded if $\|x\|_{(\infty, 2)} = \sup_{k,l} |x_{k,l}| < \infty$. We denote by l_{∞}^2 , the space of all bounded double sequences. Let $S \subseteq \mathbb{N} \times \mathbb{N}$ and let $\varepsilon > 0$ be given. By $\chi_{S(x;\varepsilon)}$ we denote the characteristic function of the set $S(x;\varepsilon) = \{(k, l) \in \mathbb{N} \times \mathbb{N} : |x_{k,l}| \geq \varepsilon\}$.

In [29] Natarajan introduce a new definition of limit of a double sequence and a double series.

Definition 1.1. Let $\{x_{m,n}\}$ be a double sequence. We say that

$$\lim_{m+n \rightarrow \infty} x_{m,n} = x$$

if for every $\varepsilon > 0$, the set $\{(m, n) \in \mathbb{N}^2 : |x_{m,n} - x| \geq \varepsilon\}$ is finite, \mathbb{N} being the set of positive integers. In such a case x is unique and x is called the limit of $\{x_{m,n}\}$. We also say that $\{x_{m,n}\}$ converges to x .

Remark 1.2. If $\lim_{m+n \rightarrow \infty} x_{m,n} = x$ then the double sequence $\{x_{m,n}\}$ is automatically bounded.

It is easy to prove the following result.

Theorem 1.3. $\lim_{m+n \rightarrow \infty} x_{m,n} = x$ if and only if

$$(1) \lim_{m \rightarrow \infty} x_{m,n} = x, \quad n = 0; 1; 2, \dots;$$

$$(2) \lim_{n \rightarrow \infty} x_{m,n} = x, \quad m = 0; 1; 2, \dots;$$

and

$$(3) \text{ for any } \varepsilon > 0; \text{ there exists an } N \in \mathbb{N} \text{ such that}$$

$|x_{m,n} - x| < \varepsilon, \quad m, n \geq N$, which we write as $\lim_{m+n \rightarrow \infty} x_{m,n} = x$, (Note that this is Pringsheim's definition of limit of a double sequence).

Theorem 1.4. If the double series

$$\sum_{m,n=0}^{\infty, \infty} x_{m,n}$$

converges,

$$\lim_{m+n \rightarrow \infty} x_{m,n} = 0$$

then

However, the converse is not true.

Definition 1.5. Given the 4- dimensional infinite matrix $A = (a_{mnkl})$ and a double sequence $x = \{x_{kl}\}$, by the A-transform of $x = \{x_{kl}\}$, we mean the double sequence $A(x) = \{A(x)_{mn}\}$, where

$$(Ax)_{mn} = \sum_{k,l=0}^{\infty, \infty} a_{mnkl} x_{k,l}, \quad m, n = 0, 1, 2, \dots,$$

assuming that the double series on the right converge. If $\lim_{m+n \rightarrow \infty} (Ax)_{m,n} = s$, we say that the double sequence $x = \{x_{kl}\}$ is A-summable or summable A to s, written as

$$x_{kl} \rightarrow s(A).$$

If $\lim_{m+n \rightarrow \infty} (Ax)_{m,n} = s$; whenever $\lim_{k+l \rightarrow \infty} x_{kl} = s$, we say that 4- dimensional infinite matrix $A = (a_{mnkl})$ is regular.

Necessary and sufficient conditions for $A = (a_{mnkl})$ to be regular for the class of all double sequences and series in the classical case have been found by Kojima [15]. It has been found that convergence and boundedness play a vital role for double sequences and series, a role analogous to that of convergence for simple sequences and series. Robison [33] proved Silvermann- Toeplitz Theorem for such a class of bounded and convergent double sequences in the classical case. Natarajan and Srinivasan [30] proved its analogue in a complete, nontrivially valued, non-archimedean field.

Theorem 1.6. (Natarajan [29]) (SILVER-TOEPLITZ Theorem) The four dimensional infinite matrix $A = (a_{mnkl})$ is regular if and only if

- (1) $\sup_{m,n} \sum_{k,l=0}^{\infty, \infty} |a_{mnkl}| < \infty$;
- (2) $\lim_{m+n \rightarrow \infty} a_{mnkl} = 0, \quad k, l = 0, 1, 2, \dots$;
- (3) $\lim_{m+n \rightarrow \infty} \sum_{k,l=0}^{\infty, \infty} a_{mnkl} = 1$;
- (4) $\lim_{m+n \rightarrow \infty} \sum_{k=0}^{\infty} |a_{mnkl}| = 0, \quad l = 0, 1, 2, \dots$;

and

- (5) $\lim_{m+n \rightarrow \infty} \sum_{l=0}^{\infty} |a_{mnkl}| = 0, \quad k = 0, 1, 2, \dots$;

The notion of difference sequence spaces was introduced by Kizmaz [14], who studied the difference sequence $l_{\infty}(\Delta)$, $c(\Delta)$ and $c_0(\Delta)$. The notion was further generalized by Et and Colak [8] by introducing the spaces $l_{\infty}(\Delta^r)$, $c(\Delta^r)$, and $c_0(\Delta^r)$. Let w denote the set of all real and complex sequences m, n be non-negative integers, then for $Z = c, c_0$ and l_{∞} sequence space, we have

$$Z(\Delta_s^r) = \{x = (x_k) \in w : (\Delta_s^r x_k) \in Z\}$$

for where

$$\Delta_s^r x = (\Delta_s^r x_k) = (\Delta_s^{r-1} x_k - \Delta_s^{r-1} x_{k+1})$$

and $\Delta_s^0 x_k = x_k$ for all $k \in \mathbb{N}$, which is equivalent to the following binomial representation

$$\Delta_s^r x_k = \sum_{v=0}^r (-1)^v \binom{r}{v} x_{k+sv}$$

Taking $s=1$, $l_{\infty}(\Delta^r)$, $c(\Delta^r)$, and $c_0(\Delta^r)$ we get the spaces studied by Et and Colak [8]. Taking $s=r=1$, we get the spaces $l_{\infty}(\Delta)$, $c(\Delta)$ and $c_0(\Delta)$ introduced and studied by Kizmaz [14]. Similarly, we can define difference operators on double sequence spaces as:

$$\Delta x_{k,l} = (x_{k,l} - x_{k,l+1}) - (x_{k+1,l} - x_{k+1,l+1})$$

$$= x_{k,l} - x_{k,l+1} - x_{k+1,l} + x_{k+1,l+1},$$

$$\Delta^r x_{k,l} = \Delta^{r-1} x_{k,l} - \Delta^{r-1} x_{k,l+1} - \Delta^{r-1} x_{k+1,l} + \Delta^{r-1} x_{k+1,l+1}$$

and

$$\Delta_s^r x_{k,l} = \Delta_s^{r-1} x_{k,l} - \Delta_s^{r-1} x_{k,l+1} - \Delta_s^{r-1} x_{k+1,l} + \Delta_s^{r-1} x_{k+1,l+1}$$

For more details about sequence spaces see ([2], [7], [31],[34]) and references therein.

An Orlicz function $M: [0, \infty) \rightarrow [0, \infty)$ is a continuous, non-decreasing and convex with $M(0) = 0$, $M(x) > 0$ for $x > 0$ and $M(x) \rightarrow \infty$ as $x \rightarrow \infty$. If convexity of Orlicz function is replaced by $M(x+y) \leq M(x) + M(y)$, then this function is called modulus function.

Lindenstrauss and Tzafriri [16] used the idea of Orlicz function to define the following sequence space.

$$l_M = \left\{ x \in w : \sum_{k=1}^{\infty} M\left(\frac{|x_k|}{\rho}\right) < \infty, \text{ for all } \rho > 0 \right\}$$

which is known as an Orlicz sequence space. The space l_M is a Banach space with the norm

$$\|x\| = \inf \left\{ \rho > 0 : \sum_{k=1}^{\infty} M\left(\frac{|x_k|}{\rho}\right) \leq 1 \right\}.$$

Also it is shown in [16] that every Orlicz sequence space l_M contains a subspace isomorphic to l_p ($p \geq 1$). An Orlicz function M satisfies Δ_2 -condition if and only if for any constant $L > 1$ there exists a constant $K(L)$ such that $M(Lu) \leq K(L)M(u)$ for all values of $u \geq 0$. An Orlicz function M can always be represented in the following integral form

$$M(x) = \int_0^x \eta(t) dt$$

where η is known as the kernel of M , is right differentiable for $t \geq 0$, $\eta(0) = 0$, $\eta(t) > 0$, η is non-decreasing and $\eta(t) \rightarrow \infty$ as $t \rightarrow \infty$.

A sequence $\mathcal{M} = (M_k)$ of Orlicz functions is called a Musielak-Orlicz function (see [27, 28]). A sequence $\mathcal{N} = (N_k)$ is defined by

$$N_k(v) = \sup \{v|u - M_k(u) : u \geq 0\}, \quad k = 1, 2, \dots$$

is called the complementary function of a Musielak-Orlicz function \mathcal{M} . For a given Musielak-Orlicz function \mathcal{M} , the Musielak-Orlicz sequence space $t_{\mathcal{M}}$ and its subspace $h_{\mathcal{M}}$ are defined as follows

$$t_{\mathcal{M}} = \{x \in W : I_{\mathcal{M}}(cx) < \infty \text{ for some } c > 0\},$$

$$h_{\mathcal{M}} = \{x \in W : I_{\mathcal{M}}(cx) < \infty \text{ for all } c > 0\},$$

where $I_{\mathcal{M}}$ is a convex modular defined by

$$I_{\mathcal{M}}(x) = \sum_{k=1}^{\infty} M_k(x_k), \quad x = (x_k) \in t_{\mathcal{M}}.$$

We consider $t_{\mathcal{M}}$ equipped with the Luxemburg norm

$$\|x\| = \inf \left\{ k > 0 : I_{\mathcal{M}}\left(\frac{x}{k}\right) \leq 1 \right\}$$

or equipped with the Orlicz norm

$$\|x\|^0 = \inf \left\{ \frac{1}{k} (1 + I_{\mathcal{M}}(kx)) : k > 0 \right\}.$$

The mid of 1960's marked the initiation of the concept of 2-normed spaces developed by Gähler [9]. Misiak [19] further illustrated the n -normed spaces. This concept was further analyzed by critics like Gunawan ([10],[11]) and Gunawan and Mashadi [12] who studied it and obtained various results. Let X be a linear space over the field \mathbb{R} of dimension d , where $d \geq n \geq 2$, $n \in \mathbb{N}$. A real valued function $\|\cdot, \dots, \cdot\|$ on X^n is called a n -norm, if it satisfies the subsequent four conditions:

- (1) $\|x_1, x_2, \dots, x_n\| = 0$ if and only if x_1, x_2, \dots, x_n are linearly dependent in X ;
- (2) $\|x_1, x_2, \dots, x_n\|$ is invariant under permutation;
- (3) $\|\alpha x_1, x_2, \dots, x_n\| = |\alpha| \|x_1, x_2, \dots, x_n\|$ for any $\alpha \in \mathbb{R}$, and
- (4) $\|x + x', x_2, \dots, x_n\| \leq \|x, x_2, \dots, x_n\| + \|x', x_2, \dots, x_n\|$

and the pair $(X, \|\cdot, \dots, \cdot\|)$ is called a n -normed space

Example. Choose $X = \mathbb{R}^n$ being furnished by the Euclidean n -norm $\|x_1, x_2, \dots, x_n\|_E$ = the volume of the n -dimensional parallelepiped spread over by the vectors x_1, x_2, \dots, x_n which might be given expressly by the formula

$$\|x_1, x_2, \dots, x_n\|_E = |\det(x_{ij})|,$$

where $x_i = (x_{i1}, x_{i2}, \dots, x_{in}) \in \mathbb{R}^n$ for each $i = 1, 2, \dots, n$. Let

$(X, \|\cdot, \dots, \cdot\|)$ be a n -normed space of dimension $d \geq n \geq 2$ and $\{a_1, a_2, \dots, a_n\}$ be linearly independent set in X . Then the following function $\|\cdot, \dots, \cdot\|_{\infty}$ on X^{n-1} defined by $\|x_1, x_2, \dots, x_{n-1}\|_{\infty} = \max \{\|x_1, x_2, \dots, x_{n-1}, a_i\| : i = 1, 2, \dots, n\}$

defines an $(n-1)$ -norm on X with respect to $\{a_1, a_2, \dots, a_n\}$.

A sequence (x_k) in a n -normed space $(X, \|\cdot, \dots, \cdot\|)$ is said to converge to some $L \in X$ if

$$\lim_{k \rightarrow \infty} \|x_k - L, z_1, \dots, z_{n-1}\| = 0 \text{ for every } z_1, \dots, z_{n-1} \in X.$$

A sequence (x_k) in a n -normed space $(X, \|\cdot, \dots, \cdot\|)$ is said to be Cauchy if

$$\lim_{k, p \rightarrow \infty} \|x_k - x_p, z_1, \dots, z_{n-1}\| = 0 \text{ for every } z_1, \dots, z_{n-1} \in X.$$

If every Cauchy sequence in X converges to some $L \in X$, then X is said to be complete with respect to the n -norm. Any complete n -normed space is said to be n -Banach space.

II. THE DOUBLE DIFFERENCE SEQUENCE SPACES

In this section, we define some new paranormed double difference sequence spaces with the help of sequence of Orlicz

functions and four-dimensional bounded-regular matrices. Before proceeding further, first we recall the notion of paranormed space as follows:

A linear topological space X over the real field \mathbb{R} (the set of real numbers) is said to be a paranormed space if there is a subadditive function $g : X \rightarrow \mathbb{R}$ such that $g(\theta) = 0$, $g(x) = g(-x)$ and scalar multiplication is continuous, i.e., $|\alpha_n - \alpha| \rightarrow 0$ and $g(x_n - x) \rightarrow 0$ imply $g(\alpha x_n - \alpha x) \rightarrow 0$ for all α 's in \mathbb{R} and all x 's in X , where θ is the zero vector in the linear space X .

Let $\mathcal{M} = (M_{kl})$ be sequence of Orlicz functions and let $A = (a_{mnkl})$ be a nonnegative four-dimensional bounded regular matrix. Then, we define the following new double sequence spaces:

$$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) = \{x = (x_{kl}) \in w(n-X) : \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] = 0, \text{ for some } \rho > 0\},$$

$$W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) = \{x = (x_{kl}) \in w(n-X) : \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] = 0, \text{ for some } \rho > 0\},$$

$$W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) = \{x = (x_{kl}) \in w(n-X) : \sup_{m,n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] < \infty, \text{ for some } \rho > 0\},$$

where $p = (p_{kl})$ is a bounded double sequence of real numbers such that $p_{kl} > 0$ for k, l and $\sup_{p_{kl}} p_{kl} = G < \infty$, and $u = (u_{kl})$ is a double sequence of strictly positive real numbers.

Remark 2.1. If we take $\mathcal{M}(x) = (x)$, then the above sequence spaces reduced to $W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$

Remark 2.2. Let $p = (p_{kl}) = 1$ for all k, l . Then the above sequence space become $W_0^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$, $W^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$

Remark 2.3. Let $u = (u_{kl}) = 1$ for all k, l . Then the spaces are reduced to $W_0^2(A, \mathcal{M}, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(A, \mathcal{M}, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(A, \mathcal{M}, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$

Remark 2.4. If we take $A = (C, 1, 1)$, we get $W_0^2(\mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(\mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(\mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$

Throughout the paper, we shall use the following inequality: Let (a_{kl}) and (b_{kl}) be two double sequences. Then

$$|a_{kl} + b_{kl}|^{p_{kl}} \leq K(|a_{kl}|^{p_{kl}} + |b_{kl}|^{p_{kl}}), \quad (2.1)$$

where $K = \max(1, 2^{G-1})$ and $\sup_{k,l} p_{kl} = G$ (See [25]).

The main purpose of this paper is to introduce new sequence spaces $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ with the help of a new definition of convergence of a double sequence and a double series. We also make an effort to study some topological properties and inclusion relations between these sequence spaces.

III. MAIN RESULTS

Theorem 3.1. Let $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions, $A = (a_{mnkl})$ be a nonnegative 4-dimensional regular matrix, $p = (p_{kl})$ be a bounded sequence of positive real numbers and $u = (u_{kl})$ be a sequence of strictly positive real numbers. Then $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ and $W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ are linear spaces over the complex field.

Proof. Let $x = (x_{kl})$, $y = (y_{kl}) \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ and $\alpha, \beta \in \mathbb{C}$. Then there exist positive numbers ρ_1 and ρ_2 such that

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] = 0, \text{ for some } \rho_1 > 0,$$

$$\text{and } \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r y_{kl}}{\rho_2}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] = 0, \text{ for some } \rho_2 > 0,$$

Let $\rho_3 = \max(2|\alpha|\rho_1, 2|\beta|\rho_2)$. Since $\mathcal{M} = (M_{kl})$ is a non-decreasing and convex, so by inequality (2.1), we have

$$\begin{aligned} & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} \Delta_s^r (\alpha x_{kl} + \beta y_{kl})}{\rho_3}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] \\ &= \\ &= \\ & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\|\frac{u_{kl} (\alpha \Delta_s^r x_{kl} + \beta \Delta_s^r y_{kl})}{\rho_3}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] \\ &\leq K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} \frac{1}{2^{p_{kl}}} [M_{kl}(\|\frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1}, z_1, \dots, z_{n-1}\|)^{p_{kl}}] \end{aligned}$$

$$\begin{aligned}
 & + K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} \frac{1}{2^{p_{kl}}} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & \leq K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & + K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & = 0
 \end{aligned}$$

Thus $\alpha x + \beta y \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. This proves that $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ is a linear space. Similarly we can prove that $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ and $W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ are also a linear space.

Theorem 3.2. Let $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions, $A = (a_{mnkl})$ be a nonnegative 4- dimensional regular matrix, $p = (p_{kl})$ be a bounded sequence of positive real numbers and $u = (u_{kl})$ be a sequence of strictly positive real numbers. Then $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, $W_\infty^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$ are paranormed spaces with the paranorm $g(x) = \inf \{\rho^{\frac{p_{kl}}{H}}\}$:

$$\begin{aligned}
 & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \\
 & \leq 1, \text{ for some } \rho > 0
 \end{aligned}$$

where $< p_{kl} \leq \sup p_{kl} = G$, and $H = \max(1, G)$.

Proof. (i) Clearly, $g(x) \geq 0$ for $x = (x_{kl}) \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. Since $M_{kl}(0) = 0$, we get $g(0) = 0$.

(ii) $g(-x) = g(x)$.

(iii) Let $x = (x_{kl})$, $y = (y_{kl}) \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. Then there exist positive numbers ρ_1 and ρ_2 such that

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \leq 1$$

and

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \leq 1.$$

Let $\rho = \rho_1 + \rho_2$. Then by using Minkowski's inequality, we have

$$\begin{aligned}
 & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & = \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & = \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & + \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]
 \end{aligned}$$

$$\begin{aligned}
 & \leq \left(\frac{\rho_1}{\rho_1 + \rho_2}\right) \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] \\
 & + \left(\frac{\rho_2}{\rho_1 + \rho_2}\right) \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]
 \end{aligned}$$

≤ 1

and thus

$$g(x + y) = \inf \{(\rho)^{\frac{p_{kl}}{H}}\}$$

$$\begin{aligned}
 & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho_1 + \rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \\
 & \leq 1
 \end{aligned}$$

$$\leq \inf \{(\rho_1)^{\frac{p_{kl}}{H}}\}$$

$$\begin{aligned}
 & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho_1}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \\
 & \leq 1
 \end{aligned}$$

$$+ \inf \{(\rho_2)^{\frac{p_{kl}}{H}}\}$$

$$\begin{aligned}
 & \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho_2}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \\
 & \leq 1
 \end{aligned}$$

Therefore, $g(x + y) \leq g(x) + g(y)$. Finally, we prove that the scalar multiplication is continuous. Let λ be any complex number. By definition,

$$g(\lambda x) = \inf \{(\rho)^{\frac{p_{kl}}{H}}\}$$

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \leq 1\}$$

$$= \inf \{(|\lambda|t)^{\frac{p_{kl}}{H}}\}$$

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{t}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}}$$

where $t = \frac{\rho}{|\lambda|} > 0$. Since $|\lambda|^{p_{kl}} \leq \max(1, |\lambda|^{supp_{kl}})$, we have

$$g(\lambda x) \leq \max(1, |\lambda|^{supp_{kl}}) \inf \{t^{\frac{p_{kl}}{H}}\} \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{t}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]^{\frac{1}{H}} \leq 1\}.$$

So, the fact that the scalar multiplication is continuous follows from the above inequality. This completes the proof of the theorem.

Theorem 3.3. Let $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions which satisfies the Δ_2 -condition. Then $W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \subseteq W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$.

Proof. Let $x = (x_{kl}) \in W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] = 0$$

Let $\varepsilon > 0$ and choose δ with $0 < \delta < 1$ such that $M_{kl}(t) < \varepsilon$ for $0 \leq t \leq \delta$.

Write $y_{kl} = (\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)$ and consider

$$\begin{aligned} & \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(y_{kl})^{p_{kl}}] \\ &= \lim_{m+n \rightarrow \infty} \sum_{k,l: |y_{kl}| \leq \delta} a_{mnkl} [M_{kl}(y_{kl})^{p_{kl}}] + \end{aligned}$$

$$\lim_{m+n \rightarrow \infty} \sum_{k,l: |y_{kl}| > \delta} a_{mnkl} [M_{kl}(y_{kl})^{p_{kl}}]$$

$$= \lim_{m+n \rightarrow \infty} \varepsilon \sum_{k,l: |y_{kl}| \leq \delta} a_{mnkl} + \lim_{m+n \rightarrow \infty} \sum_{k,l: |y_{kl}| > \delta} a_{mnkl} [M_{kl}(y_{kl})^{p_{kl}}]$$

For $y_{kl} > \delta$, we use the fact that $y_{kl} < \frac{y_{kl}}{\delta} < 1 + \frac{y_{kl}}{\delta}$.

$$\text{Hence } M_{kl}(y_{kl}) < M_{kl}\left(1 + \frac{y_{kl}}{\delta}\right) < \frac{M_{kl}(2)}{2} + \frac{1}{2} M_{kl}\left(2 \frac{y_{kl}}{\delta}\right)$$

Since \mathcal{M} satisfies the Δ_2 -condition, we have

$$\begin{aligned} M_{kl}(y_{kl}) &< K \frac{y_{kl}}{2\delta} M_{kl}(2) + K \frac{y_{kl}}{2\delta} M_{kl}(2) \\ &= K \frac{y_{kl}}{\delta} M_{kl}(2) \end{aligned}$$

and hence

$$\lim_{m+n \rightarrow \infty} \sum_{k,l: |y_{kl}| > \delta} a_{mnkl} [M_{kl}(y_{kl})^{p_{kl}}] \leq$$

$$\frac{M_{kl}}{\delta} (2) \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}].$$

Since A is regular and $x = (x_{kl}) \in W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$, we get $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$.

Theorem 3.4. Let $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions and let $A = (a_{mnkl})$ be a nonnegative matrix. Suppose that $\beta = \lim_{t \rightarrow \infty} \frac{M_{kl}(t)}{t} > \infty$. Then $W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) = W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$.

Proof. In order to prove that

$$W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) = W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|).$$

It is sufficient to show that $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \subseteq W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. Now, let $\beta > 0$. By definition of β , we have $M_{kl}(t) \geq \beta t$ for all $t \geq 0$. Since $\beta > 0$, we have $t \leq \frac{1}{\beta} M_{kl}(t)$ for all $t \geq 0$. Let $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. Thus, we have

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq \frac{1}{\beta} \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

which implies that $x = (x_{kl}) \in W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$.
This completes the proof.

Theorem 3.5. (i) Let $0 < \inf p_{kl} < p_{kl} \leq 1$. Then
 $W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \subseteq W^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$.

(ii) Let $1 \leq p_{kl} \leq \sup p_{kl} < \infty$. Then
 $W^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|) \subseteq W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$.

Proof. Let $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. Then since $0 < \inf p_{kl} < p_{kl} \leq 1$, we obtain the following

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)]$$

$$\leq \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}].$$

Thus $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$.

(ii) Let $p_{kl} \geq 1$ for each k and l and $\sup p_{kl} < \infty$. Let $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, \|\cdot, \dots, \cdot\|)$. Then for each $0 < \varepsilon < 1$ there exists a positive integer N such that

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)] \leq \varepsilon < 1$$

for all $m, n \geq N$. This implies that

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl-L}}{\rho}, z_1, \dots, z_{n-1} \right\|)].$$

Therefore $x = (x_{kl}) \in W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$. This completes the proof.

Lemma 3.6. Let $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions which satisfies the Δ_2 -condition and $A = (a_{mnkl})$ be a non-negative 4- dimensional regular matrix. Then $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ is an ideal in l_∞^2 .

Proof. Let $x = (x_{kl}) \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ and $y \in l_\infty^2$. We need to show that $xy \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$. Since $y \in l_\infty^2$, there exists $T_1 > 1$ such that $\|y\| < T_1$. In this case $|x_{kl} y_{kl}| < T_1 |x_{kl}|$ for all $(k, l) \in \mathbb{N}^2$. Since \mathcal{M} is nondecreasing and satisfies Δ_2 -condition, we have

$$[M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl} y_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$< M_{kl}(\left\| \frac{u_{kl} T_1 \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}$$

$$\leq T(T_1) M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}},$$

for all k, l and $T > 0$. Therefore

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] = 0.$$

Thus $xy \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$. This completes the proof.

Lemma 3.7. Let I be an ideal in l_∞^2 . and let $x = (x_{kl}) \in l_\infty^2$. Then x is in the closure of I in l_∞^2 . if and only if $\chi_{S(S; \varepsilon)} \in I$ for all $\varepsilon > 0$.

Proof. The proof of this lemma can be easily obtained by the same technique as in [1].

Lemma 3.8. If A is a nonnegative 4-dimensional regular matrix, then $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ is a closed ideal in l_∞^2 .

Proof. We have $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2 \subset l_\infty^2$ and it is clear that $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2 \neq \emptyset$.

For $x, y \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$, we get $|x_{kl} + y_{kl}| < |x_{kl}| + |y_{kl}|$.

Now, we have

$$[M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\| + \left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}$$

$$< \frac{1}{2} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$+ \frac{1}{2} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$< \frac{1}{2} K_1 [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$+ \frac{1}{2} K_2 [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

by the Δ_2 -condition and the convexity of \mathcal{M} . Since

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq \frac{1}{2} K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$+ \frac{1}{2} K \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r y_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

where $K = \max \{K_1, K_2\}$, so

$x + y, x - y \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$.

Let $x \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ and $y \in l_\infty^2$. Thus, there exists a positive integer K , so that for every k, l we have $|x_{kl} y_{kl}| < K |x_{kl}|$. Therefore

$$[M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq T [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

and so

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r (x_{kl} + y_{kl})}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq T \lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

Hence $xy \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$.

So $W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ is an ideal in l_∞^2

for a Musielak-Orlicz function which satisfies the

Δ_2 -condition.

Now we show that

$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ is closed. Let $x \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ there exists $x^{cd} = x_{kl}^{cd} \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ such that $x^{cd} \rightarrow x \in l_\infty^2$. For every $\varepsilon > 0$ there is $N_1(\varepsilon)$ such that for all $c, d > N_1(\varepsilon)$,

$$\left\| \frac{u_{kl} \Delta_s^r x^{cd} - u_{kl} \Delta_s^r x}{\rho} \right\| < \varepsilon.$$

Now for $\varepsilon > 0$, we have

$$\lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$= \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl}$$

$$M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl} - u_{kl} \Delta_s^r x_{kl}^{cd} + u_{kl} \Delta_s^r x_{kl}^{cd}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}$$

$$\leq \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl} - u_{kl} \Delta_s^r x_{kl}^{cd}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$+ \left\| \frac{u_{kl} \Delta_s^r x_{kl}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$\leq \frac{1}{2} \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl} - u_{kl} \Delta_s^r x_{kl}^{cd}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$+ \frac{1}{2} \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}^{cd}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

$$< \frac{1}{2} K M_{kl}(\varepsilon) \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl}$$

$$+ \frac{1}{2} K \lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x_{kl}^{cd}}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}]$$

Since $x^{cd} \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ and A is regular, we get

$$\lim_{m+n \rightarrow \infty} \sum_{k,l=0,0}^{\infty, \infty} a_{mnkl} [M_{kl}(\left\| \frac{u_{kl} \Delta_s^r x}{\rho}, z_1, \dots, z_{n-1} \right\|)^{p_{kl}}] = 0$$

so $x \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$. This completes the proof.

Theorem 3.9. Let $x = (x_{kl})$ be a bounded double sequence, $\mathcal{M} = (M_{kl})$ be a sequence of Orlicz functions which satisfies the Δ_2 -condition and A be a non-negative 4-dimensional regular matrix.

Then

$$W^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

$$= W^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

Proof. Without loss of generality we may take $x = 0$ and establish

$$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

$$= W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

Since

$$W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \subseteq W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|)$$

therefore $W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2 =$

$$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2. \text{ We show that}$$

$$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

$$\subseteq W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

Now notice that if $S \subset \mathbb{N} \times \mathbb{N}$, then

$$\lim_{m+n \rightarrow \infty} \sum_{k,l} a_{mnkl} [M_{kl}(\chi_S(k, l))^{p_{kl}}].$$

Observe that $\chi_S(k, l) \in W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$

whenever $x \in W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$ by

Lemma (3.6) and Lemma (3.7), so

$$W_0^2(A, \mathcal{M}, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2 \subseteq W_0^2(A, u, \Delta_s^r, p, \|\cdot, \dots, \cdot\|) \cap l_\infty^2$$

The proof is complete.

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Effect of Fuzzy Controller on the Stability of Thermal Power Generator

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Abstract—In power system the active and reactive power demands are never steady and they are continually changing with the rising or falling trend of load demand. Steam input to turbo-generators (or water input to hydro-generators) must be regulated continuously to match the active power demand in case of falling or rising trend of load demand failing which results in consequent change in frequency which is highly undesirable (maximum permissible change in frequency is ± 0.5 Hz). We may note that the frequency is affected mainly due to the change in real power while the reactive power is less sensitive due to the change in frequency and depends only on voltage magnitude. Thus, real and reactive power is controlled separately. The load frequency control (LFC) loop which we had taken for our discussion control the real power and frequency only. This Paper presents, the effect of Fuzzy controller on the stability of thermal Power generator. In this study Fuzzy controller is used to enhance the robustness and performance of the controller. Two performance parameters were used for the comparison. First one being the settling time and other is the overshoot of the frequency deviation were compared.

Keywords - Area control error, Fuzzy control, Load frequency control.

I. INTRODUCTION

Energy plays a vital role in any country economy. Day by day the energy consumption is increasing very rapidly. The standard of living of a given country can be directly related to per capita energy consumption. In the present scenario, every country meets its energy needs from different sources available. Some major sources of energy are discussed below:-

Solar energy can be a major source of power because Sun's energy can be utilized as thermal and photovoltaic. When we talk about solar photovoltaic (SPV) applications this energy can be used in SPV lighting System, solar powered drives (Solar water pumping system, solar vehicles), building integrated photovoltaic (BIPV). But so far it could not be developed on a large scale due to certain limitations as it is expensive and installation cost is more, efficiency is very lesser, weather dependent and only available in day time.

Wind energy can be economically used for the generation of electrical energy. Wind energy can be utilized to run a wind mill, which in turn drives a generator to produce electricity. Wind energy had certain merits as discussed: due to the availability of wind everywhere in the world, the greatest advantage of electricity generation from wind is that it is renewable and not depleted with the use like fossil fuels; villages in remote area particularly in INDIA are still in dark. But due to this technology electricity can be provided in any remote area. But it has certain demerits also as discussed: this source of power is non-steady and unreliable as there are wide variations in speed and direction of winds, favorable winds are available only in few geographical locations. Hydro energy can also be a major source of power because water is available in abundant on earth. The kinetic energy of the moving stream

while falling from the top end of the dam can be used to run a turbine, which in turn drives a generator to produce electricity. Hydro energy had certain merits as discussed: Water Power is quite cheap where water is available in abundance and the operating costs of hydroelectric power plants are quite low. But it has certain demerits also as discussed: capital cost of hydro hydroelectric power plants is higher and it takes considerable long time for the erection of such plants.

Energy from fossil fuels can also be utilized to generate electricity like in thermal, nuclear and diesel power plants. In thermal power plant coal is burned to produce heat which in turn evaporates the water then through nozzle steam produced while coming out of the nozzle hits the turbine as the result turbine rotates which in turn drives the generator to generate electricity. Thermal power plants had certain merits as discussed: Overall capital cost is lesser than that for hydro plants, occupy less space compared to hydro and can be located very conveniently near the load centre. But it has certain demerits also as discussed: Maintenance and operating costs are high and the presence of environmental hazards due to dust and hot temp in the plant were also enormous. Power system operation considered so far was under the conditions of steady load. But in actual both active and reactive power demands are never steady they continually change with rising or falling trend of load demand. So, input to the generator (steam input to turbo-generators or water input to hydro-generator) must be continuously supplied to match the real power demand, if not as a result the machine speed will vary with consequent change in frequency which is highly undesirable (max. permissible change in frequency is ± 0.5 Hz). As manual regulation is not feasible, so automatic generation control as discussed in Section-III for single area system and voltage regulation equipment must be installed on

each generator, in order to reduce the problems of stabilization in power system which further improves the voltage and frequency of supply within the permissible limits. So for automatic generation control we need different controllers which stabilize the system response due to disturbances in a short period of time. Different techniques of stabilization have been discussed in Section-II.

II. TECHNIQUES OF STABILIZATION

Different controllers had been used now days for automatic generation control and voltage regulation for generator. Some of them are as follows:-

1. PI Controller: - Conventional Proportional plus Integral controller (PI) makes the system response to be steady state in the farm of frequency deviation, but it exhibits poor dynamic performance (such as no. of oscillation and more settling time).

$$u(t) = Kp e(t) + Ki \int_0^t e(t) dT$$

2. PID Controller: - A Proportional – Integral – Derivative (PID Controller) is a control closed loop feedback mechanism system as shown in Fig. 1. and it is widely used in industrial control System. It exhibits good dynamic performance (such as no. of oscillations and setting time) and is better as compared to PI Controller.

$$u(t) = Kp e(t) + Ki \int_0^t e(T) dT + Kd \frac{de}{dt}$$

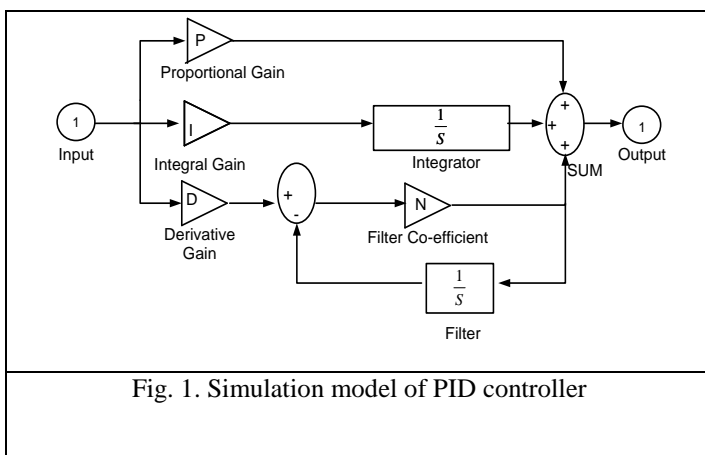


Fig. 1. Simulation model of PID controller

3. Fuzzy Logic Controller: - In the present scenario Fuzzy Logic Control system applications become very useful. The Fuzzy logic controller as shown in Fig. 2. is framed by the combination of different interfaces named as fuzzification interface, the inference rules design interface and defuzzification interface. It exhibits very good dynamic

performance and is better as compared to PI and PID controller.

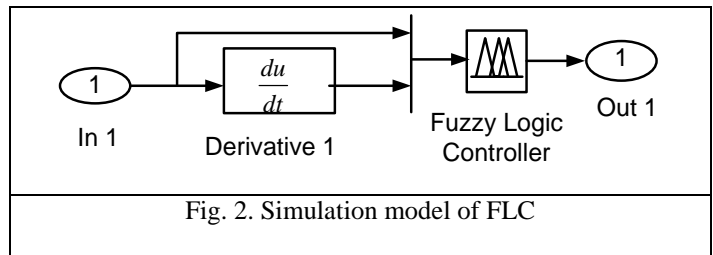


Fig. 2. Simulation model of FLC

III. THEORY OF AGC

To increase the reliable and uninterrupted power supply, there is a necessity to maintain the certain parameters of the power systems. In this study the main attention is given to the frequency deviations, peak overshoots and settling time of a thermal power systems. Normally, thermal system consumes base load and hydro system for peak load, due to easiness in control. The fluctuation of load in these systems is very common, which can either reduce their efficiency or may indulge the system to behave in an abnormal manner or may damage it, but these issues can be prevented by the use of different controllers in order to make the system response to be steady state. The controllers which are commonly used now days are conventional PI and fuzzy logic controller

Automatic generation control (AGC) is defined as the controlling of the regulation of controllable generators within a certain controllable limits with reference to the change in system frequency so as to maintain the steady state system frequency. To maintain the system frequency to be steady state AGC plays an very important role and also scheduled the system parameters values during normal period. The synchronization of different system to interconnected system depends upon (1) voltage magnitude (2) frequency and (3) phase sequence. It is to be noted that the wide variations of the system parameters like frequency voltage will lead the system to become uncontrollable or totally collapsed.

As frequency deviations generally take place due to the change in load at demand side as a result there is also a corresponding change in tie line power signal also which are then combined and feed to the controllers in the farm of a control signal. The combined signal which is feed to the controller is known as area control error (ACE). ACE is generally used to indicate when total generation must be lowered or raised in a particular control area which can be controllers. Maintaining the system frequency at steady state is very important for the generating equipments as well as for the equipments to be used at the consumer end. Hence we can say that due to the rising energy needs of any nation AGC become very useful for the interconnection of different systems to meet the increased energy needs as well as to maintain the system response to be steady state with the change in load.

In an independent power system, the main issue is not to maintain the interchange power transfer. Therefore the function of AGC is to restore frequency to the specified nominal value. With the primary LFC loop as shown in Fig. 5. the system frequency deviations due to changes in load were maintained to be steady state, which mainly depends on the regulation of governor speed. In order to reduce the frequency deviation to zero, we must need an reset action that can be achieved with the help of integral controller which changes the speed rotation settings of the turbine with reference to load perturbations. The integral controller increases the system by type 1 which forces the final frequency deviation to zero and their methodology is discussed in Section-IV. The LFC loop of a single area is shown below in Fig. 5.

IV. METHODOLOGY

While performing Simulations on Thermal system with and without controller the parameters to be used in Fig. 7 and Fig. 8 are as follows while their results and comparison are separately discussed in Section V.

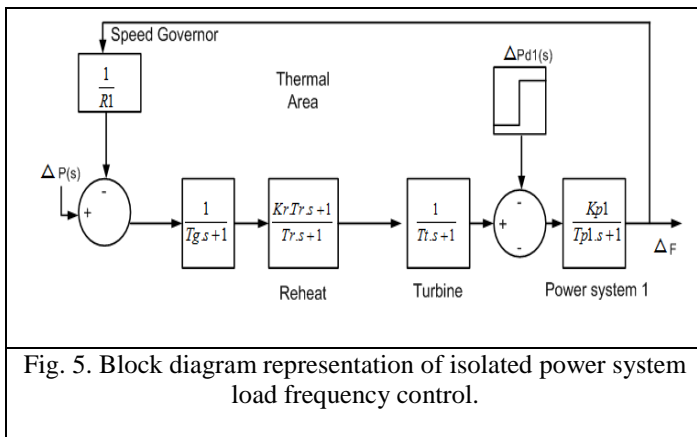
Nominal system frequency (F) =60Hz, Governor speed regulation parameters (R_i) =2.4 Hz/per unit MW, Steam governor time constant (T_g) =0.08sec, Reheat time constant (T_r) =10.0sec, Reheat constant (K_r) =0.5sec, Inertia Constant (H_i)=5sec, Area rated power(Pri) =2000MW, Steam turbine time constant (T_t) =0.3sec, $D_i = 8.33 \times 10^{-3}$ p.u. MW/Hz, $T_{pi} = 20$ sec, $K_{pi} = 120$ Hz.p.u./MW where $T_{pi} = 2H_i / f^* D_i$, $D_i = \Delta P_{Di} / \Delta f_i$, $K_{pi} = 1/D_i$, ACE= Area Control Error, B_i =Frequency bias factor, K_d , K_p , K_i = Electric governor derivative, proportional and integral gains, respectively, i = Subscript referred to area.

one output. Each membership function consists of two trapezoidal membership and five triangular memberships as shown in Fig: 6. The mechanism is realized by 49(7×7) rules for the fuzzy controller block. The following membership functions used for the designing the fuzzy controllers are shown in Table 1.

Table 1. Fuzzy logic rules

| ACE/ Δ ACE | LN | MN | SN | Z | SP | MP | LP |
|-------------------|----|----|----|----|----|----|----|
| LN | LP | LP | LP | MP | MP | SP | Z |
| MN | LP | MP | MP | MP | SP | Z | SN |
| SN | LP | MP | SP | SP | Z | SN | MN |
| Z | MP | MP | SP | Z | SN | MN | MN |
| SP | MP | SP | Z | SN | SN | MN | LN |
| MP | SP | Z | SN | MN | MN | MN | LN |
| LP | Z | SN | MN | MN | LN | LN | LN |

*LN: Large Negative; MN: Medium Negative; SN: Small Negative; Z: Zero; SP: Small Positive; MP: Medium Positive; LP: Large Positive



The fuzzy logic controller block is designed by the combination of area control error ACE_i and by the rate of change of area control error Δ ACE_i. It mainly consists of three interfaces blocks which mainly consist of two-inputs and

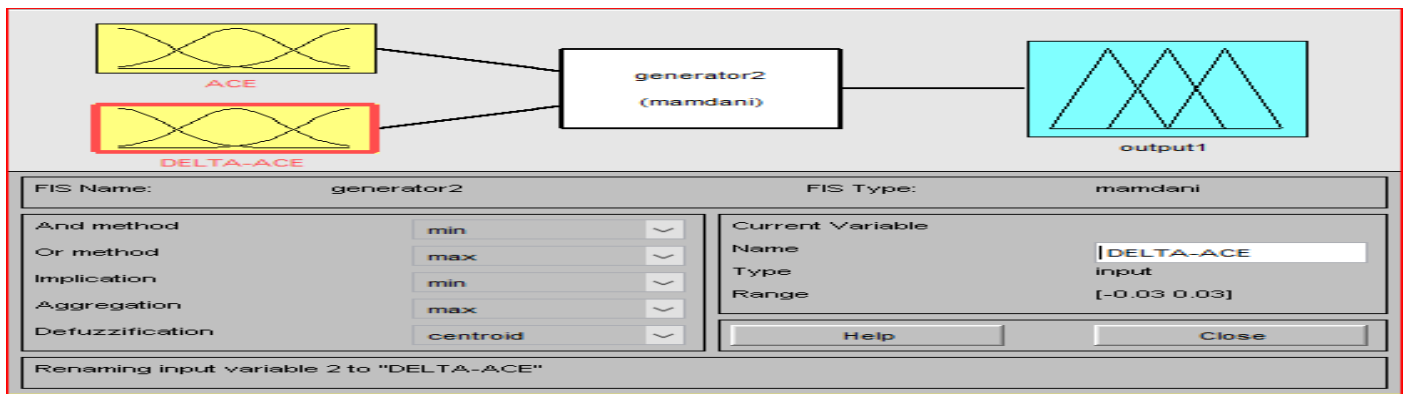


Fig. 6. Represents the I/Ps and O/Ps of the fuzzy logic controller

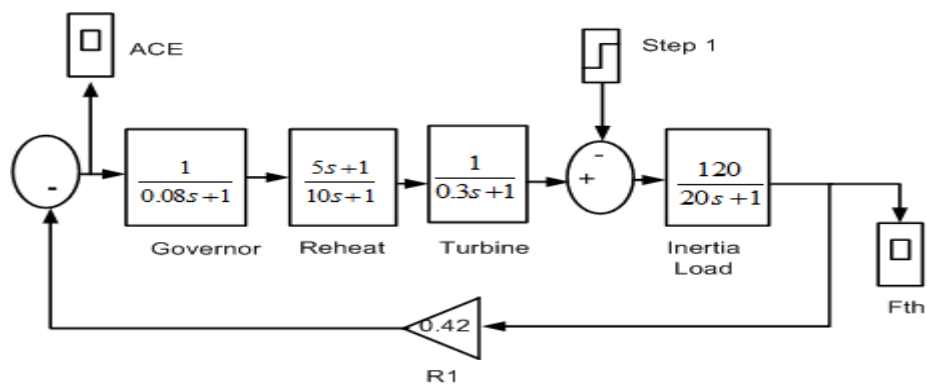


Fig. 7. Single area thermal system without any controller

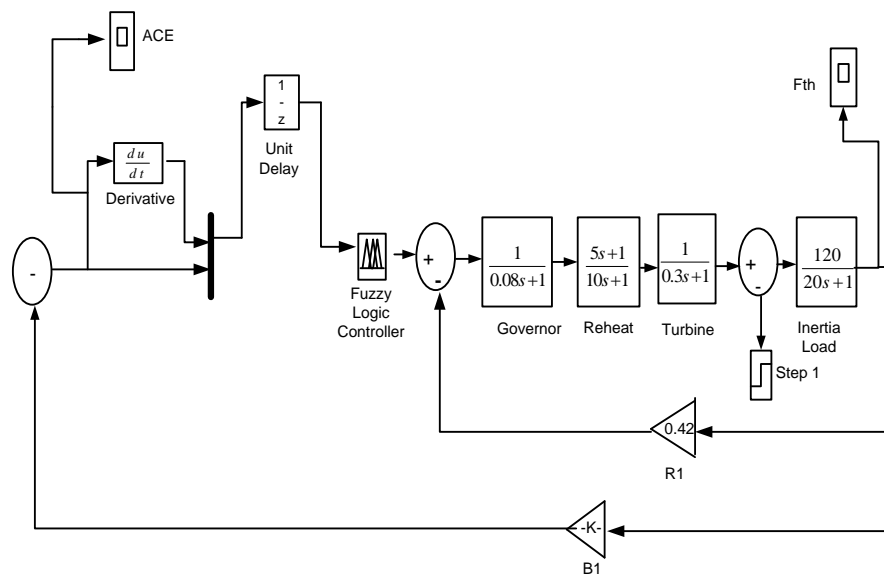


Fig. 8. Single area thermal system with Fuzzy controller

V. RESULTS DISCUSSIONS AND TABLES

Comparison of system performance with and Without Controller on Single area Thermal Power System at .5 Step Change in Load.

Simulation studies are performed to investigate the performance of the single area thermal system. A step load disturbance of .5 of the nominal loading is considered in the single area. The parameters of the power system are given in appendix.

Fig 9 and Fig 10 depicts the dynamic responses of the thermal system in the form of frequency deviations and area control error with .5 step change in load without using any controller.

Fig 11 and Fig 12 depicts the dynamic responses of the thermal system in the form of frequency deviations and area

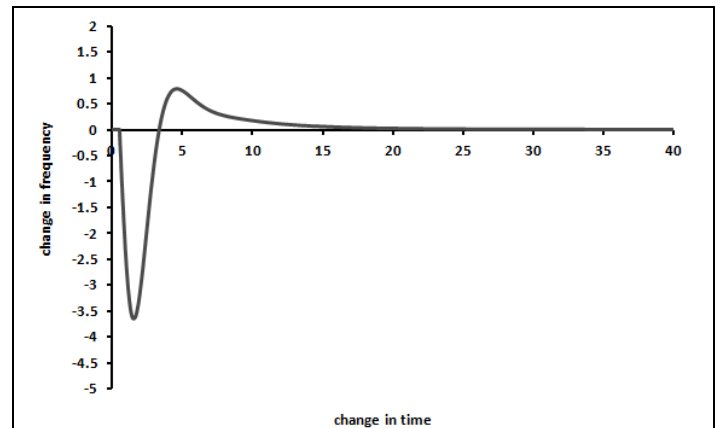


Fig. 11. Frequency response of thermal system with Fuzzy controller

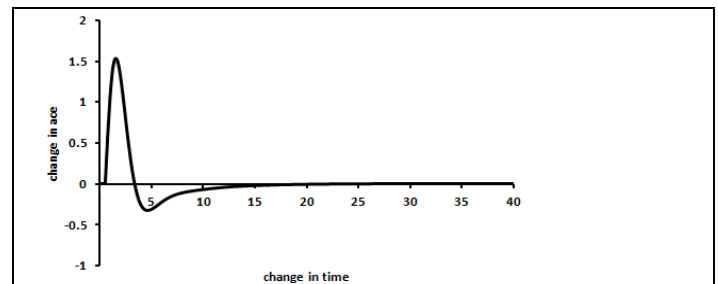


Fig. 12. ACE response of thermal system with Fuzzy controller

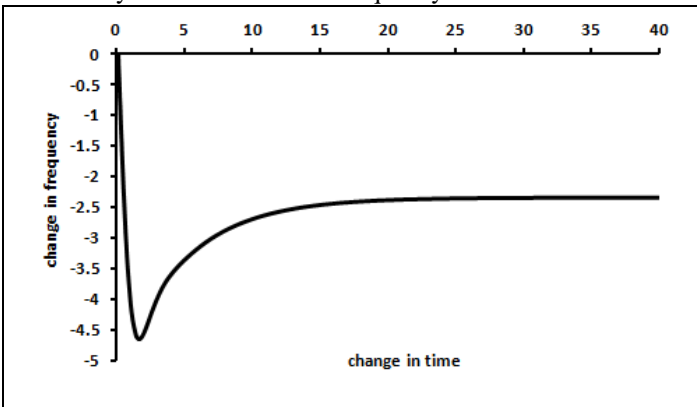


Fig. 9. Frequency response of thermal system without using any controller

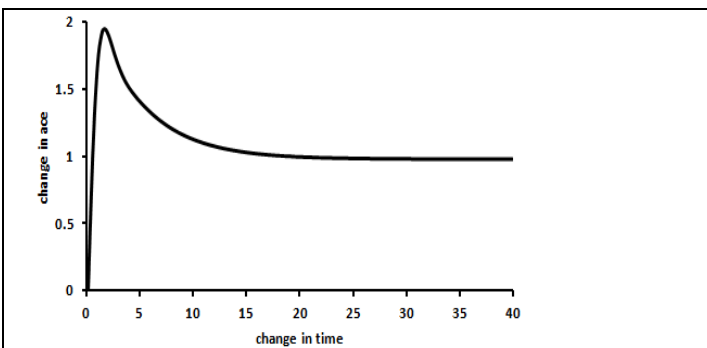


Fig. 10. ACE response of thermal system without using any controller

control error with .5 step change in load by using Fuzzy controller. Table 2 shows the comparison of frequency responses of the thermal system with and without controller in the form of peak overshoots and settling time with .5 step change in load. Table 3 shows the comparison of area control error of the thermal system with and without controller in the form of peak overshoots and settling time with .5 step change in load. Table 4 shows the best values for integrator and derivative controller after performing many simulations with .5 step change in load.

Table 2. Change in frequency of thermal system

| | without controller | with Fuzzy controller |
|------------------------|--------------------|-----------------------|
| maximum overshoot | 0 | 0.7 |
| minimum overshoot | -4.6 | -3.6 |
| settling time (in sec) | 33 | 26 |

Table 3. Change in area control error of thermal system

| | without controller | with Fuzzy controller |
|------------------------|--------------------|-----------------------|
| maximum overshoot | 1.96 | 1.5 |
| minimum overshoot | 0.9 | -0.36 |
| settling time (in sec) | 34 | 25 |

VI. CONCLUSION

In this paper, Fuzzy Controller is applied to power system. This application is an alternative and successful control for LFC. Simulation studies have been carried out using MATLAB platform to study the transient behaviour of the system due to load perturbations. It is seen from the simulations that, the proposed controller causes less peak overshoots as well as less settling time for the system. Simulation results establish the usefulness of the proposed controller for LFC.

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Stabilization Of Clayey Soil With Polyethylene Terephthalate Plastic Waste Powder

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Abstract— Issues related to environment such as global warming, climatic changes and shortage of the natural resources bringing new ideas in construction and technology with the aim of achieving the natural resources in such a way that is not harmful for environment. Conservation of construction natural materials is very challenging for civil engineers due to increase in population; people need more houses and development of modern cities which involves lot of quality natural materials. As we see on other side, there is a boom for plastic industries as it is used in most of sectors like agriculture, automotive, education, government, health, marketing and advertising, transportation. As the plastic is non-biodegradable it becomes challenge for the humans how to reduce its harmful effect on our environment as it is used in large quantities everywhere.

This research has been done to see the effect of adding polyethylene terephthalate (PET) on the properties of clayey soil. The research was conducted at Maharaja Ranjit Singh Punjab Technical University, using PET plastic waste powder from the Sheetal Factory and clay soil is collected from village Patli Dabar in Tehsil Sirsa of Haryana state.

Further, the purpose of this research was achieved through the experimental work which included sieve analysis, liquid limit, plastic limit, plasticity index, standard proctor test, UCS test and CBR test. Clay was randomly mixed PET waste powder of different varying percentages of 5%, 10%, 15%, 20% and 25%, and tests were performed on virgin clay and clay-PET powder. Liquid limit of the soil is decreased by 7.76% from 34.114% (virgin soil) to 31.4665% (at 20% PET) with addition of PET in soil and then decreases to 33.39% (at 25% PET). Plastic limit of the soil is increased by 24.10% from 16.28% (virgin soil) to 20.204 % (at 20% PET) and then decreases to 19.27% (at 25% PET). Plasticity index of the soil is decreased by 36.8432% from 17.834 (virgin soil) to 11.2625 (at 20% PET) with the addition of PET in soil and then increases to 14.12 (at 25% PET). Optimum Moisture Content of the soil is decreased by 4.5035% from 17.32% (virgin soil) to 16.54 % (at 10% PET) with addition of PET in soil and then increased from 16.54% to 19.33% (at 15% PET) and then decreased from 19.33% to 18.92% and then again increased to 20.31% (at 25% PET). Maximum Dry Density of the soil is decreased by 12.35% from 1.78gm/cc (virgin soil) to 1.56gm/cc (at 20% PET) and then increased to 1.62gm/cc (at 25% PET). Unconfined Compressive Strength of the soil is increased by 108.9% from 0.857kg/cm²(virgin soil) to 1.790kg/cm² (at 20% PET) with addition of PET in soil and then decreased to 1.686 kg/cm² (at 25% PET). CBR value of soil increases from 2.91% (virgin soil) to 10.29% (at 20% PET) and then decreases from 10.29%(at 20% PET) to 9.12% (at 25% PET) in unsoaked condition and increases from 2.11% (virgin soil) to 9.27% (at 20% PET) and then decreases to 8.32% (at 25% PET) in soaked condition. From these results it can be seen that PET waste plastic powder can be used up to 20% for improvement, further increase in percentage of PET plastic waste powder leads to decrease in strength.

Keywords— Liquid Limit; Maximum dry density; Optimum moisture content; Plastic bottle; Plasticity index ; Plastic limit ; Polyethylene Terephthalate powder ; Soil Stabilization; Standard Proctor Test; Soaked California bearing ratio test; Unsoaked California bearing ratio test; Unconfined compressive strength.

1.1 INTRODUCTION

The stabilization of soil is a technique or method to improve or maintain the stability of soil mass and chemical

alteration of soil to improve the physical and chemical properties of the soil. Soil stabilization is the concern with the geotechnical engineer because he bound to deal with all

types of soil which are available at a construction site. Soil properties are different in different places. Sometimes the soil does not meet the design requirements and simultaneously import of soil from far source is very costly. In that case civil engineer is left with only option to use the locally available material which may suitable for the soil stabilization. The magnitude of the soil stabilization is usually measured by the increase in strength. In this work, I use PET plastic waste powder for stabilization of clayey soil to see its effects on properties of clayey soil.

1.2 APPLICATIONS OF SOIL STABILIZATION

The process of soil stabilization is useful in the following applications:

- a. Reducing the permeability of soils.
- b. Bearing capacity of foundation soils can be increased.
- c. Shear strength of the soils can be increased..
- d. Improving the durability under adverse moisture and stress conditions.
- e. Natural soils can be improved for the construction of airfields and highways.

1.3 Objectives

- To study the effect on properties of soil on adding Polyethylene Terephthalate powder into it.
- To solve the disposal of the plastic waste by using it in soil stabilization and reduce its adverse effect on environment to some extent.

1.4 Methodology

- Related literature was reviewed before the start of this study to understand the application of PET powder for the stabilization of the weak soil through the theoretical background.
- Collection of virgin soil and PET waste plastic powder.

- Determination of liquid limit, plastic limit, plasticity index, OMC, MDD, Unconfined compressive strength and CBR value of the virgin soil.
- Addition of 0%, 5%, 10%, 15%, 20% and 25% of PET waste plastic powder in the virgin soil for testing of their Liquid limit, Plastic limit, OMC, MDD, UCS value and CBR value.
- Results and discussions.

2. Literature Review

A.I.Dhatrak et.al. (2015) compared the engineering properties of weak soil by adding waste plastic. He observed that for the construction of flexible pavement to improve the sub grade soil using waste plastic bottles is an alternative method. He added the plastic waste in the proportion of 0.5%, 1%, 1.5%, 2%, and 2.5% by weight of dry soil. CBR value was increased.

Bala Ramauduparamkusam et.al. (2013) conducted the experiments to see the effect of waste plastic on dry density and CNBR value of red mud. He noted that the value of MDD of red mud was increased with increase in plastic waste till 2%, further increase in the plastic waste decrease the value of MDD and OMC value remained same. Increase in the CBR value was also observed by adding 0.5%, 1%, and 2% of the waste plastic and was noticed to be decreased after addition of 3% and 4%. Increasing CBR value shows that by adding plastic waste upto 2% the thickness of pavement can be reduced.

Anas Ashraf et. al. (2011) done the stabilization of soil by using plastic bottles. He performed plate load test on sand reinforced with layers of plastic bottles. The bottles cut to halves placed at middle and one third position of tank. The cut bottles which are placed at the middle are very effective in increasing the strength of the soil as shown by the results.

Achmed Fauji et. al (2016) collected samples R3 and R4 from different sites of Kuantan. Crushed glass and waste HDPE in varying percentage 4%, 8%, and 12% by dry total

weight of soil sample were taken. Various properties like specific gravity, atterberg limits, standard compaction, tri-axial test and CBR test of soil sample before stabilization and after stabilization were evaluated. On addition of above materials, the increase in plasticity index was about 10% for sample R2 and 2% for R2 sample. The value of OMC was decreased and MDD was increased. CBR value of both the samples was increased after adding the waste HDPE.

3. Materials

a) Soil

For this work, the virgin soil sample has been collected from Patli Dabar village in Tehsil Sirsa of Haryana state. The virgin soil was tested in the geotechnical engineering laboratory of Giani Zail Singh Campus, Bathinda to determine the various properties of virgin soil, the results of tested soil are given below in the table.

| Properties | Values |
|---|--------|
| Liquid Limit (%) | 34.114 |
| Plastic Limit (%) | 16.28 |
| Plasticity Index | 17.834 |
| Optimum Moisture Content (%) | 17.32 |
| Maximum Dry Density (gm/cc) | 1.78 |
| Unconfined compressive Strength (Kg/cm ²) | 0.857 |
| Unsoaked California Bearing Ratio (%) | 2.91 |
| Soaked California Bearing Ratio (%) | 2.11 |

b) PET Plastic:

PET powder has been collected from Sheetal Plastic Industries in Amarpura Basti which is located few kilometers away from Giani Zail Singh Campus College, Bathinda. Polyethylene terephthalate commonly abbreviated PET is the most common thermoplastic polymer resin of the polyester family and is used in containers for liquids and foods. PET is reported as one of the most abundant plastics in solid urban waste whose effective reuse/recycling is one of the critical issue which needs immediate attention. In this work, I have used the PET waste plastic powder for the stabilization of the clayey soil. Clay and PET powder is shown in photo.



Photo: Clayey soil and PET waste plastic powder

4. Experimental Results and Discussion

The results obtained from the laboratory testing of the original soil and its mixing with different proportions of polyethylene terephthalate plastic waste powder has exhibited here. The soil sample was tested to improve the various properties of the soil such as liquid limit, plastic limit, plasticity index, optimum moisture content, maximum dry density, unconfined compression test and CBR test. All the soil samples were tested in the laboratory, the results obtained from that testing of soil sample showing variations in the results are shown in the figures by bar graphs to understand the variations in values of results.

4.1 EFFECT OF PET ON LIQUID LIMIT

Liquid limit value of soil samples with different proportions of PET have been determined by conducting the tests in laboratory. Results obtained from the tests showing variation of liquid limit as shown in the figure

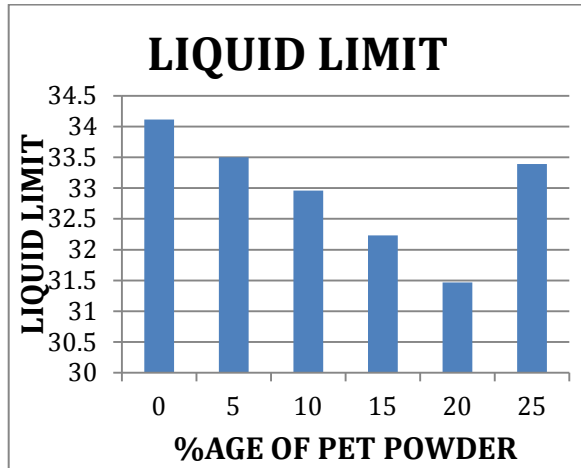


Figure 4.1 Variation in liquid limit value

Liquid limit of the soil is decreased by 7.76% from 34.114% (virgin soil) to 31.4665% (at 20% PET) with addition of PET in soil and then increases to 33.39% (at 25% PET).

4.2 EFFECT OF PET POWDER ON PLASTIC LIMIT

Plastic limit value of soil samples with different proportions of PET powder have been determined by conducting the tests in laboratory. Results obtained from the tests showing variation in plastic limit as shown in the figure 4.2.

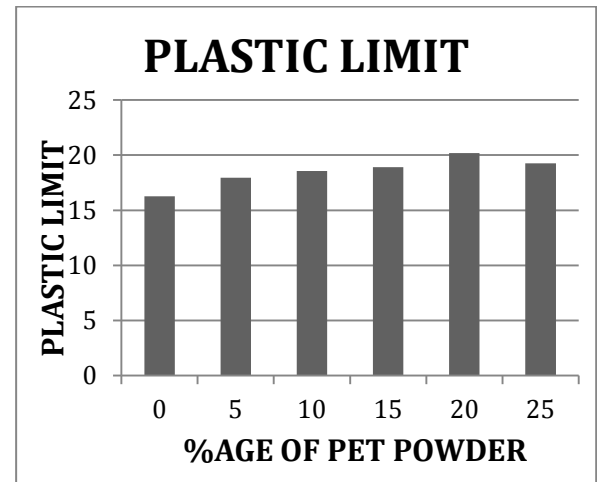


Figure 4.2 Variation in plastic limit value

Plastic limit of the soil is increased by 24.10% from 16.28% (virgin soil) to 20.204 % (at 20% PET) and then decreases to 19.27 % (at 25% PET).

4.3 EFFECT OF PET ON PLASTICITY INDEX

Plastic index value of soil samples with different proportions of PET powder is the difference between liquid limit and plastic limit. Results obtained from the calculations showing variation in plasticity index as shown in the figure 4.3

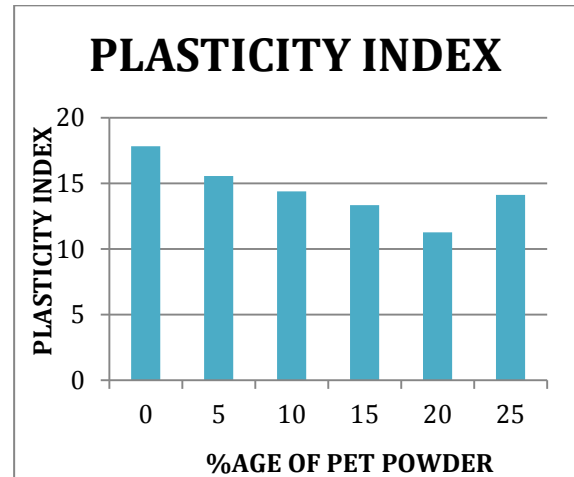


Figure 4.3 Variation in plasticity index value

Plasticity index of the soil is decreased by 36.8432% from 17.834 (virgin soil) to 11.2625 (at 20% PET) with the addition of PET in soil and increases to 14.12% (at 25% PET).

4.4 EFFECT OF PET ON OPTIMUM MOISTURE CONTENT

OMC values of soil samples with different proportions of PET powder have been determined by conducting the standard proctor tests in laboratory. Results showing variation in the OMC is shown in the figure 4.4.

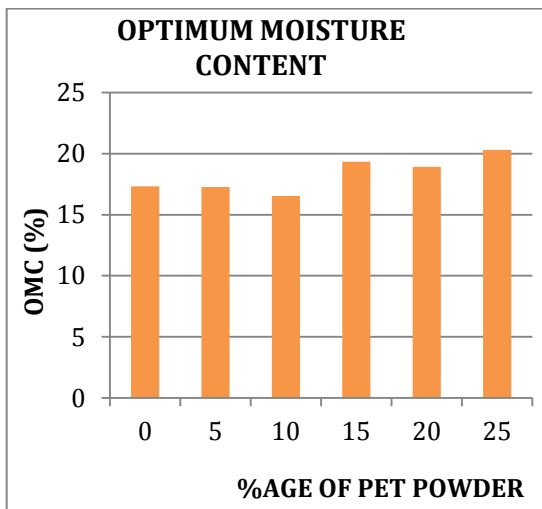


Figure 4.4 Variation in OMC value

Optimum Moisture Content of the soil is decreased by 4.5035% from 17.32% (virgin soil) to 16.54 % (at 10% PET) with addition of PET in soil and then increased from 16.54% to 19.33% (at 15% PET) and then decreased from 19.33% to 18.92%.and then increases to 20.31% (at 25% PET).

4.5 EFFECT OF PET ON MAXIMUM DRY DENSITY

MDD values of soil samples with different proportions of PET powder have been determined by conducting the standard proctor tests in laboratory. Results obtained from the tests showing variation in the MDD as shown in the figure 4.5

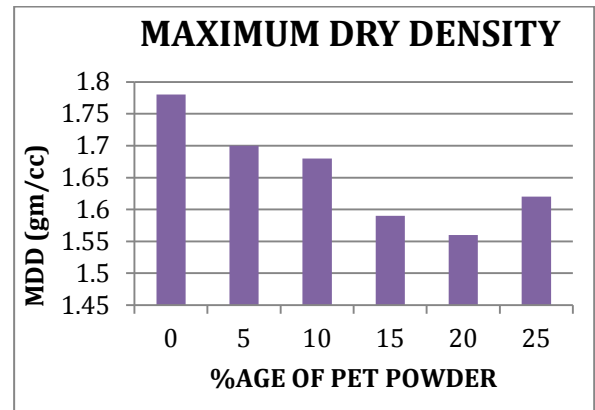


Figure 4.5 Variation in MDD value

Maximum Dry Density of the soil is decreased by 12.35% from 1.78gm/cc (virgin soil) to 1.56gm/cc (at 20% PET) and then increases to 1.62 gm/cc (at 25% PET).

4.6 EFFECT OF PET ON UNCONFINED COMPRESSIVE STRENGTH

UCS values of soil samples with different proportions of PET have been determined by conducting the UCS tests in laboratory. Results obtained from the tests showing variation in the UCS as shown in the figure 4.6.

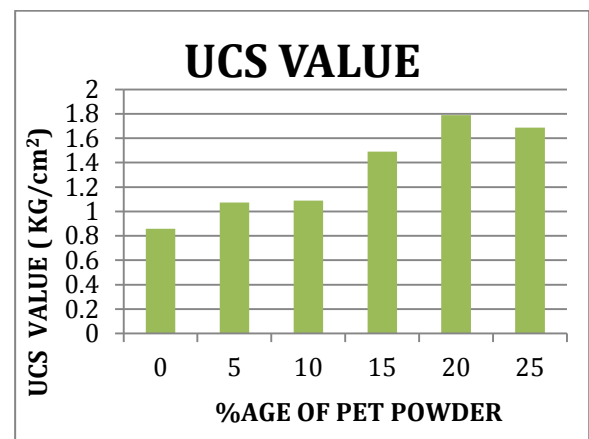


Figure 4.6 Variation in UCS value

Unconfined Compressive Strength of the soil is increased by 108.9% from 0.857kg/cm² (virgin soil) to 1.790kg/cm²(at 20% PET) and then decreases to 1.686 kg/cm² (at 25% PET).

4.7 EFFECT OF PET ON CALIFORNIA BEARING RATIO VALUE

CBR values of soil samples with different proportions of PET have been determined by conducting the CBR tests in laboratory. Results obtained from the tests showing variation in the CBR values in unsoaked and soaked condition is shown in the figure 4.7 and 4.8 respectively.

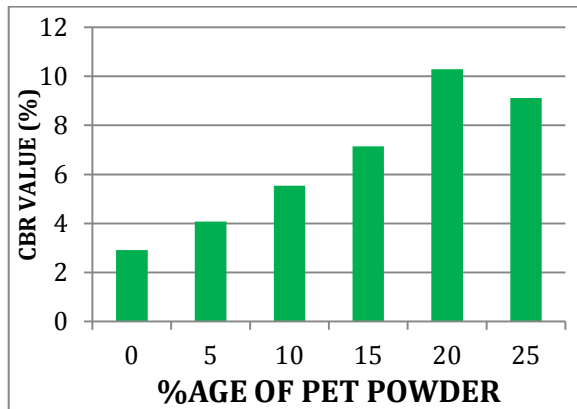


Figure 4.7 Variation in CBR value in unsoaked condition

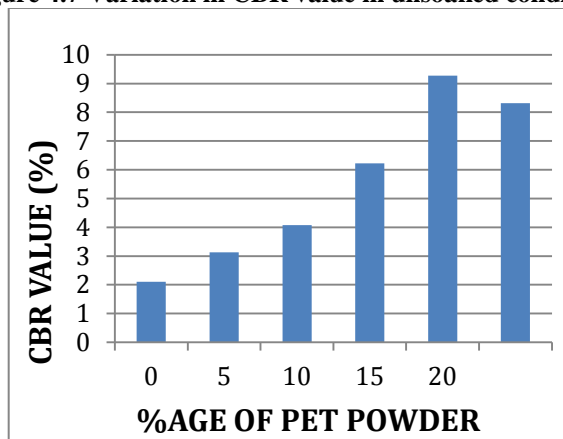


Figure 4.8 Variation in CBR value in soaked condition

CBR value of soil increases from 2.91% (virgin soil) to 10.29% (at 20% PET) and then decreases from 10.29%(at 20% PET) to 9.12% (at 25% PET) in unsoaked condition and increases from 2.11% (virgin soil) to 9.27% (at 20% PET)and then decreases to 8.32% (at 25% PET) in soaked condition.

5. Conclusions

This study investigated the effect of adding PET powder on the properties of the soil. On the basis of experimental work the following conclusions can be drawn:-

- Liquid limit of the soil is decreased by 7.76% from 34.114% (virgin soil) to 31.4665% (at 20% PET) and then increases to 33.69% (at25% PET).
- Plastic limit of the soil is increased by 24.10% from 16.28% (virgin soil) to 20.204 % (at 20% PET) and then decreases to 19.27% (at 25% PET).
- Plasticity index of the soil is decreased by 36.8432% from 17.834 (virgin soil) to 11.2625 (at 20% PET) with the addition of PET in soil and then increases to 14.62 (at 25% PET).
- Optimum Moisture Content of the soil is decreased by 4.5035% from 17.32% (virgin soil) to 16.54 % (at 10% PET) with addition of PET in soil and then increased from 16.54% to 19.33% (at 15% PET) and then decreased from 19.33% to 18.92% (at 20% PET) and increases to 20.31% (at 25% PET)
- Maximum Dry Density of the soil is decreased by 12.35% from 1.78gm/cc (virgin soil) to 1.56gm/cc (at 20% PET) and then increases to 1.62gm/cc (at 25% PET).
- Unconfined Compressive Strength of the soil is increased by 108.9% from 0.857kg/cm²(virgin soil) to 1.790kg/cm² (at 20% PET) and then decreases to 1.686 kg/cm²(at 25% PET).
- CBR value of soil increases from 2.91% (virgin soil) to 10.29% (at 20% PET) and then decreases from 10.29%(at 20% PET) to 9.12% (at 25% PET) in unsoaked condition and increases from 2.11% (virgin soil) to 9.27% (at 20% PET) and then decreases to 8.32% (at 25% PET) in soaked condition.

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Design and Implementation of GSM based Smart Home Automation

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Abstract— This paper describes the design and performance enhancement of Global-System-for-Mobile-Communication (GSM) based domestic appliances control system. It provides the password protected environment to control the home application using Short Message Service (SMS). The enhancement performed through GSM module (SIM300) by providing wireless environment. SIM300 used to receive the text message from the user that is act as a password and matched by the microcontroller. If sent password is matched with microcontroller's stored password then microcontroller automatically enables further switching action for home appliances such as lamp, buzzer, door locks, fans, water pumps, air conditioner, television, refrigerator etc. The system consists of a GSM module, a high-performance low-power Phillips 8-bit microcontroller (P89v51RD2xx), Driver Unit (ULN2003), Relays and some electronics biasing components. The driving software is designed with KEIL complier using embedded C language. The designed system is activates the appliances based on user's message as well as status (ON/OFF) of the corresponding appliances are displayed on the Alphanumeric Liquid Crystal Display (LCD).

Keywords— GSM Module, Home Appliances, LCD, Microcontroller and Relays.

I. INTRODUCTION

This paper focuses to design and provide a wireless communication link to control home appliances through SMS for the users. In current scenario most of the people are connected with the mobile phone and want to get easy access of technology through their cell phones [1-3]. With the progress of the electronics technology in the last decades, a new concept called Smart Home has become prevalent and through this concept people have been trying to control and secure their home appliances remotely by using SMS with low cost [4-7]. GSM based remote control management is a subject of creating interest which has found application in different zones. Many works are going on in this field all over the world [8-10]. So it gives motivation to us for designing a system for smart home automation through SMS. Fig.1. illustrates the Structure of GSM based Smart Home Automation.

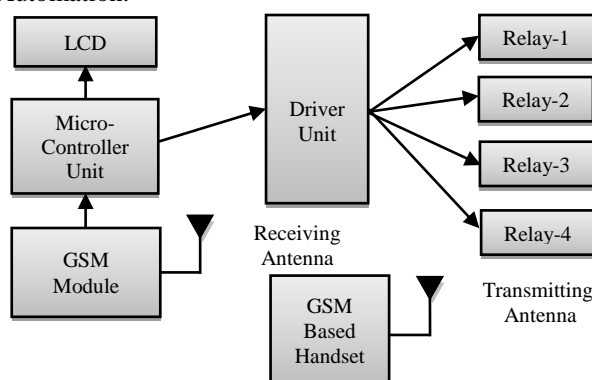


Fig. 1. Structure of the GSM based Samrt Home Automation.

II. SYSTEM DESIGN AND IMPLEMENTATION

The complete system is splits into hardware and software section. The hardware section consists of embedded system that is based on microcontroller (P89v51RD2xx), a GSM module (SIM300), GSM Mobile Phone, Driver Unit (ULN2003), LCD and switching device (Relay). The GSM module provides the communication media between owner and designed system through SMS. The GSM modules uses the AT commands to send the SMS message. The format of the message is predefined as per the datasheet of GSM (SIM300). As GSM module receives the message, microcontroller extracts the command automatically and turns ON/OFF the corresponding appliances as per matched password. The alphanumeric Liquid-Crystal-Display (LCD) is used to display the switching status of the appliances either it is ON or OFF as per given instructions by the microcontroller. The detailed configuration of the designed system is given as:

A. Scehematic Design

All proposed hardware components and devices are virtually connected in the schematic design with the help of professional ISIS 7 Proteus designing and verification software. The circuit of hardware prototype was designed in Proteus. The components description is available in the software which can be edit during to simulation or run time. After the completion of circuit designing, simulation is performed and virtually verified the circuit performance on Proteus with embedded C code. The schematic design of Smart Home Automation is shown in Fig. 2.

B. Microcontroller (P89V51RD2xx)

This system is designed with the micro-controller (P89v51RD2xx) and a clock/timeout generator circuit. It consists of four ports and each port having eight pins, so the total input/output pins of this microcontroller are 32. The clock frequency of this microcontroller is 11.0592 MHz (~ 12 MHz) and it operates on +5V dc supply. It also contains 128 byte of Random-Access-Memory (RAM), 4K byte of Read-Only-Memory (ROM) and one Serial COM port. Microcontroller is the heart of the system because overall operation is controlled by it through decoding of received text message and matches message or password with embedded C code which is stored in the ROM of microcontroller and it also passes the signal to corresponding relay through relay driver, if the data is matched with the stored data. Then the concerned device will be ON/OFF according to received command from microcontroller.

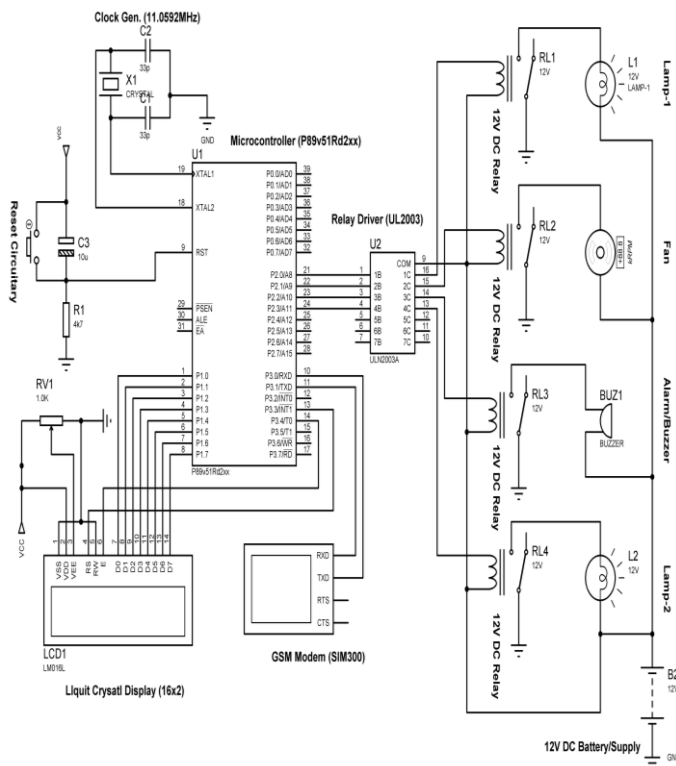


Fig. 2. Schematic design of Smart Home Automation.

C. Display Unit (LCD 16x2)

The system display unit contains an alphanumeric Liquid-Crystal-Display (LCD) which displays the character as well as numeric in two rows, each row consists of 16 characters and total number of characters displayed is 32 at a single time. In this system LCD is used to display the status of corresponding appliances. The operating voltage of the LCD is 5V.

D. GSM Module (SIM300)

GSM Module is wireless modem which provides the facility to send or receive short text messages as well as the

dial or receive call through Universal-Asynchronous-Receiver/Transmitter (UART) communication medium. The serial baud rate of SIM300 is adjustable with 1200 to 115200 bits per sec (bps) and default baud rate of SIM300 is 9600 bps. Its operating voltage is 7-15V, 1.5-2.0A DC and works on the EGSM-900 MHz, PCS-1900MHz and DCS-1900 MHz frequencies. The GSM module is connected to microcontroller through voltage level converter (MAX232). Level converter maintain the voltage level between microcontroller and GSM module. The operation of SIM300 is performed based on AT commands which is programmed by the user and stored in microcontroller. Table I. shows the some examples of AT commands of GSM Module and its uses.

TABLE I. AT Commands of GSM Module.

| S. No. | AT Command | Uses |
|--------|------------|---|
| 1 | AT+CMGF | Message Mode |
| 2 | AT+CMGS | Message Send |
| 3 | AT+CMGR | Message Receive |
| 4 | AT+CNMI | Set Baud Rate |
| 5 | AT+CALARM | Set alarm time |
| 6 | AT+CCLK | Set data and time |
| 7 | AT+CPOWD | Power down |
| 8 | AT+CPAS | Change incoming to ringing |
| 9 | AT+CMIC | Set the gain level of microphone |
| 10. | AT+ECHO | Set the parameters for echo suppression |

E. Driver Unit (ULN2003)

The drives unit contains integrated circuit ULN2003 which is used to drive the relays in the system. ULN2003 is 16 pins Dual-in-Package (DIP) integrated circuits which operate on +12V DC supply. Out of 16 pins, two pins 8 number and 9 number are connected to ground and supply respectively; and remaining 14 pins use used for input and output connections (1-7 number for inputs and 10-16 for outputs). UNLN2003 works as buffer circuit means whenever you need a high current by default it gives low current.

F. Relay Unit

The switching action in the system is performed by relay unit. The relay is a smart switch which operates automatically by received input signal. The relays have been connected to the microcontroller through driver unit (UNL2003). The operating voltage of the relay is +12V DC supply but it controls the switching action of AC appliances. The connections of the relay are made as per basic pin configuration. In a basic relay there are three contacts: Normally-Open (NO), Normally-Closed (NC) & Common (COM). At the initial stage, the COM is connected to NC. All loads are connected with COM port of Relay and direct power source is connected with NO port.

III. SOFTWARE DEVELOPMENT

In the software development section source code of the system are designed. The source code is written in Embedded C language on Keil4 Compiler. Keil4 is an integrated toolset

for the development of embedded application employing Atmel and Phillips microcontroller. The compile tool is used to convert embedded C Language to HEX File that is the bundle of software module which provides the interfacing between microcontroller, SIM300, ULN2003, LCD and Relay. The HEX file is stored into the Phillips microcontroller using ECEFlash. Fig. 3. illustrates the flow chart of Smart Home Automation.

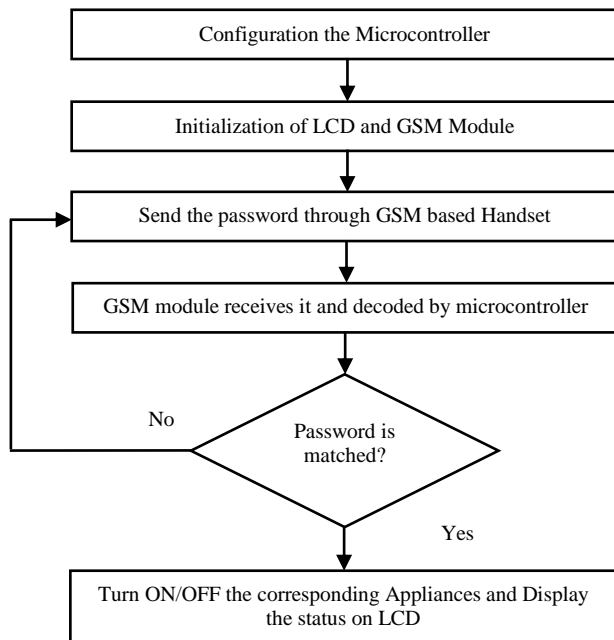


Fig. 3. Flow chart of Smart Home Automation.

IV. CONCLUSION

The GSM based Smart Home Automation system is successfully able to control of the appliances from any location of the world where GSM service is available. The designed and implemented system is very economical, password protective, auto configurable and remotely controlled solution for home automation.

The wide capabilities of this system are what make it so interesting. The user can be remotely controlled any of the appliances from the home or any place where the designed system is installed by sending a text message (or password) through any GSM based handset or cell-phone. The designed system provides the password protective smart home automation for home appliances.

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Impulsive Responses Of Damped Mechanical And Electrical Oscillators

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Abstract: In this paper, the impulsive responses of damped mechanical and electrical oscillators are obtained by the Mohand Transform. This paper brings up the Mohand Transform as a new technological approach for obtaining the impulsive responses of damped mechanical and electrical oscillators. The Mohand transform provides an effective and simple tool for obtaining the impulsive responses of damped mechanical and electrical oscillators.

Keywords: Damped Mechanical and Electrical oscillators; Impulsive Responses; Mohand Transform.

I. INTRODUCTION

The energy of a simple harmonic oscillator persists indefinitely without the reduction of amplitude and remains constant throughout the motion. In practice, the oscillator is acted upon by the frictional forces arising from the viscosity of the medium or from within the system itself which causes the reduction of amplitude and hence the energy of the oscillator with time. In electrical oscillator, energy is dissipated due to the presence of resistance of the circuit. However, in the presence of small damping force does not have any significant effect on the undamped oscillations of the oscillator. In such a case, the frictional forces acting on the oscillator are directly proportional to the velocity of the oscillator only [1-5]. This paper discusses the theory of a mechanical oscillator and an electrical oscillator by Mohand Transform to obtain their impulsive responses which is generally obtained Laplace transform approach [1, 4]. This Transform has been applied to boundary value problems in most of the science and engineering disciplines [6, 7]. The purpose of paper is to demonstrate the Mohand Transform for analyzing the impulsive responses of damped mechanical and electrical oscillators.

II. BASIC DEFINITION

A. Mohand Transform

If the function $h(y)$, $y \geq 0$ is having an exponential order, then the Mohand transform [6, 7] of $h(y)$ is given by

$$M\{h(y)\} = \bar{h}(q) = q^2 \int_0^{\infty} e^{-qy} h(y) dy$$

The Mohand Transform [6, 7] of some of the functions are given by

- $M\{y^n\} = \frac{n!}{q^{n+1}}$, where $n = 0, 1, 2, \dots$
- $M\{e^{ay}\} = \frac{q^2}{q-a}$,
- $M\{\sin ay\} = \frac{aq^2}{q^2+a^2}$,
- $M\{\cos ay\} = \frac{q^3}{q^2+a^2}$,
- $M\{\sinh ay\} = \frac{aq^2}{q^2-a^2}$,
- $M\{\cosh ay\} = \frac{q^3}{q^2+a^2}$,
- $M\{\delta(t)\} = q^2$

B. Mohand Transform of Derivatives

The Mohand Transform [6, 7] of some of the derivatives of $h(y)$ are given by

$$M\{h'(y)\} = qM\{h(y)\} - q^2h(0)$$

or

$$M\{h'(y)\} = q\bar{h}(p) - q^2h(0),$$

$$M\{h''(y)\} = q^2\bar{h}(p) - q^3h(0) - q^2h'(0),$$

and so on.

III. MATERIAL AND METHOD

A. MECHANICAL (DAMPED) OSCILLATOR

The differential equation of damped oscillator subjected to the impulsive force [1, 3] is given by $\ddot{x}(t) + 2a\dot{x}(t) + \omega^2 x(t) = g(t)$ (1), where $g(t) = \gamma\delta(t)$, $\delta(t)$ is a delta function (impulsive force per unit mass) and γ is its strength, $2a = \frac{r}{m}$ represents the damping constant per unit mass, $\omega = \sqrt{\frac{k}{m}}$ represents the natural frequency of the oscillator. For a lightly damped oscillator, $a < \omega$.

The initial boundary conditions as follows [3-5]:

- (i) If we measure the time from the instant when the oscillator is crossing its mean position, then at $t = 0$, $x(0) = 0$.
- (ii) Also, at the instant $t = 0^+$ (i.e. just after applying the impulsive force), we assume that the velocity of the oscillator is maximum i.e. $\dot{x}(0^+) = v_0$.

The Mohand transform of (1) provides

$$q^2 \bar{x}(q) - q^3 x(0) - q^2 \dot{x}(0) + 2a\{q\bar{x}(q) - q^2 x(0)\} + \omega^2 \bar{x}(q) = \gamma q^2 \dots (2)$$

Here $\bar{x}(q)$ denotes the Mohand transform of $x(t)$.

Applying boundary conditions $x(0) = 0$ and $\dot{x}(0) = v_0$ and simplifying (2), we get

$$\bar{x}(q) = \frac{(\gamma + v_0)q^2}{q^2 + 2aq + \omega^2}$$

Or

$$\bar{x}(q) = \frac{(\gamma + v_0)q^2}{(q + \beta_1)(q + \beta_2)}$$

where $\beta_1 = a + i\sqrt{\omega^2 - a^2}$ and $\beta_2 = a - i\sqrt{\omega^2 - a^2}$ such that $\beta_1 - \beta_2 = 2i\sqrt{\omega^2 - a^2}$.

$$\text{Or } \bar{x}(q) = \frac{(\gamma + v_0)q^2}{(\beta_2 - \beta_1)(q + \beta_1)} - \frac{(\gamma + v_0)q^2}{(\beta_2 - \beta_1)(q + \beta_2)}$$

Applying inverse Mohand Transform, we get

$$x(t) = (\gamma + v_0) \frac{[e^{-\beta_1 t} - e^{-\beta_2 t}]}{(\beta_2 - \beta_1)} \dots \dots \dots (3)$$

To find γ , applying condition $\dot{x}(0) = v_0$ and solving, we get

$$x = 0 \dots \dots \dots (4)$$

Using (4) in (3), we get

$$x(t) = v_0 \frac{[e^{-\beta_1 t} - e^{-\beta_2 t}]}{(\beta_2 - \beta_1)}$$

Or

$$x(t) = v_0 e^{-at} \frac{[e^{i\sqrt{\omega^2 - a^2}t} - e^{-i\sqrt{\omega^2 - a^2}t}]}{2i\sqrt{\omega^2 - a^2}}$$

Or

$$x(t) = \frac{v_0 e^{-at}}{\sqrt{\omega^2 - a^2}} \sin \sqrt{\omega^2 - a^2} t \dots \dots (5)$$

When $r = 0$, $a = \frac{r}{2m} = 0$, then (5) reduces to

$$x(t) = \frac{v_0}{\omega} \sin \omega t$$

The equation (5) provides the impulsive response of a lightly damped oscillator and reveals that it is independent on the strength of the impulsive force. Also, the behavior of oscillator is oscillatory with amplitude of oscillations reduces with time exponentially. When the damping force is zero, the amplitude of oscillations remains constant.

For an overdamped oscillator [5], $a > \omega$, therefore, replacing $\sqrt{\omega^2 - a^2}$ by $i\sqrt{a^2 - \omega^2}$ in (5), the displacement of an overdamped oscillator is given by

$$x(t) = \frac{v_0 e^{-at}}{i\sqrt{a^2 - \omega^2}} \sin i\sqrt{a^2 - \omega^2} t$$

Or

$$x(t) = \frac{v_0 e^{-at}}{\sqrt{a^2 - \omega^2}} \sinh \sqrt{a^2 - \omega^2} t \dots \dots (6)$$

This equation (6) provides the impulsive response of heavily damped oscillator and reveals that the motion of heavily damped oscillator is non-oscillatory.

B. ELECTRICAL (DAMPED) OSCILLATOR

The differential equation of electrical oscillator (LRC circuit) subjected to the impulsive Potential [8-9] is given by

$$Q(t) + 2a\dot{Q}(t) + \omega^2 Q(t) = g(t) \dots \dots (7), \text{ where } g(t) = \gamma \delta(t), \text{ where } g(t) = \gamma \delta(t), \delta(t) \text{ is a delta potential}$$

(impulse) and γ is its strength, $\omega = \sqrt{\frac{1}{LC}}$ represents the

angular frequency of the electrical oscillator, $2a = \frac{R}{L}$ represents the damping coefficient. $Q(t)$ is the instantaneous charge.

The initial boundary conditions [10, 11] as follows:

- (i) At $t = 0$, $Q(0) = 0$.

- (ii) Also, at the instant $t = 0^+$ (i.e. just after applying the impulsive potential, we assume that the current in the circuit is maximum i.e. $\dot{Q}(0^+) = i_0$.

The Mohand transform of (1) provides

$$q^2 \bar{Q}(q) - q^3 Q(0) - q^2 \dot{Q}(0) + 2a\{q \bar{Q}(q) - q^2 Q(0)\} + \omega^2 \bar{Q}(q) = \gamma q^2 \dots (8)$$

Here $\bar{Q}(q)$ denotes the Mohand transform of $Q(t)$.

Applying boundary conditions [12] $Q(0) = 0$

and $\dot{Q}(0) = i_0$ and simplifying (8), we get

$$\bar{Q}(q) = \frac{(\gamma + i_0)q^2}{q^2 + 2a q + \omega^2}$$

Or

$$\bar{Q}(q) = \frac{(\gamma + i_0)q^2}{(q + \beta_1)(q + \beta_2)}$$

where $\beta_1 = a + i\sqrt{\omega^2 - a^2}$ and $\beta_2 = a - i\sqrt{\omega^2 - a^2}$ such that $\beta_1 - \beta_2 = 2i\sqrt{\omega^2 - a^2}$.

$$\text{Or } \bar{Q}(q) = \frac{(\gamma + i_0)q^2}{(\beta_2 - \beta_1)(q + \beta_1)} - \frac{(\gamma + i_0)q^2}{(\beta_2 - \beta_1)(q + \beta_2)}$$

Applying inverse Mohand Transform, we get

$$Q(t) = (\gamma + i_0) \frac{[e^{-\beta_1 t} - e^{-\beta_2 t}]}{(\beta_2 - \beta_1)} \dots \dots \dots (9)$$

To find γ , applying condition $\dot{Q}(0) = i_0$ and solving, we get

$$\gamma = 0 \dots \dots \dots (10)$$

Using (10) in (9), we get

$$Q(t) = i_0 \frac{[e^{-\beta_1 t} - e^{-\beta_2 t}]}{(\beta_2 - \beta_1)}$$

Or

$$Q(t) = i_0 e^{-at} \frac{[e^{i\sqrt{\omega^2 - a^2}t} - e^{-i\sqrt{\omega^2 - a^2}t}]}{2i\sqrt{\omega^2 - a^2}}$$

Or

$$Q(t) = \frac{i_0 e^{-at}}{\sqrt{\omega^2 - a^2}} \sin \sqrt{\omega^2 - a^2} t \dots \dots (11)$$

When $R = 0$, $a = \frac{R}{2L} = 0$, then (11) reduces to

$$Q(t) = \frac{i_0}{\omega} \sin \omega t$$

This equation (11) provides the impulsive response of an electrical oscillator and reveals that it is independent on the strength of the impulsive potential. Also, the behavior of oscillator (charge) is oscillatory with the amplitude of oscillations reduces with time exponentially. The decrease in amplitude i.e. damping depends upon resistance R in the circuit. Such a damping is called resistance damping [2, 9]. If $R = 0$, the amplitude would remain constant. Hence in LRC circuit, the resistance is the only dissipative element.

IV. CONCLUSION

In this paper, we have successfully applied the Mohand Transform to obtain the impulsive responses of damped mechanical and electrical oscillators and exemplified it for successfully analyzing the theory of damped mechanical and electrical oscillators. A new and different method is exploited for obtaining the impulsive responses of damped mechanical and electrical oscillators.

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Elzaki Transform Means To Design A Protective RC Snubber Circuit

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Abstract: The overstressing caused by excessive time rate of growth of voltage across the power electronic devices like SCR, TRIAC, DIAC etc. is usually reduced by applying protective circuits like snubber circuit, crowbar circuit etc. The protective snubber network of resistor and capacitor shunted from SCR is designed for a d. c. circuit with load of resistor and inductor to avoid the unnecessary faulty operation of the circuit. In this paper, Elzaki transform means is applied to determine the time rate of growth of the voltage across power electronic device SCR and hence the suitable values of components (resistor and capacitor) of protective snubber network so that the unnecessary faulty operation of the circuit is avoided. The purpose of paper is to prove the applicability of Elzaki Transform means to determine the time rate of growth of the voltage across power electronic device SCR and hence the suitable values of components of protective snubber network shunted from SCR for avoiding the faulty operation of d. c. circuit with load of resistor and inductor.

Index terms: Protective snubber Network, Elzaki Transform, Rate of Growth of Voltage, SCR.

I. INTRODUCTION

The silicon – controlled rectifier SCR is one of the power electronic devices which works at high voltage and is a part of the family of thyristor. It has been noted that a small growth in time rate of change of the voltage across SCR, turns it on and if this rate is greater than its dV/dt rating, then it would start conducting without triggering pulse at the gate [1]. For the proper functioning of the circuit containing SCR, it must be protected against its false triggering. This protection is achieved by the protective snubber network of resistor and capacitor shunted from the SCR [2]. To minimize the effect of the excessive time rate of growth of the voltage across the SCR, it is necessary to determine the values of components of the protective snubber network so that false triggering of SCR resulting in the faulty operation of the circuit is avoided [3]. The Elzaki transform method has been applied in science and engineering disciplines [4, 5, 6, 7] and also comes out to be very effective tool to determine the time rate of growth of the voltage across SCR and hence the suitable values of components of protective snubber network shunted from SCR for avoiding the faulty operation of d. c. circuit with load of resistor and inductor.

II. BASIC DEFINITIONS

A. Elzaki Transform

If the function $\bar{h}(y)$, $y \geq 0$ is having an exponential order and is a piecewise continuous function on any interval, then the Elzaki transform of $\bar{h}(y)$ is given by [4, 5]

$$E\{\bar{h}(y)\} = \bar{h}(p) = p \int_0^\infty e^{-\frac{y}{p}} \bar{h}(y) dy.$$

The Elzaki Transform [6, 7] of some of the functions are given by

- $E\{y^n\} = n! p^{n+2}$, where $n = 0, 1, 2, \dots$
- $E\{e^{ay}\} = \frac{p^2}{1-ap}$,
- $E\{\sin ay\} = \frac{ap^3}{1+a^2p^2}$,
- $E\{\cos ay\} = \frac{ap^2}{1+a^2p^2}$,

B. Inverse Elzaki Transform

If we write $E[\bar{h}(y)] = \bar{h}(p)$, then inverse Elzaki transform [4, 5] of the function $\bar{h}(p)$ is given by $E^{-1}[\bar{h}(p)] = \bar{h}(y)$, where E^{-1} is called the inverse Elzaki

transform operator. The Inverse Elzaki Transform of some of the functions are given by

- $E^{-1}\{p^n\} = \frac{y^{n-2}}{(n-2)!}, n = 2, 3, 4 \dots$
- $E^{-1}\left\{\frac{p^2}{1-ap}\right\} = e^{ay}$
- $E^{-1}\left\{\frac{p^3}{1+a^2p^2}\right\} = \frac{1}{a} \sin ay$
- $E^{-1}\left\{\frac{p^2}{1+a^2p^2}\right\} = \frac{1}{a} \cos ay$

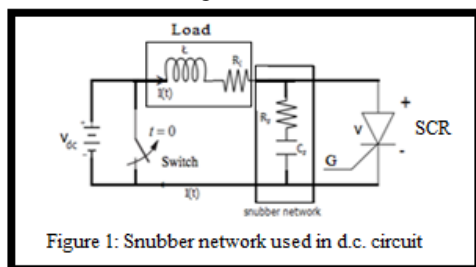
C. Elzaki Transform of Derivatives

The Elzaki Transform of some of the Derivatives [6, 7] of $h(y)$ are given by

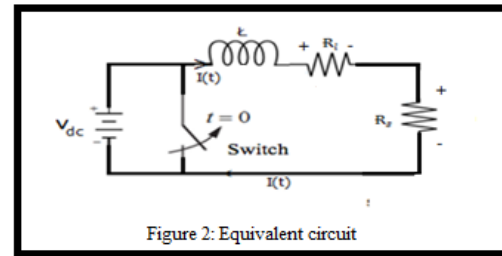
- $E\{h'(y)\} = \frac{1}{p} E\{h(y)\} - p h(0)$
or $E\{h'(y)\} = \frac{1}{p} \bar{h}(p) - p h(0),$
- $E\{h''(y)\} = \frac{1}{p^2} \bar{h}(p) - h(0) - p h'(0),$
and so on

II. MATERIAL AND METHOD

Considering a protective snubber network of resistor and capacitor shunted from SCR. This circuit is connected to a d. c. circuit with load of resistor and inductor as shown in figure 1.



In practice, the time rate of change of d.c. voltage switched across SCR must be below its $\frac{dv}{dt}$ rating, otherwise, it would begin conducting without the gate trigger pulse [1]. As the switch is opened at $t = 0+$, the capacitor (C_s) behaves like a short circuit and the SCR being in the forward blocking condition provides a very high resistance to the current and works as an open switch [3]. The equivalent circuit for the given situation is shown in figure (2).



Applying Kirchhoff's loop law to the circuit (figure 2) at $t = 0+$, we get

$$L \frac{dI(t)}{dt} + R_s I(t) + R_L I(t) = V_{dc}$$

Rearranging the equation, we get

$$I(t) + \frac{R_s + R_L}{L} I(t) = \frac{V_{dc}}{L} \dots \dots (1) \quad \equiv \frac{d}{dt}$$

Differentiating (1) w.r.t. to t , we get

$$\dot{I}(t) + \frac{R_s + R_L}{L} I(t) = 0 \dots \dots (2)$$

Taking Elzaki transform of (2), we get

$$\frac{1}{p^2} \bar{I}(p) - I(0) - p I(0) + \frac{R_s + R_L}{L} \left[\frac{1}{p} \bar{I}(p) - p I(0) \right] = 0 \dots \dots (3)$$

$\bar{I}(p)$ is the Elzaki transform of $I(t)$. It is noted that at $t = 0$, then $I(0) = 0$ as the current through the inductor cannot change instantaneously [8, 9, 10].

$$\text{From (1), } I(0) = \frac{V_{dc}}{L}$$

Rearranging and simplifying (3), we get

$$\bar{I}(p) = \frac{V_{dc}}{R_s + R_L} \left[p^2 - \frac{p^2}{1 + \frac{R_s + R_L}{L} p} \right] \dots \dots (4)$$

Taking inverse Elzaki transform of (4), we get

$$I(t) = \frac{V_{dc}}{R_s + R_L} \left[1 - e^{-\frac{R_s + R_L}{L} t} \right] \dots \dots (5)$$

Differentiating (5) w.r.t. t and simplifying, we get

$$\dot{I}(t) = \frac{V_{dc}}{L} e^{-\frac{R_s + R_L}{L} t} \dots \dots (6)$$

Now $\dot{I}(t)$ is maximum when $t = 0$ and is given by

$$[\dot{I}(t)]_{\max} = \frac{V_{dc}}{L}$$

$$\text{Or } L = \frac{V_{dc}}{[\dot{I}(t)]_{\max}} \dots \dots (7)$$

On applying the ohm's law, the maximum voltage across the SCR is given by

$$[\dot{V}(t)]_{\max} = R_s [\dot{I}(t)]_{\max}$$

$$\text{Or } [\dot{V}(t)]_{\max} = R_s \frac{V_{dc}}{L}$$

$$\text{Or } R_s = \frac{L}{V_{dc}} [\dot{V}(t)]_{\max} \dots \dots (8)$$

The values of elements L, R_L, R_s , and C_s are chosen in such a way that the circuit becomes critically damped and the capacitor takes minimum time to charge [11, 12]. On applying the condition of critical damping [9, 10], we have

$$R_L + R_s = \sqrt{4L/C_s}$$

$$\text{Or } C_s = \frac{4L}{(R_L + R_s)^2} \dots\dots\dots (9)$$

It is clear from (8) and (9) that the suitable value of $\dot{V}(t)$ is used to avoid the false triggering of the SCR, and from the given values of L and R_L , we can find the values of components R_s and C_s of protective snubber network.

IV. CONCLUSION

In this paper, Elzaki transform means has been applied successfully for determining the time rate of growth of the voltage across the power electronic device SCR and hence the suitable values of components of protective snubber network shunted from SCR for avoiding the faulty operation of d. c. circuit with load of resistor and inductor. The method has come out to be successful tool to determine the time rate of growth of the voltage across SCR and hence the components of protective snubber network shunted from SCR for avoiding the faulty operation of d. c. circuit with load of resistor and inductor.

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Artificial Neural Networks; Latest Trends and Their Comparative Analysis

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Abstract— We know that living beings like humans and animals have the capability of understanding and processing information that is provided by our brains. More specifically, there are trillions of neurons which combine to form a neural network. These neurons function by exchanging electrical pulses which are called **action potentials**. Technology has taken leaps ahead and come up with computerized algorithms that replicate these biological neural networks, which we call **artificial neural networks**. The artificial neural networks help in differentiating between human and animal brain cells. In scientific terms, the phrase neural network is used to refer to both biological and non-biological systems. Both **artificial intelligence** and neural networks come under a class of paradigms that deal with information processing. These paradigms are governed by principle by which biological neural network deals with data and information. We have artificial intelligence and **cognitive modeling** working to attempt to imitate these properties of our biological neural networks. Today, artificial neural networks are being used in fields of **image analysis** and **speech recognition**. By doing this, we have been able to develop software as well as hardware based robots, that are either autonomous or self-governing. The aim of this paper is to provide a brief introduction to artificial neural networks, review the latest trends in ANN, and compare these latest trends based on their application areas in the modern world.

Keywords— action potentials; artificial intelligence; artificial neural networks; cognitive modeling; image analysis; speech recognition

I. INTRODUCTION

Going by the definition, a neural network is a group of interconnected neurons. Scientifically speaking, a neural network is composed of artificially created neurons, which are sometimes referred to as nodes, whereas a biological neural network has chemically connected and functionally associated neurons. The neural network that is created artificially is the one we use to solve artificial intelligence problems. Each neuron is further connected to other neurons to form an extensive network of neurons. The neurons are connected at synapses, which are formed between axons and dendrites, though other types of connections are also possible. In addition to transmitting electrical signals, other types of signals are also generated by neurotransmitter diffusion. We can infer that neural networks are a collection of algorithms that are designed keeping the human brain as a reference, in terms of remembering patterns. The sensory data is interpreted by a machine that allows the ability of perception or by clustering the raw input. The imitation of mammalian cerebral cortex in case of artificial neural networks is done on a much smaller scale. In comparison to the human brain, ANNs have a lot more processing units. The researchers in this field don't aim to accurately design the networks the same way as a human brain. For instance, the function of retina of the eye has been accurately simulated. In spite of the complicated mathematics involved, one can still gain knowledge at an operational level of the basic structure and functionality. We use neural networks to cluster and classify data. They can be considered to be a layer that facilitates clustering as well as classification function and is present over the data that is stored and managed. According to the various similarities between the inputs, the unlabeled data

is grouped and classified then a defined dataset is used to train on. Another feature of neural networks is that they also extract features from the various algorithms that are used to perform clustering and classification. Therefore, it can also be further used in algorithms used in reinforcement learning, prediction, classification and regression.

II. LATEST TRENDS IN ARTIFICIAL NEURAL NETWORKS

I. Reinforcement Learning:

The most commonly used forms of machine learning are supervised and unsupervised learning. Another type of learning is reinforcement learning. In supervised learning we make use of labeled dataset, and the output that is generated is part of the set that contains all the expected outputs. In unsupervised learning, we have an unlabeled dataset and we form connections between this unlabeled data and perform classification and clustering. Reinforcement learning makes use of decision making that is based on the previous experiences in a sequence. The algorithm interacts with the environment and learns about how to make further moves that lead towards the goal. Each move has an outcome, which can be positive or negative. A move that pushes closer towards the goal will be rewarded and one that doesn't will be penalized. This is how most gaming algorithms incorporate reinforcement learning, by examining which moves will make the computer win the game and reach the goal state. All of this is done without having to specify the rules to the algorithm, it learns by playing the game again and again until all the possible moves have been made. At present the only major field of application is in game playing algorithms, otherwise the use of reinforcement learning is limited. Continuous analysis is going on to determine further applications of this technology.

Some of the industrial application areas that can be considered:

- Higher education: Advancement has been achieved in teaching and learning methodologies.
- Healthcare: Has helped in coming up with treatment policies especially in case of chronic diseases like diabetes and schizophrenia.
- Finance: An example is a reinforcement learning program of the name "LOXM" that is being used to execute trades in the stock market. It has given the advantage of increasing speed of the client orders and then executing them at the best possible prices.

II. Quantum Computing:

Quantum computers use quantum physics to compute calculations at speeds that cannot be matched by any supercomputer. We are aware of how computers use bits and bytes. However, quantum computers use qubits (Quantum bits) to store information. There is still a lot to do in order to handle the obstacles in quantum computing. This includes challenges like maintaining coherence of qubits, removing unwanted and noise inducing computations. The coming years are expected to bring about more research on quantum computers and how to create strategies to reduce the error rates to make meaningful computations possible. The challenging problem could be to solve almost unsolvable problems like climate change, presence of earth-like planets in the galaxy or our body's ability to destroy cancer.

III. Facial Recognition:

Whether it is Google winning the recent lawsuit or China's SenseTime, Facial recognition has received a lot of criticism recently. However, this technology would grow continually in the coming years. Facial recognition is one of the artificial intelligence applications that find its use in identifying someone by making use of their digital image or even by the patterns of their facial features. The future is sure to see this technology being used in various areas with improvement in its accuracy and degree of reliability. One example of the application area of facial recognition is in Facebook's Deepface software that helps to tag people in pictures. Another one is the facial recognition feature as a phone unlocking mechanism introduced by iPhone X. The wave of personalization of everything is dominated by the use of facial recognition. This technology is basically the stepping stone to biometric identification, which is non-invasive in nature and is easy to deploy.

IV. Deep Learning:

The most popular type of algorithm in AI is considered to be machine learning. This too becomes hard to work with as the dimensions of data keep getting increased. Consider the

task of calculating how much a gadget will cost you when it is bought from a particular shop. In this case, only two dimensions of data are present. Another case is when we use text to speech software. The problem grows by a tenfold due to increase in the number of dimensions. Image recognition, voice control, self functioning machines are all backed up by deep learning. Amazon Alexa and Google Home are now household names with voice commands enabling them to perform a wide variety of functions. These technologies make use of natural language processing algorithms to understand the words being spoken as a command. This use of deep learning in applications that are being used in the day to day life has led to development of algorithms that aim to solve problems of tougher domains.

V. Edge intelligence

Edge Intelligence (EI) brings reforms in the way data is acquired, stored and extracted. This is done by making the shift of process from storage devices initially in a cloud onto the edge. The goal here is to achieve independence for edge devices by shifting resources responsible for decision-making closer to where the data is stored. This results in faster communication and improvement in near to real outcomes. Ever since IoT was introduced, the number of connected devices has increased significantly, with this number expected to increase exponentially sometime soon in the future. The area of challenge here is to connect the large number of devices to the cloud. Organizations are now coming up with solutions that make use of edge intelligence. Talking about edge intelligence, one wonders about edge computing. It is noteworthy that edge intelligence is leaps and bounds ahead of edge computing in terms of its functionality. We deal with computing at the edge in the latter, by means of minimal processing. Edge intelligence takes a step ahead and makes use of edge devices that are capable of working completely independently. A step towards this direction was taken by Amazon when the launch of AWS DeepLens was announced. DeepLens can be described as a small camera that is based on Ubuntu and Intel Atom, which is powerful enough to run and evaluate visual machine learning models. It is considered to be the first recognized edge intelligence device that is of commercial use. It was followed by a launch by Microsoft, of Vision AI Developer Kit. Edge intelligent devices that are quickly being developed will undoubtedly be adopted by the industries. Some of such devices are Intel's NeuroCompute Stick and the cameras launched by OpenMv.

III. COMPARING THE ANN TRENDS MENTIONED BASED ON THEIR APPLICATIONS

The recent groundbreaking advancements in artificial intelligence have made it possible for us to see how AI based applications and services are being developed. These vary from home assistants to the surveillance systems that use both audio and video mode.

In case of reinforcement learning, the application provided is to train the algorithm in order to learn how to make decisions based on previously made moves. The procedure is to devise a mathematical framework using which we can solve the problem. The shortcoming here is that the real world problems are much too complicated and it is not possible for a typical reinforcement learning algorithm to solve them. Some success has been achieved by researchers who were able to implement deep neural networks and modeled the required policies and value functions. This area of reinforcement learning is called deep reinforcement learning. Attempts are being made in order to merge reinforcement learning technology with much more sophisticated deep learning structures and so far the results have been impressive.

Attempts to push quantum computers forward in order to construct the most powerful quantum computer are being made. Such a computer can be of great help to the field of machine learning by making it possible to search through large datasets containing medical, consumer and financial information. It will further help to make sense of the vast amounts of data that is to be handled.

Facial recognition technology has really hit a stride in the recent times and has found its use in various areas of application. This mainly includes identification at times of monitor, examine and investigation activities. This also includes identifying potential and active threats. Business holders identify suspects in cases of theft or shoplifting and can even keep a track of individual customer purchases. Social media platforms also implement facial recognition in their face filters feature. There is also usage of this technology at public level in railway stations, airports and cash points. Another area where this technology is being adapted progressively is in the field of medicine.

As mobile computing and IoT began propagating, billions of devices were connected to the Internet, which resulted in generation of large number of data bytes. Because of this trend, there is urgency in implementing AI at the network edge to help in maximizing the potential benefits of edge big data. In order to face this challenge, we have come up with a promising solution, namely edge computing that holds the power to shift computing tasks and services from the network to the network edge. We call this edge AI or edge intelligence, which can be considered as a new inter discipline that has generated a lot of interest among researchers. The detailed study in edge intelligence is still in its early stages and the requirement is a dedicated platform to check on the recent developments in this field.

IV. CONCLUSION

Artificial neural networks are theoretically and constitutionally motivated by the neural networks present in the human brain. This technology is of great use as it finds its

use in areas like voice control, biometric identification and imaging analysis. Since the mid-20th century, when the artificial neural networks began to be developed, technologies have started to develop at a fast pace. Because of this, today, we are aware of all the possible advantages of artificial neural networks, the areas where still development is required and the shortcomings that one might encounter during their use. A thing to remember is that the various disadvantages of artificial neural networks are being eliminated gradually, with their advantages increasing at the same time. Clearly, this technology is bound to become an essential part of our daily life with its importance increasing with every advancement.

Neural network research is inspired by the following aspirations: to be able to better comprehend the human brain and to foster computers that are capable to deal with notional problems and problems that are poorly defined. For instance, computers are unable to understand speech and perceive facial expressions. Comparatively, humans do extremely well at these tasks.

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Pattern Recognition; Approaches and Applications

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Abstract— Pattern Recognition is a swiftly developing field, which finds its use in assisting developments in cognate fields such as image processing, text and document analysis and neural networks. In a way pattern recognition is closely related to machine learning, and it is also being applied in fast sprung areas like bio metrics, bioinformatics, multimedia data analysis and most recently data science. It is the process of recognizing and detecting patterns by using some machine learning algorithms. Pattern recognition can be understood as the ordination of data based on knowledge already gained or on statistical data attained from patterns and/or their representation. One of the crucial facets of the pattern recognition is its application potential. Pattern recognition can be of two types, including “supervised,” where previously known patterns can be erect in a given data, and/or “unsupervised,” where completely different and new patterns are uncovered. The major goal of this review paper is to provide a brief introduction to pattern recognition, review the industrial implementation by considering a real-life example, explain the various best known approaches for pattern recognition and list its applications in the modern world.

Keywords— Pattern recognition; supervised; unsupervised; industrial implementation.

I. INTRODUCTION

Pattern recognition can be elucidated as the automated recognition of patterns and regularities in data. Pattern recognition is adjacent to machine learning and artificial intelligence, together with applications like data mining, knowledge discovery in databases (KDD), and it is commonly used interchangeably with these terms. However, these are distinguished, as machine learning is one of many approaches for recognition of patterns in our data, while other approaches include hand-crafted rules or heuristics. A modern and complete definition of pattern recognition is:

“Pattern recognition is concerned with automatic spotting of desired patterns, arrangements and regularities in data with the aid of computer algorithms and also considering these regularities to take actions such as classifying the data into different categories.”

It is the science of building inferences from perceptual data, using statistics, probability, geometry, machine learning, signal processing, and algorithm design as the tools. Thus, it is of chief importance to artificial intelligence and computer vision, and has applications in engineering, science, medicine, and business. However, the most crucial problems in pattern recognition are yet to be solved. A feature extraction mechanism computes symbolic and/or numeric information from the real world observations. Then a classifier is used to classify or describe these extracted features. The procedure followed for the recognition of patterns consists of many steps that ensure efficient description of the desired patterns. Pattern recognition can also be defined as the deposition of input data into indistinguishable classes by pulling out the significant attributes or features of the data from a background of immaterial detail.

Let us take into account an example of a fish-packing plant that wants to automate the method of sorting fishes on a conveyor belt according to their species. As a pilot project, we try to separate sea bass from salmon using optical sensing

(Figure1).

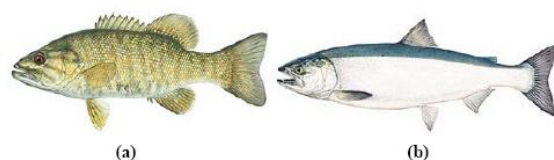


Figure 1: Objects to be classified; Sea bass & Salmon

We set up a camera (see Figure 2), take multiple sample images, and note some physical and structural differences between the kinds of fish in terms of length, lightness, width, number, shape of fins, position of the mouth, and so on, and this suggests features to look at in our classifier. We also notice variations within the images, variations in lighting, and placement of the fish on the conveyor, sometimes even static because of the electronics of the camera.

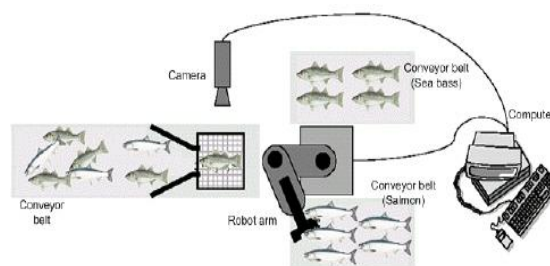


Figure 2: The fish-packing system.

Given that there is a significant difference between the population of sea bass and salmon fish, we view them as having distant models, divergent descriptions, which are usually mathematical in form. The goal and approach in pattern classification is to perceive the class of these models, process the sensed data to oust noise, and for any sensed pattern, choose the model that coincides best. In our prototype system, first, the camera captures an image of the fish (Figure 2). Next, the camera's gestures are pre-processed to simplify

consequent operations without losing any relevant information in the acquired image. In a similar case, we might use segmentation procedure in which images of different fish are segregated from each other and also create a separation from background. The information from a single fish is forwarded to a feature extractor, whose whole idea is to curtail the data by calibrating certain features or properties. These features are then moved to a classifier that evaluates the evidence provided and makes a final verdict pertaining to the species.

II. PATTERN RECOGNITION APPROACHES

Patterns that are generated from the raw data depend on the nature of the data. Pattern generation may be based on the statistical feature of the data. In some situations, underlying structure of the data decides the type of the pattern that is generated. In some instances, neither of the two situations exists. In such situations, a system is developed and trained for desired responses. Thus, for a given problem one or more of different approaches may be used to obtain the solution. The four best-known approaches for the pattern recognition are:

- A. Template Matching
- B. Statistical Classification
- C. Syntactic Matching
- D. Neural Networks

A. Template Matching:

One of the primarily used approach in pattern recognition which is based on matching the acquired templates. Matching is done to resolve the similarities between two entities such as edges, curves, points, or shapes of the same type. In template matching, a prototype of the pattern that is to be recognized is made available. The pattern to be identified is coordinated against the stored template while seeing all the allowable operations such as rotation, translation and scale changes. The similarity measures can be optimized depending on the training set made available during learning. Often, a template is learned from the training set provided. Template matching approach is highly demanding in terms of computational power required. With the help of modern day computes that are equipped with faster processors, high memory count and higher graphical processing power have made this approach more feasible.

B. Statistical Classification:

The statistical pattern recognition approach infers the statistical basis for allotment of data. It produces random parameters which speak for the properties of the pattern to be recognized. The main goal of this classification method is to trace which class or category a given sample resides in. Statistical methodologies such as statistical hypothesis testing, correlation and bayes classification are useful in implementation of this approach. The efficiency of the representation is calculated by how well patterns from different classes are separated. To measure the proximity of the given sample with one of the classes, statistical pattern recognition uses probability of error. Bayesian classifier is the most popular choice for applying

statistical methods to pattern recognition. However, it is often difficult to implement due to the complexity and edge cases of the problems and especially in the case where the dimensionality of the system is high. We may also consider more simplified solutions such as a parametric classifier based on assumptions of mathematical forms such as linear, quadratic or piecewise. Initially a parametric form for the decision borderline is specified; then the best decision boundary of the stated form is found based on the classification of training samples. In these systems it is always important to understand how the number of samples influences the classifier design and performance.

C. Syntactic matching:

In many scenarios there exists interrelationship or interconnection between the features associated with a pattern. In such situations, it is relevant to assume a hierarchical relationship where a pattern is viewed as consisting of simple sub patterns which are built with yet another sub pattern. This is considered as the basis of syntactic pattern recognition. In this approach symbolic data structures like arrays, strings, trees, or graphs are used for representation of different patterns. These data structures specify the affair between foundation pattern components and allow the representation of hierarchical models. Thus, complex patterns can be described from simpler ones. The recognition of unidentified patterns can be achieved by correlating its symbolic representation with a count of predefined objects. This comparison aids in calculating the similar measurements between the unknown inputs and the known patterns. The symbolic data structures used for portrayal of the patterns are represented by words or symbols or strings. The individual symbols in a string represent segments of the atomic pattern. One of the most widely used and powerful symbolic structure for higher dimensional data representation is a graph. A graph consists of a set of nodes and edges in which the nodes represent simpler sub patterns and the edges represent the relations within those sub-patterns. These relations will be temporal, spatial or of any other type based on the problem in hand. A prime important subclass of a graph is a tree. Tree further have three different classes of nodes, which are root, interior and leaf. Trees are transitional between strings and graphs. They are commonly used for pattern recognition applications because they are more powerful as compared to strings as a representation of the object and computationally less expensive when compared to graphs. Another form of symbolic representation is the array which is a special type of graph which has nodes and edges arranged in a regular form. This type of data structure is quite effective for low level pattern representation. Structural pattern recognition is believed to be useful because it provides a depiction of how a given pattern is formulated from the primitives in extension to classification. This method is useful in case where the patterns have a definite structure which can be captured in terms of a set of rules. However, due to parsing complexities the implementation of a syntactic approach is limited. It is very difficult to use this method for segmentation of noisy patterns and another problem is deduction of the grammar from training data. Powerful pattern

recognition capabilities can be acquired by combining the syntactic and analytical pattern recognition techniques.

D. Neural networks:

Neural computing is based on the way by which biological neural system stores and manipulates information. It can be viewed as parallel computing environment that constitutes of interconnection of large number of simple processors. Neural network have been profitably used in many tasks of pattern recognition and machine learning systems. The structure of neural system is derived from analogies with biological neural systems. Many algorithms have been designed to work with neural networks. In these algorithms, a set of rules defines the evolution process managed by the synaptic connections of the networks, thus allowing them to learn how to carry out specified tasks. Neural network models use a network of weighted directed graphs in which the nodes are artificial neurons and directed edges are connections within neuron outputs and neuron inputs. The neural networks have the capability to learn complex nonlinear input-output relationships, use sequential training procedures, and accustom themselves to the data. Different types of neural networks are employed for pattern classification. Among them feed forward network and Kohonen-Network is commonly used. The learning process requires updating network architecture and connection weights so that a network can systematically perform a specific classification/clustering task. The neural network models are getting increasingly popular because of their competence to solve pattern recognition problems, ostensibly low dependence on domain-specific knowledge, and due to the availability of efficient learning algorithms for use. Neural networks are also used for implementing nonlinear algorithms, feature extraction and classification. In addition to that, existing feature extraction and classification algorithms can also be drawn on neural network architectures for efficient implementation. In spite of the possibly different underlying principles, almost all of the well-known neural network models are essentially equivalent or analogous to classical statistical pattern recognition methods.

III. APPLICATIONS

A. Image processing, segmentation and analysis:

Pattern recognition is used to provide human recognition intelligence to machines which is needed in image processing.

B. Computer vision:

Pattern recognition is helpful in obtaining useful features from given image/video samples and it is used in computer vision for different applications like biological and biomedical imaging.

C. Seismic analysis:

Pattern recognition is also used for the discovery, imaging and interpretation of temporal patterns in seismic array recordings. Statistical pattern recognition is executed and used in different types of seismic analysis models.

D. Radar signal classification/analysis:

Pattern recognition methods are used in assorted applications of radar signal classifications like mine detection and identification.

E. Speech recognition:

Pattern recognition paradigms have helped in achieving greatest success in speech recognition. It is used in assorted algorithms of speech recognition which attempts to side step the problems of using a fundamental level of description and treats larger units such as words as pattern.

F. Fingerprint print identification:

The fingerprint recognition technique is a leading technology in the biometric market. A number of recognition methods have been implemented to perform fingerprint matching out of which the pattern recognition approach is widely used.

IV. CONCLUSION

With the advancement in the Internet and information, technology has made the manufacturing sector to reach any part of the globe. These inclinations have pushed pattern recognition to the high edge of computer and engineering research and applications. Today pattern recognition is an elemental part in most machine intelligence systems designed for decision making tasks which are used in a diversity of applications such as artificial intelligent system and image processing and analysis. Nowadays the interest in the field of pattern recognition comes from applications such as data mining, biometrics, financial forecasting, and computer vision. It is necessary to note that there is no simple path for optimal solutions and that multiple methods and approaches have to be used.

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Enhance Personalized Intellectual Image Search using Combined Methodology of Hits Algorithm and Ranking Method

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Abstract: The most popular and progressively more advanced social medias like YouTube, WhatsApp, Facebook, Twitter and other photo sharing sites gives freedom to upload, download, tagged and comment on photos, videos, etc. In this context, the heavily generated metadata helps these social media for sharing and organizing the multimedia content. Rather these metadata also helps for advance media management and retrieval system. The best suitable technique for this kind of web searching which is improved by giving the proper ranked to the returned list on the modified user interested search items.

Enhanced personalized intellectual search is the technique which develops social annotations by considering the user interest and query importance. With the help of fundamental material we correlate the users preferred choice and the request related to user precise topic search.

The projected system contains following techniques:

1. For performing the annotation prediction according to the user prediction annotations for the image, we used a Multi-correlation Tensor Factorization model which is totally ranking based.
2. After that for mapping the result of query and interest of user into the similar user precise topics search, we used User precise Topic Modeling.
3. We introduced the Enhanced personalized intellectual search by adding on more ranking technique which gives ranks to the user preferred image according to the intellectual way.

Keywords: Enhanced Personalized Intellectual image search, Multi-Correlation Tensor factorization based on Ranking, User Precise Topic Search, Social tagging.

1. INTRODUCTION

1.1 Background

The process which performs customizing of web search results of particular user is known as Web Personalization. This kind of techniques is mostly used by Online Shopping agencies such as Snapdeal, Amazon, Flipkart, etc. which suggest the proper refined result to that particular user

according to his interest. Due to this, the huge collection of metadata is generated which not only provide users in

organizing & sharing social multimedia content, rather it can also facilitate some important information to enhance the retrieval of media and the management of that data. The social sharing websites such as Facebook, Twitter gives us freedom to share photos, audio, video, and it can also provide the technique of tagging other user and his friends and comment on that content. In this area, Enhanced Personalized Intellectual search provides excellent results by giving the

proper ranks to web search results of that particular user according to the user precise topic projected search.

1.2 Motivation

Afterwards essential the relation between queries and tags, we performs amalgamate operation to get a final ranked list of user precise topic projected search. During the utilization of this two-step schemes, some problems may occurs which are partially categorized into two parts as follows.

1) The main purpose of Enhanced Personalized Intellectual Search is to give the proper rank on the results returned by approximating the user's preference used for the individual related query. The direction of interpretation between the result and rank is simply straight and not so influenced. As an alternative, we can separately compute the results of query, as an alternative of directly considering the query correlation as well as user preference.

2) There is very long process of merge strategy. Here, we instantaneously consider the user's preference and dependence of query in order to challenge the problem occurred in Enhanced Personalized Intellectual Image Search problem.

1.3 Problem Statement

Fundamentally the image looking out scheme goes beneath a protracted thought which has non-personalized search and customized search. Then the most issue that we've got taken into consideration is that, we've got nominative the interest space of that exact user.

If we have a tendency to succeed to induce a slightest of some knowledge set of that data, then we will determine the interested space of that user and per that knowledge, we have a tendency to simply get the particular question. By doing this sort of search are able to save the precious time of user and thanks to this user can get the particular want result.

So to resolve this drawback, we will develop totally diverse algorithms and technologies that in relations helps us to induce the mandatory result for the reason that the user interest.

II PROPOSED METHODOLOGY

2.1 System Overview

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

2.2 Framework

The framework of this system is shown in It contains two stages: offline model training stage and online

personalized search response stage For the offline stage, three types of data including users images and tags as well as their ternary interrelations and intra-relations are first collected. We then perform users annotation prediction. Many methods for tag recommendation and prediction have been proposed in social bookmark sites. Since the photo sharing websites utilize a different tagging mechanism that repetitive tags are not allowed for unique images, besides the common noisy problem, it has more severe sparsely problem than other social tagging systems.

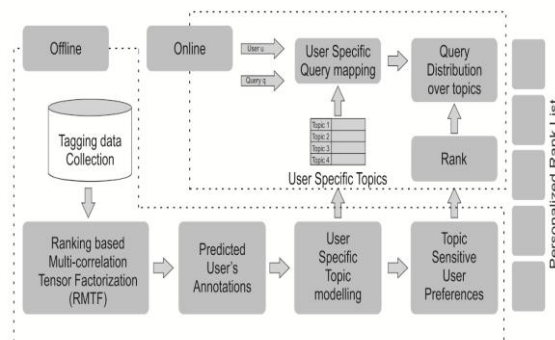


Fig.1 Proposed Framework

However, this formulation has two problems.

1) It is unreasonable to assign the query to a single tag in the tag vocabulary, e.g., when a user searches "cheer dance", he/she would like the images that he/she annotated with semantic related tag "cheerleader" are also ranked higher.

2) There are variations in individual user's tagging patterns and vocabularies, e.g., the tag "jaguar" from an animal specialist should be related to "leopard", while a car fan will consider "jaguar" more related to "autos". To address the two problems, we perform User-specific Topic Modeling to build the semantic topics for each user. The user's annotation for an image is viewed as document.

III SYSTEM IMPLEMENTATION

3.1 Tagging and upload images

The operating of personalized search result's as follows: initial whenever the user submits his question the keyword based mostly search is performed and every one the photographs relating to the keyword are presented the user. This can be a non-personalized search in alternative words. once the non-personalized search the user must click on any of the image on the results of non-personalized search. On this click event the non-personalized search pictures are filtered. All the digressive pictures to the user interest are filtered out and also the relevant pictures are presented the user. this can be the personalized image search. Then user must once more click onto any image of personalized image search result. On this click event the hierarchic results of pictures is presented the

user. In ranking module the photographs are hierarchic on the premise of recognition. The personalized search pictures are filtered once more to induce the ranking result. This can be the economical approach that is split into 3 steps for user.

In this thought, user initial have transfer the photographs that are relevant to their search and for uploading the photographs we'd like to own a information which may stores the photographs in such the simplest way that user can even place tags on it image. For storing the photographs, we have a tendency to enforced a number of the algorithmic program that helps US to store the every and each facet of that image that in any helps US to retrieve those pictures a lot of quickly.

3.2 Storing Images

Here the most tasks are to store the photographs that are uploaded by the actual user. During this project we have a tendency to store the some certification of that image corresponding to image name, the name of user transfer that image, the changed date of uploaded image. The foremost vital issue to store during this project is that, we have a tendency to don't seem to be storing solely the name of that image; instead we can conjointly stores the tags that are placed on those pictures. With the facilitate of this tagging system are able to acknowledge the users interest and that we can get the precise plan of what user need to look in terms of his needs. thus by this technique, we are able to get the personalized image search by the mean of the ranking system within which we are able to contemplate the precise purpose underneath the thought to the amount of that user, thus we are able to handle that downside.

3.3 Obtaining the corresponding tags connected to that image

After that we have a tendency to that notice that that tag is a lot of relevant to that image and according the attitude of the user data, we are able to decide that amongst the massive variety of dataset of the tags offered at user admin finish. By considering this dataset, we have a tendency to could bear to the conclusion that, if we have a tendency to succeed to seek out the acceptable tags within the terms of user approachable info, then we are able to determine the precise expectation of the user.

3.4 Steps of Operation

Here the operating of our system is largely functioned underneath the results of personalized image search algorithmic program. However once we found that, already some algorithmic program is functioning underneath such circumstances then we have a tendency to understand that we've got to enhance the standard of our report. So, during this situation, we have a tendency to decide that if user need to look the image in line with his interest then initial of all, the

computer program can offers the randomized result that in terms known as because the Non-Personalized Search. This search is additionally contains the expected results of user, however the matter with this result's that, it consist a lot of garbage information than the specified one. So, during this case user get a lot of sophisticated once he/she found that the expected result wasn't found within the correct method.

After that, we are able to implement the newest running technology that behaves sort of a user interest information. This personalized image search techniques works underneath the law of dispute action which implies that each one alternative garbage information ar skipped from the result and solely the specified output is shown to the user.

Rather doing this, we have a tendency to move forward to the new approach that tells US the very fact that user interest is a lot of relevant than the user perspective. Here during this technique, we have a tendency to offers the rank to each & every image in line with user interest and if the user search that image then we offer him the resulted pictures in line with ranking based mostly image search

The operating of system is delineated well within the following figure

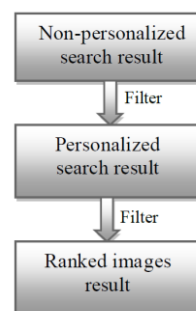


Fig. 2 Steps of operation

IV EXPERIENTIAL RESULTS

4.1 System Analysis

We check the planned system on four image information's that are the 2000-Flickr database, the 6000-COREL information, the 8000-combined information composed of 2000-Flickr and 6000-COREL pictures, and also the 12000-enlarged information composed of the 8000-combined pictures and 4000 new pictures obtained by looking WebPages. These four image databases have twenty, 60, 80, and a hundred and twenty classes, severally. In every class, there are a hundred pictures that share a typical linguistics thought. Specifically, the 2000 Flickr pictures and 4000 new pictures are obtained by checking out class connected keywords victimization the Apes from Flickr, Google pictures, and Google Picasa. Given a precise keyword, we have a tendency to transfer the highest one hundred fifty relevant pictures, and so manually choose

the foremost representative a hundred pictures to create a linguistics class.

The images within the 6000-COREL information are chosen from the 60 hand-picked classes of the COREL benchmark image information. In our system, we have a tendency to use a 100-dimensional low-level visual feature vector to represent a picture. We have a tendency to conjointly set the manifold-related parameters as follows: $\sigma_1 = \text{zero.05}$, $\sigma = 0.05$, and $\alpha = 0.99$. To facilitate the analysis method, we have a tendency to style Associate in nursing automatic RF theme altogether experiments to simulate the \$64000 users' RF that is predicated on the idea that each one pictures within the same class share a typical linguistics that means.

4.2 Retrieval Results based on numerous ways

The entire question pictures are from the image information. As a result, the retrieved pictures will be mechanically outlined as relevant or digressive to this question image supported the illustrious categorical info. we have a tendency to construct the class-conscious manifold sub graphs by performing arts question sessions victimization ten distinctive, indiscriminately hand-picked information pictures. For every question session, our system performs four reiterative RF retrieval processes and came back prime twenty five pictures for iteration. A retrieved image is taken into account to be relevant if it belongs to identical class because the question image. The retrieval preciseness is computed because the magnitude relation of the variety of relevant pictures to the overall number of came back pictures for iteration. We have a tendency to compare the planned system with 2 manifold primarily based mostly systems that are L1-distance based gMRBIR and linguistics clusters-based manifold ranking CBIR systems, severally. So as to get a much better performance comparison with alternative peer CBIR systems, we have a tendency to conjointly compare the planned system with 5 representative CBIR systems. In detail, they're world soft label SVM-based CBIR system, memory learning SVM-based CBIR system, long run virtual-feature-based CBIR system, long cooperative learning-based CBIR system, and dynamic linguistics feature-based long run learning CBIR system. The planned system and these entire seven peer systems are compared on the 2000-Flickr, 6000-COREL, and 8000- combined databases.

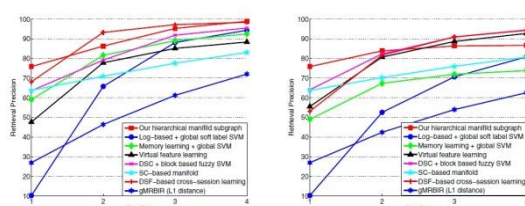


Fig 3 Retrieval results on the 2000-Flickr database

For the 12000-enlarged information, we have a tendency to compare the planned system with 5 non-manifold based mostly CBIR systems as a result of typical manifold-based CBIR systems don't work for an outsized information. Specifically, the dimensions of the traditional manifold graph is $N \times N$, wherever N is that the total variety of pictures within the information. additionally, these manifold-based systems need to work out many $N \times N$ matrices together with the affinity matrix W , its square matrix D , the intermediate matrix X (e.g. $D^{-1/2} \times W \times D^{-1/2}$), and also the inverse of $(1 - \alpha \times X)$. As a result, the pc cannot assign enough memory to run these huge matrices connected arithmetic operations once the amount of pictures in very information reaches a precise level (e.g., 12000).

Our planned class-conscious manifold-based CBIR system works on outsized information because of the involvement of many little subgraphs. It will perform the retrieval task as long as every subgraph doesn't exceed the memory capability of the running machine. This is benefited from the hierarchical data structure of the manifold graphs compares the common retrieval preciseness of those systems on four databases within the context of getting a hundred correct feedback and having tier of fifty inaccurate feedback.

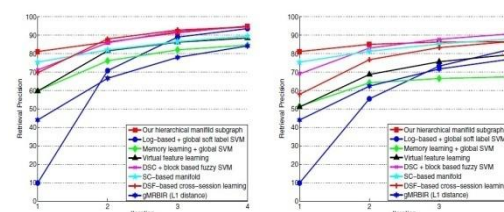


Fig 4 Retrieval results on the 6000-COREL database

To introduce the noise, we have a tendency to let the simulated "user" misclassify some relevant pictures as digressive and a few digressive pictures as relevant. Altogether experiments, we have a tendency to use identical experimental setup for all the compared strategies that were enforced by our analysis cluster victimization the parameters explained in every analysis paper. Specifically, we decide identical ten of the overall information pictures to be the coaching pictures to create the training base for all the experiments and use the remaining pictures because the testing pictures to judge the web retrieval performance. All the experiments run on identical check machine with Intel Core2 Quad central processor at two.66GHz, 4GB of RAM and Window XP OS. The figure clearly shows that the planned class-conscious manifold subgraph system achieves comparable retrieval ends up in the context of correct RF on four databases because the competitor CBIR system, that isn't identical for four databases.

Specifically, the planned system severally achieves the common retrieval preciseness of ninety eight.89%, 94.98%, 86.46% and 79.59% at the last retrieval iteration on the 2000-Flickr, 6000-COREL, 8000-combined, and 12000-enlarged image databases.

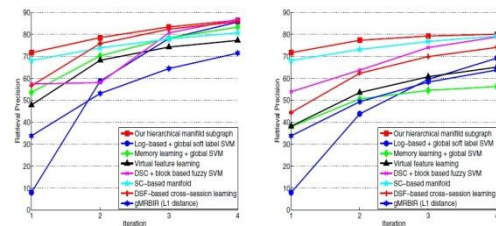


Fig 5 Retrieval results on the 8000-combined database

For the 12000- enlarged information, the planned system improves the competitor system by one.76%. Once inaccurate RF is concerned, the planned system severally achieves the common retrieval preciseness of eighty six.64%, 86.47%, 80.08% and 74.34% on 2000-Flickr, 6000-COREL, 8000-combined, and 12000- enlarged image databases. It improves the competitor CBIR system, linguistics clusters-based manifold CBIR system by 1.01% on the 8000-combined information.

It conjointly improves the competitor CBIR system by three.28% on the 12000-enlarged image information. This spectacular performance boost clearly demonstrates the quality and the noise resilience of the planned system. This noise resilience feature in the main results and important structure of class-conscious manifold subgraphs.

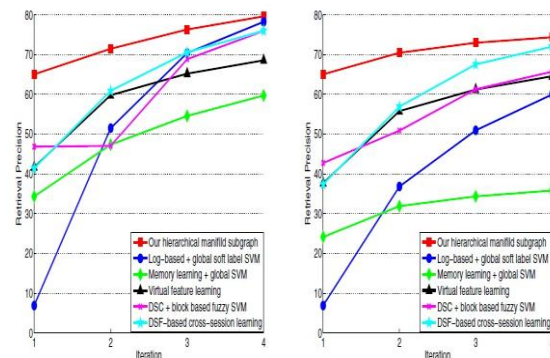


Fig. 6 Retrieval results on the 12000-enlarged database

This gives US the clear plan of the system. Victimization this we are able to have the transient detail approach and also the desired result from the system. the particular screenshot of the project are offers follows for a lot of elaborated approach.

V CONCLUSION

How to effectively utilize the rich user metadata in the social sharing websites for personalized search is challenging as well as significant. In this paper we propose a novel framework to exploit the users' social activities for personalized image

search, such as annotations and the participation of interest groups. The query relevance and user preference are simultaneously integrated into the final rank list. Experiments on a large-scale Flickr dataset show that the proposed framework greatly outperforms the baseline. In the future, we will improve our current work along four directions.

1) In this paper, we only consider the simple case of one word-based queries. Actually, the construction of topic space provides a possible solution to handle the complex multiple words-based queries. We will leave it for our future work.

2) During the user-specific topic modeling process, the obtained user-specific topics represent the user's distribution on the topic space and can be considered as user's interest profile. Therefore, this framework can be extended to any applications based on interest profiles.

3) For batch of new data (new users or new images), we directly restart the RMTF and user-specific topic modeling process. While, for a small amount of new data, designing the appropriate update rule is another future direction.

4) Utilizing large tensors brings challenges to the computation cost. We plan to turn to parallelization (e.g., parallel MATLAB) to speed up the RMTF converge process. Moreover, the distributed storing mechanism of parallelization will provide a convenient way to store very large matrices and further reduce the storage cost.

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Blockchain Technology: Functioning and Implications

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Abstract— During the initial years of Internet, it was not possible for people to understand and predict the impact Internet will have on all the aspects of our life. The advent of **blockchain** technology could be considered synonymous to how Internet has altered the way we do certain things. Blockchain technology is here to radically change the way **transactions** are managed. It is all set to disrupt the way transactions are handled at present. The shift onto blockchain technology will displace the intermediate parties upon whom there were reliance to implement regulatory safeguards against **money laundering** and **black market** activity.

Keywords— black market; blockchain; money laundering; transactions

I. INTRODUCTION

Blockchain is widely known to be the record-keeping technology that is used in Bitcoin. As suggested by its name, Blockchain consists of multiple numbers of blocks threaded together. It stores transactional records of public in various databases. These records are what we call “block” and the several databases are called “chain”. The transactional records are stored in a network that is connected via peer-to-peer nodes. This storage is called a “digital ledger”. Whenever a transaction is to be made, it is first authorized and permitted by the digital signature of the owner. This step authenticates the transaction and ensures that it is safe being tampered. Therefore, the information in the digital ledger is highly secure. The transactional records are visible to numerous computers in the network. The fact is that anyone can view the data, but they cannot modify or corrupt it.

Whenever new data is stored in a block, it is added to the blockchain. Each block on the blockchain is made up of digital information. This information is of three types.

- i. The transaction date, time and amount of our purchases are stored in the block.
- ii. Details about the participants of the transaction are stated here. A block for our purchases from an online store records our name along with the name of the store. However, instead of using our actual name, our purchases are recorded using a unique digital signature that is like a username of some sort.
- iii. It is also important to know some way of distinguishing one block from another. For this purpose, a unique code is stored in each block. This code is called hash and it helps us to tell one block from another. A hash is

a cryptographic code that is generated by a special algorithm.

In cases where we add something to our purchase at the last moment, the details of our new transaction look nearly identical to our earlier purchase, but it is still possible to differentiate between the two blocks because of their unique hash values. Here we are considering an example related to shopping online, but in actual practice, a single block on a Bitcoin blockchain can store around 1MB of data. This means that a single block can store a few thousand transactions in one place.

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II. WORKING OF BLOCKCHAIN

In the blockchain, all blocks are available to us for viewing. For adding a block to the blockchain, the following steps are to be followed:

1. A transaction is made. The transaction is grouped along with a number of similar transactions in the block.
2. The transaction first has to be verified. In case of other public records, someone is in charge of managing new data entries. Meanwhile, in blockchain, it is the job of the network of computers. On making a purchase, this network checks back on the transaction to confirm its smooth processing. By doing this, the details of the purchase, which includes the time, amount and participants, are checked.
3. This transaction, then, has to be stored in a block. After it has been verified, the amount, our digital signature and the shop’s digital signature are all bundled together and stored in a block. Here, this transaction combines thousands of other such transactions.

4. The next step is to assign a hash to the block. Once all the transactions of a block are verified, it must be assigned a unique code. When the hash is assigned, the block is added to the blockchain.

III. IMPORTANCE OF BLOCKCHAIN

In order to better understand how blockchain is of importance, we consider an example where we have to transfer money from our bank account to a friend's account. We log on to the online banking website and transfer the amount to the other person's account. After completion of our transaction, the bank updates the transaction records. Although this process seems to be simple, there are some potential securities issues that we tend to neglect. These transactions are very easy to tamper with. Because of this vulnerability of transactions, there has been an evolution of third-party payment applications, and also has eventually led to the development of blockchain technology. Keeping records of data and various transactions are an important part of business. Usually this information is managed by a third-party, which takes more time and money. This is where blockchain comes to our aid by cutting short this long process and also facilitates faster processing of the transaction and saves time as well as money. Blockchain technology has the capability to support applications related to various industries as manufacturing, finance, supply chain, etc.

IV. ADVANTAGES AND IMPLICATIONS OF BLOCKCHAIN

The emergence of blockchain technology has proved to be quite advantageous to us in the digital world.

- **Highly secure:** A signature called digital signature is used to authorize a transaction in order to prevent frauds during the process. This makes it impossible to modify or corrupt the data in the block without the owner's digital signature.
- **Decentralized System:** Using blockchain, transactions are carried out with the mutual consensus of users which results in smoother, safer and faster transactions, as opposed to the conventional method, where permission of regulatory authorities is needed.
- **Automation Capability:** It is possible to program and generate actions, events and payments systematically and automatically using blockchain technology.
- **Prime application:** Bitcoin is blockchain's primary application and the reason of its development. Blockchain technology has helped to create financial services like digital wallets. Another feature is that it has also facilitated

microloans and micropayments for people in less ideal economic conditions.

- **Concept of trust:** Conventionally, lawyers are hired to create trust between two different parties, while also taking up time and money. With the introduction of crypto currency, the trust equation has radically changed, especially within the area of international transactions. In some cases, the organizations are located at areas where certain resources are scarce and in order to be safe from corruption, blockchain is being implemented to be safe from tricks of third-party intermediaries that are unreliable.
- **In politics:** Blockchain technology is being implemented in trying to curb and stop election fraud at the ballot box during elections.
- **In transportation based applications:** Blockchain technology is capable of creating a decentralized network that follows the peer-to-peer structure for applications like Airbnb and Uber, which will allow users to pay for tolls, parking, etc.
- **In healthcare industry:** A secure platform can be created using blockchain technology to store sensitive patient data. This can allow sharing of patient with appropriately authorized people.

V. CONCLUSION

Blockchain technology has had quite an impact on society. The fundamental feature of this technology is that it can confirm and authorize transactions. The implications of this technology are still not widely known which is why people tend to expect more from blockchain. The thing to remember is that this technology is here to stay, having real value and expandability. The scope of blockchain can be widened and made more users friendly with its adaptation into the daily lives of people.

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Design and Fabrication of Paper Cutting Machine Using Geneva Mechanism

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Abstract— Automation in paper cutting machine is useful up to a large extent in a continuous process. This machine will be able to cut equal lengths of paper at high speeds. A four slot geneva wheel rotates by the action of a crank, feeding the paper to the cutter. Geneva mechanism can be defined as an intermittent drive mechanism which converts intermittent motion into continuous motion. Cutting is achieved by a spring mechanism. The main objective of this concept is to eliminate the tedious and time consuming process of paper marking, and to make an automatic machine which is capable of cutting equal lengths of paper with each stroke at high speeds with a high level of accuracy, thereby reducing time and manual labour. This machine can be used in stationery shops, schools, colleges, paper as well as other industries, etc.

Keywords— crank; cutter; chain drive; Geneva mechanism; Geneva wheel; ram; roller

I. INTRODUCTION

The automatic paper cutting machine using geneva mechanism is an automatic machine capable of cutting paper into equal lengths accurately. This machine employs a geneva mechanism which is essentially an indexing mechanism capable of converting intermittent motion into continuous motion. This machine also employs a crank and lever mechanism along with the geneva mechanism which performs the cutting operation with the help of a cutter. The machine is run by a 12v geared DC motor. The geneva mechanism used in this machine ensures equal length cutting of paper without the use of sensors making the machine more simplistic and hence reducing the costs associated with automatic paper cutting. Paper is fed to the cutter with the help of rollers which are rotated by the geneva wheel.

The geneva mechanism eliminates the paper marking process and feeds equal length of paper to the cutter with its each rotation. This mechanism essentially consists of a geneva wheel, bearings, crank and crank pin. The geneva wheel consists of n number of slots in which the crank pin can be seated to rotate the wheel. In the most common arrangement, the geneva wheel consists of 4 slots at 90 degrees angle from one another. Thus it rotates 90 degrees in one stroke by the crank pin. If a wheel has n slots, then the rotation made by one stroke would be $360/n$. If we consider the 4 slot mechanism, since the wheel rotates 90 degrees in one stroke and there are 4 crank strokes per cycle of a geneva wheel the total rotation would be 360degrees. Thus the geneva wheel would convert the intermittent motion by four strokes per one cycle of the crank into a continuous rotating motion.

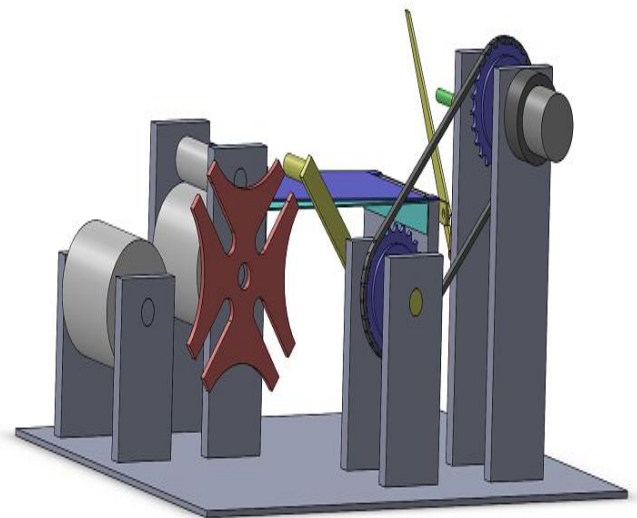


Fig 1- Block diagram of the proposed machine[1]

II. LITERATURE SURVEY

The design process involved in this project was considered from the article titled Automatic Paper Cutting Machine using Geneva Mechanism [2].

In a paper titled “Design and Analysis of Paper cutting machine work on Geneva Mechanism” [3], the design and analysis of paper cutting machine using geneva mechanism has been analyzed. A kinematic study of mechanism having geneva wheel and gear train to achieve intermittent motion was provided through this analysis.

In the paper “Aspects Theoretical and Practical based on the Finite Element Analysis and Modeling of Geneva Mechanism” [4], the modeling of geneva mechanism was observed. Some theoretical and practical aspects regarding modeling of geneva mechanism having four slots, using the CATIA graphic program, have been presented in the paper.

III. METHODOLOGY

The first step in turning any project into reality is to design its elements first to check which configurations and specifications will be best suited for the project. Design of different components was done first in this project too, and after finalizing the designs for all the components and assembling them in CATIA, procurement of different components and raw materials to make components was started. The next process was to make different components which were not procured. The components made were- mounts, base, shafts, geneva shaft, geneva wheel, crank, crank pin, rollers, cutter and ram. After procurement and construction of the components, these components were then assembled on top of the base and the machine was started to test up to what thickness of paper, the machine's performance was satisfactory.

IV. COMPONENTS REQUIRED

The major components used in the machine are as follows:

1. Geneva wheel
2. Crank
3. Chain drive
4. DC motor
5. Cutter
6. Roller
7. Power source

1. **Geneva wheel-** Geneva wheel is a cross like structure which consists of a number of slots through which it can be rotated by the action of a crank pin. A 4 slot configuration is mostly used in the geneva wheel. The slots are added on the wheel in such a way that they are at an equal angle from one another. Geneva wheel takes up intermittent motion given to it by the crank and converts it to continuous motion.



Fig 2- A simple geneva wheel having 4 slots

2. **Crank-** An elliptical crank having a crank pin on one of its faces is used in this project. The other face of the crank is connected to the sprocket of chain drive through a shaft. Crank is essentially an arm attached to a rotating shaft to impart to or receive from a rotating shaft, its circular motion.
3. **Chain drive-** Chain drive is a power transmission component which essentially consists of two sprockets and a chain. Sprockets are teathed wheels whose tooth can conveniently fit into the space between two chain links of a chain. On rotation of one of the sprockets, the motion is transmitted to the chain wound on the sprocket which carries this motion to rotate the other sprocket.
4. **DC Motor-** Operation in any electric motor is based on simple electromagnetism. When a current carrying conductor generating a magnetic field is placed in an external magnetic field, it experiences a force proportional to the strength of the external magnetic field and to the current in the conductor. A DC motor's internal configuration is designed to make use of magnetic interaction between the conductor and external magnetic field to create rotational motion. The motor used in this project is geared type with 12volts and 300rpm with 0.7485Nm of torque.
5. **Cutter-** cutter is essentially a tool designed to cut the paper into equal lengths. It is provided with a straight edge to ensure smooth paper cutting.
6. **Roller-** a wooden roller has been used in this project instead of metal rollers. Roller is the component which feeds the paper to the cutter. Use of a wooden roller makes the process of paper feeding smoother.
7. **Power source-** the power source used in this project is a 12v dc battery, which makes the unit easily portable.

V. DESIGN CALCULATIONS

• GENEVA WHEEL

Various terms used are:-

R = Radius of the Geneva Wheel

r_1 = Radius of driving crank

r_p = Radius of crank pin

e = centre distance

α = semi-indexing angle (driven)

β = semi-indexing angle (driver)

z = number of slots on the driven disk

ω = angular velocity of driving crank

No. of slots on Geneva wheel (Z) = 4

$N_{\text{motor}} = 300 \text{ rpm}$

For Z = 4

- Semi indexing angle (α) = 45°
- Gear ratio (E) i.e. ratio driving crank to geneva wheel = 1:1
- Indexing time ratio = $V = \frac{[Z-2]}{2z}$
 $= \frac{[4-2]}{2 \times 4} = 0.25$
- Semi indexing angle (driver crank) = $\beta = \frac{\pi[Z-2]}{2Z} = \frac{\pi[4-2]}{2 \times 4} = \pi/4$ [2]
- For entry without shock (R/e) = $\sin(\pi/z)$
 $= \sin(\pi/4)$
 $= 0.707$
- Now, on the basis of space available, centre distance (e) = 70mm

$$\frac{R}{e} = 0.707$$

$$R = 0.707 \times 70$$

$$= 50\text{mm}$$

Radius of geneva wheel = 50mm

Hence, diameter of geneva wheel = 100mm

$$\text{g) Angle of locking } \gamma = \frac{\pi}{Z[Z+2]}$$

$$= 270^\circ$$

- S_{min} = distance between centre of Geneva wheel radii of curvature and slot on wheel

$$S_{\text{min}} = 0.2929 e^{[2]}$$

$$= 0.2929 \times 70$$

$$= 20\text{mm}$$

Length of slot is 36 mm and its thickness is 20mm

• Chain drive

Given parameters are:

- No. of teeth on sprocket = $Z = 14$
- Pitch = $P = 13\text{mm}$
- Speed = $n = 300\text{rpm}$
- No. of links = $L_n = 28$

$$\alpha = 360/Z = 360/14 = 24.714$$

$$\text{Diameter of sprocket}^{[5]} = D = \frac{P}{\sin(\frac{\alpha}{2})}$$

$$= \frac{13}{\sin(\frac{24.714}{2})}$$

$$= 13/0.214 = 60.09 = 60 \text{ mm}$$

Velocity ratio = $i = 1:1$

$$\text{Average velocity}^{[5]} = v = \frac{ZPn}{60 \times 1000}$$

$$= \frac{14 \times 13 \times 300}{60 \times 1000}$$

$$= 1.05 \text{ m/s}$$

$$\text{Length of chain, } L = L_n \times P$$

$$= 28 \times 13$$

$$= 364\text{mm}$$

Centre distance of sprocket wheels^[5] = a

$$= \frac{P}{4} \{ [L_n - Z]^2 \}$$

$$= 160 \text{ mm}$$

VI. LAYOUT AND DESIGN

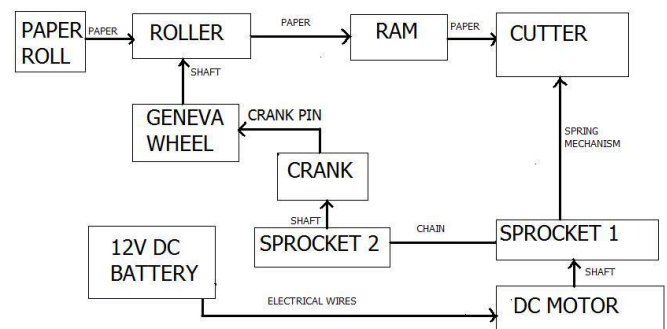


Fig 3- layout of the machine

Designing of the machine has been done through CATIA ^[6]. Different components were made and then assembled. Different views of the machine are provided below:-

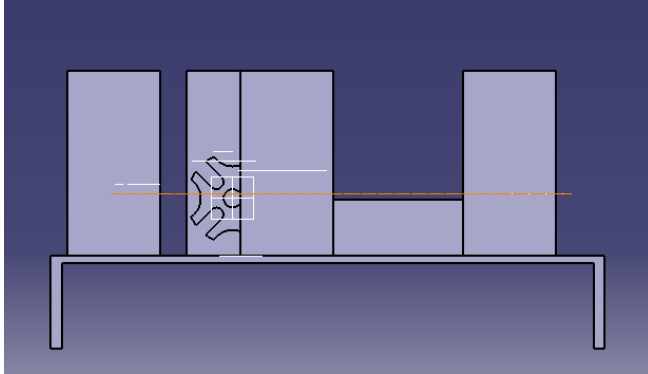


Fig 4(a) - front view of the machine

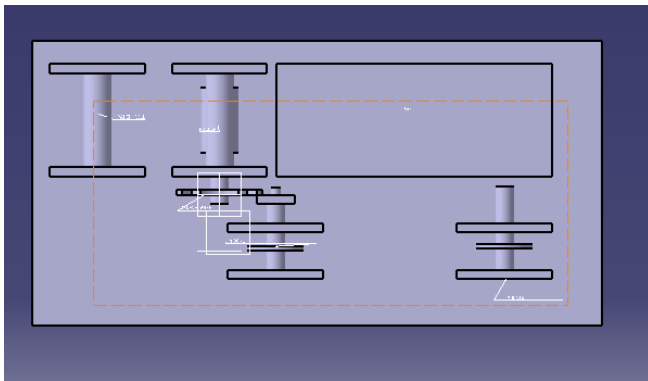


Fig 4(b) – top view of the machine

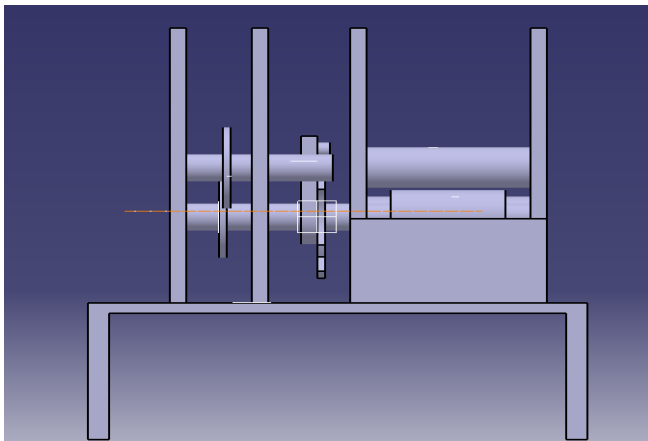


Fig 4(c) – side view of the machine

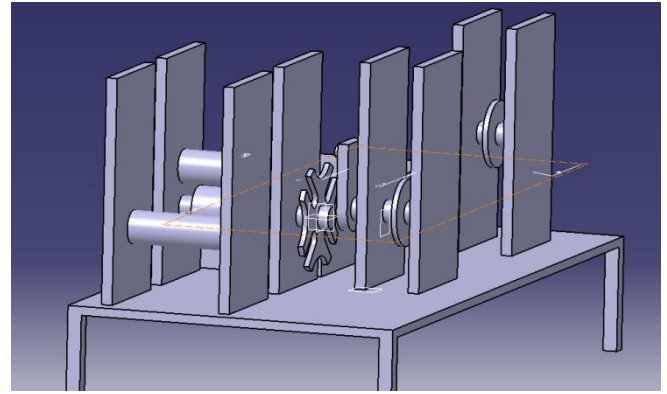


Fig 4(d) – auxiliary view

VII. WORKING

Power is provided to the motor by the dc battery. On the rotation of the motor shaft, the sprocket 1 connected to the shaft also begins to rotate which in turn moves the chain providing motion to the sprocket 2. By the rotation of sprocket 2, the crank connected to it also starts to rotate and the crank pin is inserted into the slot of geneva wheel giving it intermittent motion. For one complete cycle of the crank, the crank pin provides 4 strokes to the geneva wheel keeping it in constant motion. By the motion of the geneva wheel, the rollers also start rotating about the shaft connecting them and geneva wheel. Paper rollers feed the paper to the ram which has a smooth surface providing less coefficient of friction for the paper to slide on them to reach the cutter. On the sprocket 1 side, the sprocket shaft is further connected to a spring and connecting rod which moves the cutter up and down and cutting the paper being fed through the ram. Equal cutting of paper is achieved in this process as geneva wheel rotation is dependent on the crank pin strokes and the geneva wheel is moved by only 90 degrees for one stroke, thereby feeding equal quantity of paper to the cutter with every stroke.

VIII. LIST OF COMPONENTS AND THEIR SPECIFICATIONS

| S.NO. | NAME | QUANTITY | SPECIFICATIONS |
|-------|--------------|----------|---|
| 1 | Geneva wheel | 1 | 100mm dia, 20mm slot |
| 2 | battery | 1 | 12v DC |
| 3 | motor | 1 | 12v DC geared, 300rpm , 0.7485Nm |
| 4 | roller | 2 | 1- 40mm dia 2- 25mm dia And 60mm length |
| 5 | mounts | 8 | 40mm width, 5mm depth, length variable |

| | | | |
|----|---------------------|--------------------|---|
| 6 | bearings | 8 | 6202 |
| 7 | Shafts | 2 | 20mm dia |
| 8 | sprocket | 2 | 60mm pcd, 15mm pitch |
| 9 | Chain | 1 | 15mm pitch |
| 10 | Base | 1 | 2ft length, 1ft width, 5mm depth |
| 11 | Electrical wires | As per requirement | 1 sq. mm cross section |
| 12 | Cutter | 1 | 65mm length |
| 13 | Crank and crank pin | 1 | Crank dia.- 100mm Crank pin dia.- 20mm |

X. APPLICATIONS

1. In paper industries.
2. In textile industries.
3. In stationery shops.
4. In schools and colleges, etc.

XI. RESULTS

After testing the machine for different speeds by adding a dc motor speed controller, following results were obtained:

Power at 100%, cutting speed = 110 cutting strokes per min

Power at 50%, cutting speed = 55 cutting strokes

Optimum cutting speed = 82 cutting strokes per minute

Thickness up to which paper could be cut is 4mm, beyond which, machine fails to perform satisfactorily.

XII. CONCLUSION

The machine made by us can cut papers up to a thickness of 4mm efficiently. By carrying out modifications in cutting mechanism, paper of much more thickness would be possible to cut efficiently. Also with minor alterations in the cutter material and dimensions it can be further used in textile industries for cutting cloth. To conclude, we can say that the automatic paper cutting machine using geneva mechanism is a cost effective machine capable of being used by industries to quicken the process of paper cutting, along with reducing the cost of the process.

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Fig 5- Assembled View of the machine

IX. ADVANTAGES

1. Equal length paper cutting at high speeds
2. By changing cutter shape, paper can be cut into different shapes and sizes.
3. Simple and economical machine.
4. Eliminates the process of paper marking.
5. Fully automatic machine, hence human error eliminated.
6. Easy portability due to less weight

Effectiveness and Efficiency of Unit Testing for Object Oriented Programs

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Abstract: Testing is the most important method used to validate a software product. In object-oriented software, a class or a small collection of classes is generally chosen to represent a unit for unit testing purposes. Object-oriented systems introduce new issues to unit testing when compared to procedural systems. In the latter, functions are often the units, whereas a class is more than just a collection of functions. In this work we explore some issues relating to the unit testing of object-oriented systems, using the experimental approach for validation. Specifically, the research work makes the following contributions:

- Proposes a framework for assessing the effectiveness and the efficiency of unit testing and applies it to evaluate different coverage criteria.

The experimental work in software testing has so far, generally focused on evaluating the effectiveness (fault detection capability) of a coverage criterion. The important issue of testing efficiency has not been sufficiently addressed. We propose an experimental framework for evaluating both effectiveness and efficiency of coverage based unit-testing approaches. This uses a novel approach to generate minimal test suites satisfying a given coverage criterion from a large collection of test cases and enables the evaluation of the relative performance of coverage-adequate test suites for different coverage criteria.

Keywords—Unit Testing, System testing, Use case, FDET, TET

I. INTRODUCTION

The goal of any software development methodology is that the developed software will meet its specifications under the expected deployment environments. For this assurance, various code validation activities are carried out during software development which can cost as much as 50% to 75% of the total development cost. Commonly used code validation techniques include testing, static analysis of the code, and code inspection. Static analysis and inspection are powerful approaches to identify defects in the code, but have limitations, as they do not execute the code. This has led to

testing becoming the preferred method by which a software product is shown to satisfy its requirements.

1.1 Software Testing

Testing is the most important method used to validate a software product. The word program “testing” may be defined

differently in different circumstances, but most commonly it refers to the process of exercising a program with the intent of observing errors[1,2]. A key purpose of testing is to increase the confidence in the code being developed.

Complex software are generally developed by following a modular approach in which the required functionality is grouped into a hierarchy of modules where at each level a module represents a set of semantically related functionality and uses a set of interfaces to interact with other modules. A module may be further divided into smaller modules and the modules at the lowest level represent the units of program (building blocks) of the software being constructed. Software development is a complex process and its various development activities are carried out by a team of developers having different roles and responsibilities; inevitably the process is inherently error prone. In order to maximize defect detection, testing at different levels are applied in a software project. The key levels are [1]:

- **Unit Testing** - refers to the testing of individual program units in isolation.
- **Integration Testing** - refers to the testing for interface faults in the combined program units.
- **System Testing** - refers to the testing of the system as a whole by putting all parts of the system in place. The system may have electrical, mechanical, or other components as per the system requirements.
- **Acceptance Testing** - refers to the testing of the system from the perspective of the user.

The purpose of these different levels of testing is to detect defects that are introduced in the major phases of software development - requirement gathering, system specifications, design, and coding. This relationship is shown in Figure 1, as the V-model for software testing [3].

Additionally, regression testing is a testing activity that tests the changes made to the program-units due to bug fixes, change in specifications, or refactoring (i.e. improving the design of the code). Regression testing does not represent any specific level in testing; rather it can be applied at any level mentioned above.

Any software development process is subject to the constraints of industry, so an important goal of testing is to identify as many defects as possible in the software being developed while keeping the efforts applied to a minimum [2,4]. Software testing is a hard problem due to the inherent difficulties associated with it and more systematic approaches are required to deal with the complexity of the problem [5].

How does testing work? In testing, the target code is executed by providing a set of test inputs that have been chosen so as to maximize the possibility of observing discrepancies in the expected behavior of the target code. Two approaches are used to select suitable test inputs for performing testing, namely, the black-box approach and the white-box approach.

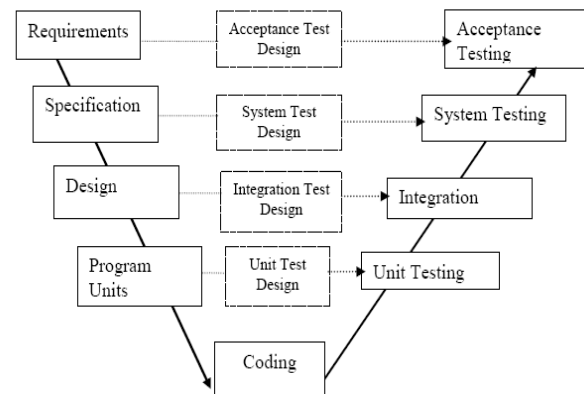


Fig 1 V-Model for Software Testing

II EVALUATING EFFECTIVENESS & EFFICIENCY OF COVERAGE CRITERIA FOR UNIT TESTING

We propose a general approach for comparison of coverage criteria experimentally using tool supported mutation analysis. This approach enables us to compare coverage criteria based on their effectiveness and efficiency. This is achieved by evaluating the effectiveness and efficiency of a set of coverage adequate test suites for each of the coverage criteria under study over a set of test programs, which are seeded with artificial faults. For a test program, this approach requires availability of a test-pool, which is “sufficiently large” so as to facilitate construction of multiple coverage-adequate test suites for each coverage criterion under study, randomly. As an application of the proposed approach, we describe an experiment comparing three control- flow-based coverage criteria, namely, block, branch, and predicate coverage.

2.1 An Approach for Evaluating Coverage Criteria

We develop a general framework to facilitate comparison among different coverage criteria. The proposed approach is a two-phase testing process for obtaining coverage

information and the fault data. First we define some important terms that are used in this work.

Coverage-adequate Test Suite - A test suite satisfying some completeness criterion, e.g. 90% branch coverage.

Minimal Test Suite - A test suite which is constructed by selecting tests cases monotonically, in such a fashion that it takes minimum number of test cases required to satisfy a given criterion.

Test-Pool - A collection of a large number of test cases which can be used for the generation of multiple coverage-adequate test suites, for the different coverage criteria under study, by selecting a subset of the test cases from the test pool.

Mutation Operator - A handle to seed faults in a test - program in some specific context.

Mutant - A faulty version of a program containing exactly one known fault. It is obtained by applying a mutation operator at an appropriate place in the program

2.2 Goals of the Approach and Research Questions

The goals of the approach are to compare the coverage criteria based on their effectiveness and efficiency, including their respective effort requirements. We streamline the investigations by (1) framing a set of questions that must be answered in order to achieve the goal, and (2) define a set of metrics that will help to answer these questions. The goals result in framing of the following questions.

- Which coverage criterion has better effectiveness?
- Which coverage criterion needs more testing effort?
- Which coverage criterion is more efficient?
- Which coverage criterion is more reliable?
- Do specific fault types influence the effectiveness of a coverage criterion more than others?

Additionally, we study the various code-elements coverage achieved by the various coverage criteria and measure the variability in the effectiveness and efficiency of the coverage adequate test suites for the different coverage criteria. Finally, we investigate the issue to choose a suitable coverage criterion for a given program.

2.3 Metrics for Evaluation

To answer the research questions, we need suitable metrics. We measure the effectiveness (FDET) of a test suite T for a program P as the fraction of total faults revealed by T in P.

$$FDET = \frac{\text{Number of faults revealed by T in P}}{\text{Total number of faults present in P}}$$

In order to measure effectiveness, we only need to ensure that the test suite satisfies the desired coverage criterion. However, for evaluating cost related concerns like efficiency, the size of a test suite also matters. Given that testing cost (or effort) is proportional to the size of the test suite, it follows that one can always make a test suite larger, by adding more test cases which do not increase the coverage any further, but thereby increase the testing cost accordingly.

The testing effort (TET) required for a coverage adequate test suite T for program P is measured as, $TET = \frac{\text{Number of test cases needed to satisfy the given coverage criterion for P}}{\text{Size of test suite T}}$

To ensure that testing efforts are not overestimated (as explained above), we need to ensure that a constructed test suite is of the smallest possible size and meets the desired coverage criterion. There is no theoretic way of generating such a test suite; therefore, we need to determine a practically viable method to construct it. We construct a minimal test suite for a given criterion by selecting test cases from a large test-pool monotonically by following a “greedy strategy” in order to satisfy that criterion. Note that the resulting test suite need not necessarily be optimally minimum as it may be possible that addition of a test case during test suite construction can make some other earlier selected test cases as redundant. Our method algorithm is given which enables systematic and reproducible construction of coverage-adequate minimal test suites. It is these test suites that are used in the effectiveness, testing effort, and efficiency evaluations.

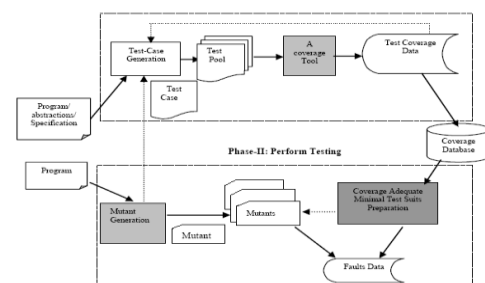


Fig 2 Process for the experimental comparison of coverage criteria

To demonstrate the efficiency of a coverage criterion for a program P, we combine the effectiveness with the effort required in testing. To quantify this, we use a metric called the Performance Index (PIT) of a minimal test suite T which is defined as,

$$\text{PIT} = \frac{\text{Number of faults revealed by test suite T in P}}{\text{Size of the minimal test suite T}}$$

So PIT reflects the average cost of finding a defect (i.e. the efficiency) in terms of number of test cases required using a test criterion for the program under test.

The reliability of a coverage criterion is accessed by the variability in PIT of the different coverage adequate test suites used in the study. The influence of the different fault types on the effectiveness of the various coverage criteria under study (Research question #5) is obtained by computing and analyzing FDET for individual seeded fault types in a test program.

III EXPERIMENTAL SETUP

The factor in the study is control flow based coverage criteria and the alternatives are block, branch, and predicate coverage criteria. In this section, we present the various instruments used in our experiment.

Test-Programs

We have considered five Java programs of moderate size (300 to 1500 non-commented lines of code (NCLOC)). The programs were taken from diverse domains to maximize the applicability of our results. The first program is Hotel-Management which is a

Simple command line hotel management application program written by the author. The second program, Postal Codes, aims at recognizing postal codes of a few countries. Cruise Control is the third program that is widely used for state based testing experiments. JavaVector is the Vector class in the Java Collection framework. Our fifth program is the game Monopoly. A brief description of these programs is given below.

IV EXPERIMENT EXECUTION AND DATA COLLECTION

The experiment was conducted using the two-phase process. In phase one, for each test-program, we first constructed a “sufficient test-pool” and obtained the required test coverage

information for each test case in the test-pool for the three coverage criteria.

In phase two, we generated multiple mutants of the test-program and added more tests to the test-pool, where required, in order to cover all the mutants. Using the test coverage information for all the test cases in the test-pool, we subsequently generated twenty-five random coverage-adequate minimal test suites for each of the three coverage criteria. The mutants were then tested by executing all the twenty-five coverage test suites for the three coverage criteria, and information regarding killed-mutants was recorded.

For each test-program, the following data were recorded and analyzed:

- The number and type of mutants generated and killed by the coverage test suites.
- Code coverage information for the coverage test suites.
- The number of blocks, branches, and predicates for each test-program.

The data obtained for all five programs were separately analyzed to determine the effectiveness and efficiency of the three coverage criteria. We first present program-wise data analysis. Subsequently, results were also compared across all the test programs.

4.1 Program-wise Analysis

For each test-program, we graphically demonstrate (a) Faults seeded as per the mutation operator used, (b) Average FDET of the three coverage criteria, (c) Average PIT of these coverage-adequate test suites, and (d) Average coverage achieved by the coverage-adequate test suites for the three coverage criteria.

Program-1: Hotel Management The results showed that the effectiveness FDET of the predicate test suites was better than branch and block test suites but required more testing effort TET (see Figure 3 (d) - #TC stands for number of test cases). The box plot for the efficiency PIT (Figure 3 (c)) shows that overall; the branch test suites were more efficient followed by the predicate test suites but the block test suites, on average, performed poorly. The block test suites showed highest variability in performance whereas the predicate test suites were most consistent.

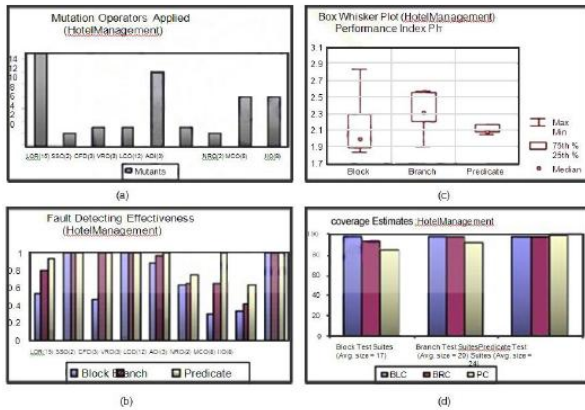


Fig 3 Data Analysis for the Hotel Management Program

The reason for higher PIT for the branch test suites is that this program has some methods with branch-constructs (if, while-statements) placed in such a fashion that it took just a few tests (one or two) to cover the blocks of the methods but needed more tests to cover its branches. As the sizes of these methods were relatively large, the additional tests used in the branch test suites found more faults compare to the block test suites. The program has some methods with composite conditions but of lower cardinality (mostly two) and accordingly, the branch test suites also did well on the MCO bugs.

Program-2: Postal Codes the results showed that in this case also the predicate test suites had better FDET but higher TET than the other two coverage criteria (Figure 4). The predicate coverage demonstrated much better results in the case of missing condition bugs (seeded using the MCO operator). The block test suites showed the best PIT, but there was a wider variability in the results. The block test suites performed rather poorly in case of CFD and MCO bugs. The branch test suites revealed more bugs than the block test suites and performed more consistently; their PIT showed less variability.

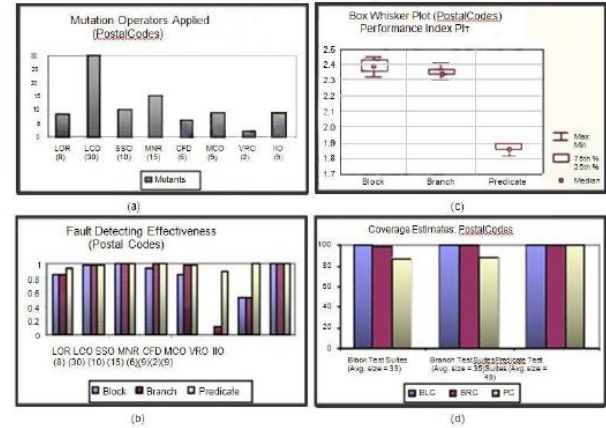


Fig 4 Data Analysis for the Postal Codes Program

This Program has some relatively large algorithmic methods with many composite conditional statements. The predicate and branch test suites performed well whereas block test suites performed poorly (Figure 4 (b)). Specifically, due to the presence of conditionals of larger cardinalities, predicate test suites were most effective on the MCO bugs compared to the other coverage criteria.

Program-3: Cruise Control The FDET of the predicate test suites were found to be similar to the branch test suites due to the fact that the branch test suites also found some of the MCO bugs. Block test suites showed better PIT than the other coverage criteria, but it also had highest variance. Once again, the branch test suites were consistent compared to the block test suites and also proved to be more efficient than the predicate test suites.

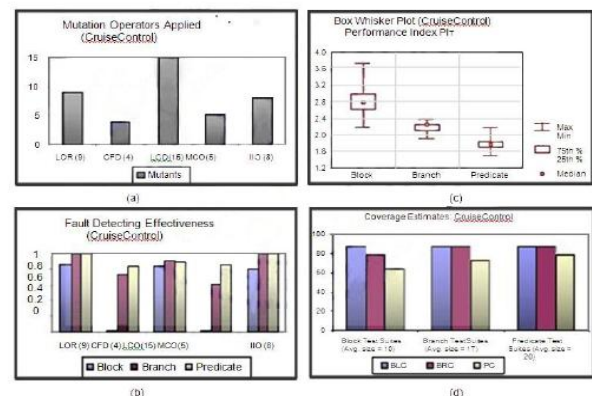


Fig 5 Data Analysis for the cruise Control Program

We observed small differences in the performance of the three coverage criteria in terms of size of the test suites and corresponding PIT. This was because most of the class methods under test are of a small size (less than 15 NCLOC), well re-factored to perform single functions, and having one or two balanced conditional statements (e.g. if with else statements) involving mostly simple conditions. The intra-method structural complexity of the program is quite low but inter-method interaction is high. This resulted into similar requirements for the three coverage criteria and hence the similar average performance of these three coverage adequate test suites.

4.2 Effectiveness Analysis at Method-level

To obtain statistical evidence for the Effectiveness of the three coverage criteria, we have investigated some important methods (of a relatively large size), of the classes of these five test programs. We collected various statistics of these methods like size, number of blocks, branches and predicates, number of faults inserted, faults identified by the coverage test suites, etc. The reason for doing analysis at method level is that it provides more data points, thereby allowing better statistical analysis of the results obtained. Since the control structure is typically represented at method level, analysis at method level is the right level of granularity for coverage analysis. To get help in the answering process, we also framed a set of null hypotheses to be evaluated using ANOVA. The research questions and relevant null hypotheses for this analysis are:

- Whether branch coverage or block coverage, is more effective in the methods under investigation. Here the null hypothesis is

H01: $FDEBr = FDEBl$

- Whether predicate coverage or branch coverage, is more effective in the methods under investigation. The null hypothesis in this case is

H02: $FDEpr = FDEBr$

- Whether predicate coverage or branch coverage, is more effective in the methods having composite conditions. The null hypothesis in this case is

H03: $FDEpr = FDEBr$

Table shows the results of statistical analysis of Effectiveness data where μ denotes mean Effectiveness (FDET) of a

coverage criterion over twenty five test suites. The statistical analysis results presented in this section are the results of method level analysis which is done on a sample size of 22 methods selected from the five test programs. We selected those methods in which three or more faults were seeded. For the first two hypotheses, we included Effectiveness data for all 22 methods. However, the third hypothesis was validated on 6 out of 20 methods as these were the methods having composite conditions. Our results show that the Effectiveness of the branch coverage criterion was better than that of the block coverage criterion. (row 1 table, statistical significance $\alpha = 0.01$). When comparing branch coverage criterion with predicate coverage, we did not find enough evidence to reject the null hypothesis (row 2 table). However, method level analysis revealed that the predicate-coverage criterion performed better than the branch-coverage criterion in methods having composite conditional statements. This difference was confirmed to be statistically significant at a level of $\alpha = 0.05$ (row 3).

4.3 Data Analysis for the JavaVector program

The reason for the diversity in results is due to the fact that there are many methods in JavaVector that do not contain any conditionals (usually dealt best by predicate coverage). Also of the conditionals present, most were simple and hence both the branch and the block test suites showed similar behavior.

Program-5: Monopoly This is a nicely designed object-oriented program as it has inheritance hierarchies with small method sizes and other object-oriented features. The results of this program showed similar trends as previously obtained but with less variability. The three coverage criteria seem to have similar FDET, TET and PIT measures. Control flow bugs like MCO and CFD bugs again accounted for the cause of difference in FDET of the three coverage criteria.

This program consists of mostly small methods with states and transitions. Many methods just have a simple-if statement (without the “else” part) and therefore the branch test suites were somewhat larger than the block test suites and consequently having considerably less PIT (Figure 5 (b)). In the absence of composite conditions, branch test suites and predicate test suites performed equally. Also please note that due to the non-deterministic behavior of the two threads of

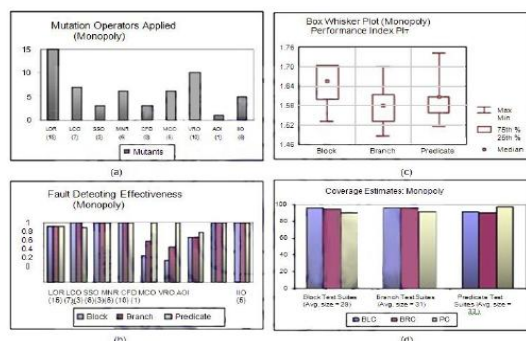


Fig 6 Data Analysis for the Monopoly program

control, some regions of the test-program were not reached by all the test cases in the test-pool, and accordingly, all the test suites missed the faults inserted in those regions.

Program-4: JavaVector the FDET of the three coverage criteria was found to be quite different from the above three programs. Branch test suites performed best followed by block and then predicate tests. Their TET requirements were in the opposite order, i.e. the branch test suites size was the biggest followed by block test suites and then predicate test suites. The three coverage test suites demonstrated similar PIT with predicate test suites showing greatest variability.

| Si N o. | Evaluation Parameter | Null Hypothesis | p-val ue | Result At = 0.05 |
|---------------|-------------------------|--------------------|-------------|---------------------|
| 1 | Effectiveness | H01 : FDEBr = | 0.001 | FDEBr > |
| 2 | Effectiveness | FDEBr = | 0.760 | FDEBr |
| 3 | Effectiveness | FDEBr = | 0.030 | Not rejected |
| | * | H02 : FDEpr = | | FDEpr > |
| | | FDEBr = | | FDEBr |
| | | H03 : FDEpr = | | |
| | | FDEBr = | | |

Experimental work in software testing has generally focused on evaluating the fault detection capability of testing criteria. However, test managers also interested in the relation between the fault-detecting abilities of the different testing strategies and their effort requirements, so as to optimize the total testing effort. We have proposed a tool-supported controlled experimentation framework to facilitate

comparison among different coverage criteria which handles both the issues of testing effectiveness as well as efficiency. For each coverage criterion under study, multiple coverage-adequate minimal test suites of a program are generated from a test-pool, which are then executed on a set of program mutants to obtain faults data.

We demonstrate that the proposed approach is applicable by describing the results of an experiment comparing three structural coverage-testing methods, namely, block coverage, branch coverage and predicate coverage using five Java programs. For each program, we randomly generated twenty-five minimal test suites, for each coverage criterion under study, from a sufficiently large test-pool. Then we created a sufficient number of mutants using a set of applicable mutation operators and tested them within the set of generated minimal test suites for each coverage criterion. The three structural coverage criteria were compared in terms of their effectiveness (FDET), the testing effort requirements (TET), and efficiency (PIT).

We found that the predicate coverage criterion demonstrated the best effectiveness but at the greater cost, i.e. it required more testing effort than the other two criteria. On the other hand, the block coverage criterion took the least testing effort, but had a lower Effectiveness than the other two. The branch coverage criterion performed in between the two others in terms of the Effectiveness and the testing effort requirements. The efficiency of the block coverage criterion was found to be on the higher side but this result exhibited greater variability (was less consistent). On the other hand, the efficiency for the branch coverage criterion was found to be slightly less than that of the block coverage but was relatively consistent. The efficiency for the predicate test suites was observed to be lower than the other two. The overall results suggest that the branch test suites are better tradeoff in terms of the effectiveness and efficiency. Their effort requirements in terms of test suite size are smaller than that of the predicate test suites but larger than the block test suites. Based on our investigation for choosing a suitable criterion to test a given program, we observed that the branch coverage criterion is the best choice for getting good results with moderate testing efforts. The effectiveness can be further improved by considering predicate coverage for the

methods containing composite conditionals but with increased effort requirements.

The proposed approach facilitates comparison for all such coverage criteria for which test coverage information can be obtained. We can effectively compare coverage criteria not only within a family of a particular section of their classification, but also across their classification as well. With the help of proper tool support, for instance, we can use the proposed approach for comparing criteria in data-flow testing or in mutation testing. The automation incorporated in the approach is an alternative to control the human related variability in software testing experiments, which would enable a more reproducible test outcome. This would not only reduce the cost of the experimentation but also enable researchers to capitalize on their findings.

V CONCLUSION

combination of a set of verification approaches for a given problem is a promising area of further investigations.

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Lpg Refrigeration System

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Abstract- In spite of the fact that administration offices are not ready to ceaselessly supply a significant segment of power in both the urban just as in country regions. Still the individuals in these areas require refrigeration for an assortment of socially important purposes, for example cold storage or storing medical supplies and domestic kitchens this task has the curiosity of utilizing LPG rather than power for refrigeration. This arrangement is advantageous for refrigeration in areas having alarms in power. It deals with the rule that during the transformation LPG into vapour form, LPG expands. As a result of this expansion, there is a weight drop and addition in volume of LPG that results in the drop of temperature and a refrigerating effect is made. This refrigerating impact can be utilized for cooling purposes. So this work gives refrigeration to socially applicable needs just as replaces a dangerous atmospheric deviation maker refrigerants. While experiencing the literature survey in LPG refrigeration framework, Conventional VCRS (Vapor Compression Refrigeration System) utilizes LPG as refrigerant and created the refrigerating effect. Be that as it may, in our proposed exceptionally straightforward sort of refrigeration framework in which the high weight LPG is going through a capillary (narrow) tube and expands. After expansion the state of LPG is transformed over from liquid to gas and a short time later it experiences the evaporator where it assimilates the warmth and produces the refrigerating impact. After evaporator it experiences the gas burner where it consumes.

Keywords- Capillary Tube; Evaporator; Expansion; LPG Refrigeration; Refrigeration; Refrigerating Effect.

I. INTRODUCTION

The term refrigeration implies cooling a space, substance or framework to lower as well as keep up its temperature underneath the surrounding one (while the eliminated heat is dismissed at a higher temperature). In different words, refrigeration is counterfeit (human-made) cooling. Vitality as warmth is taken out from a low-temperature supply and moved to a high-temperature repository. Crafted by vitality move is generally determined by mechanical methods, however can likewise be driven by heat, attraction, power, laser, or different methods. Refrigeration has number of applications, which includes family unit coolers, mechanical coolers, cryogenics, and cooling. Warmth siphons may utilize the warmth yield of the refrigeration cycle, and furthermore might be intended to be reversible, yet are generally like cooling units.

Refrigeration has largely affected industry, way of life, agribusiness, and settlement designs. Preserving food goes back to in any event the antiquated Roman and Chinese domains. Notwithstanding, mechanical refrigeration innovation has quickly developed in the only remaining century, from ice gathering to temperature-controlled rail vehicles. The presentation of refrigerated rail vehicles added toward the west extension of the US (United States), permitting settlement in regions that didn't have primary vehicle channels, for example, waterways, or

valley trails. Settlements were additionally creating in barren pieces of the nation, loaded up with newfound common assets.

As very comparative standards will be satisfied by working liquids (refrigerants) applied to warm siphons, refrigeration, and natural Rankine cycles; a few working liquids are applied by these advancements. Smelling salts were principal refrigerants. Refrigeration can be characterized as "The study of giving and keeping up temperature underneath that of encompassing climate". It is the constant extraction of warmth from a body.

II. METHODS OF REFRIGERATION

Strategies for refrigeration can be delegated

- non-cyclic,
- cyclic,
- thermoelectric
- magnetic.

Non-cyclic Refrigeration:-

In non-cyclic refrigeration, cooling is achieved by melting ice or by subliming dry ice (solidified carbon dioxide). These techniques are utilized for little scope refrigeration, for example, in research centers and workshops, or in versatile coolers. Ice owes its adequacy as a cooling operator to its dissolving purpose of 0 °C (32 °F) adrift level. To liquefy, ice must assimilate 333.55 kJ/kg (around 144 Btu/lb) of warmth. Staples kept up close to this temperature have an expanded stockpiling life.

Solid carbon dioxide has no liquid phase at normal atmospheric pressure, and sublimates directly from the solid to vapor phase at a temperature of -78.5°C (-109.3°F), and is effective for maintaining products at low temperatures during sublimation. Systems such as this where the refrigerant evaporates and is vented to the atmosphere are known as “total loss refrigeration”.

Cyclic Refrigeration:-

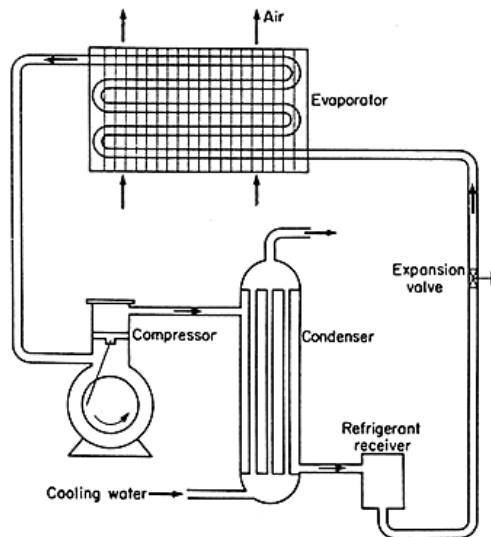


Fig. 1 :- Cyclic Refrigeration

This comprises of a refrigeration cycle, where warmth is taken out from a low-temperature space or source and dismissed to a high-temperature sink with the assistance of outer work, and its opposite, the thermodynamic force cycle. In the force cycle, heat is provided from a high-temperature source to the engine, some portion of the warmth being utilized to create work and the rest being dismissed to a low-temperature sink. This fulfills the second law of thermodynamics.

Thermoelectric Refrigeration:-

Thermoelectric cooling utilizes the Peltier impact to make a warmth transition between the intersection of two unique kinds of materials. This impact is generally utilized in outdoors and convenient coolers and for cooling electronic parts and little instruments.

Magnetic Refrigeration:-

Magnetic refrigeration, or adiabatic demagnetization, is a cooling innovation dependent on the magnetocaloric impact, an inherent property of attractive solids. The refrigerant is frequently a paramagnetic salt, for example, cerium magnesium nitrate. The dynamic attractive dipoles for this situation are those of the electron shells of the paramagnetic particle.

A solid attractive field is applied to the refrigerant, compelling its different attractive dipoles to adjust and placing these degrees of opportunity of the

refrigerant into a condition of brought down entropy. A warmth sink at that point assimilates the warmth delivered by the refrigerant because of its loss of entropy. Warm contact with the warmth sink is then broken so the framework is protected, and the attractive field is turned off. This expands the warmth limit of the refrigerant, along these lines diminishing its temperature beneath the temperature of the warmth sink.

III. LPG` REFRIGERATION

Petroleum gas is put away in a liquid state before its use as fuel. The vitality spent for pressurizing and liquefying isn't recuperated later. On the off chance that it's swollen in partner degree evaporator, it will get vaporized and ingest warmth to deliver cooling. This property has been utilized for refrigeration and cooling. So the liquefied type of LPG can be utilized for cooling and the expanded LPG gas can be additionally utilized for burning as a fuel. In this refrigeration framework, the copper curl is kept inside the fridge and the LPG gas is gone through this loop as the temperature of the gas is low it begins making the cooler temperature decline continuously and simultaneously, opposite side cooking should be possible. It comprises of a metal edge, copper pipe, fridge body, pressure check, pipe, controller, pressure sensor and temperature pointer. It can assume a significant job in cafés where persistently cooling and warming is required likewise in compound enterprises for refrigeration reason. In distant regions where power isn't accessible this refrigeration framework utilizing LPG framework will come into utilization for cooling reason.

IV. OBJECTIVES

The Objectives of this project are as follows:

Economical: The components we used for design are cheap and easily available. Also the overall cost of the product is less.

Inexpensive and Affordable: This project reduced the cost of designing refrigerator.

Refrigeration Capacity: This was the main goal of our project. We have designed the device which will meet all different cooling loads.

V. COMPONENTS

1. LPG Gas Cylinder: Liquefied Petroleum Gas is combination of Propane (C_3H_8) and Butane (C_4H_{10}). LPG is utilized as a fuel for domestic purpose, drying can industrial, LPG be horticultural, to agricultural, another cooking, heating fuel.

2. Capillary Tube: It is long length and it is coiled to several turns so that the capillary tube to 2.28 mm. They have small internal diameter. Internal diameter

tube an application varies from 0.5 (0.020 to 0.09inch).

3. Evaporator: It's the evaporators where the actual cooling effect takes place in the refrigeration systems. The evaporators are heat exchanger surface that transfer the heat from the substance to be cooled to the refrigerant, evaporators refrigeration thus removing the heat from the cabin are used for wide variety and hence the available form of the substance.

4. Pressure gauges: Instruments that are used to measure pressure are called pressure gauges or vacuum gauges. These gauges are available in 63mm, 100mm, and 150mm sizes and can be customized as per client.

5. Digital Temperature probe: A digital temperature probe is a device that provides for temperature measurement through an electrical signal.

6. ON/OFF Valve: A flow control valve is used to control the flow or pressure of a fluid.

7. High Pressure Pipes: The range of high pressure pipes covers most application where there is a requirement to transfer gas at high pressure. They consist of a steel pipe with steel ball fitted to both ends.

8. High Pressure Regulator: This type of regulator is used to send high pressure gas from the cylinders. These are mainly used in functions to Bhatti stoves.

VI. WORKING

This work replaces the regular refrigerant by LPG as a cooling medium in a refrigerator. It works on the rule that during the change in LPG from liquid into vaporous structure, LPG expands. Because of this expansion pressure drop happens and increment in volume of LPG. It brings about the drop of temperature and a refrigerating impact is delivered and it is utilized for cooling purposes. In this refrigeration framework the high pressure LPG is gone through fine cylinder and it expands, after expansion the stage change happens and it convert from liquid to gas. At that point it goes through the evaporator where it assimilates the idle warmth of the stored item and produces the refrigerating impact. The fundamental thought behind LPG refrigerator is to utilize the LPG to absorb heat. The straightforward component of the LPG refrigeration working is shown in the figure below.

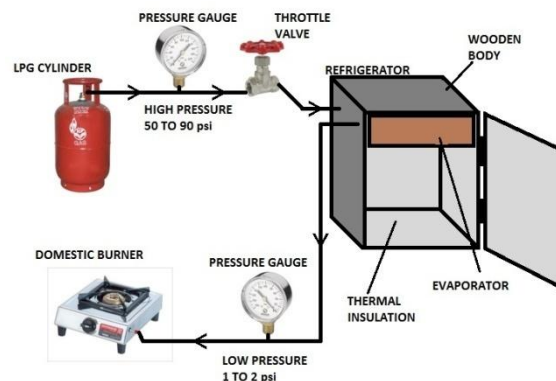


Fig. 2 :- LPG Refrigeration System

□ LPG is put away in the LPG chamber under high pressure. At the point when the gas tank of controllers is opened then high pressure LPG goes through the high pressure pipe. This LPG is passing by high pressure gas pipe to capillary tube.

□ High pressure LPG is changed over in low pressure at capillary with enthalpy stays constant.

□ After capillary tube, low pressure LPG is gone through the evaporator. LPG is changed over into low pressure and temperature vapour form and passes through the evaporator which ingests heat from the chamber. In this way the chamber gets chill off. Subsequently we can accomplish cooling impact in refrigerator.

□ Subsequent to going through the evaporator low pressure LPG is gone through the pipe to burner. We can utilize the low pressure LPG in burning processes.

VII. APPLICATIONS

- The framework can all around be utilized in mechanical focal cooling and homegrown refrigeration and cooling too.
- It very well may be utilized in vehicles running on LPG or different Gaseous fuel for cooling.
- Then again the innovation whenever executed in heavy utility vehicles or transportation, it would help in far off transportation of eatables as the refrigeration framework inside the vehicle and the expense of running the vehicle can be borne at the same time.
- Cooling and storage of fundamentals in distant regions and in crisis vehicles, for example, stockpiling of basic bio-synthetic compounds, injections, and so forth in an emergency vehicle, is effectively conceivable.
- It tends to be utilized for zero cost cooling of spaces like airports, shopping centers, and so forth which have their own gas turbine power-plants.

VIII. ADVANTAGES

- Cooling is free of cost as no electricity is needed for operating the air conditioner and refrigerator.

- LPG isn't consumed during cooling measure, just expanded and further utilized for cooking, as car fuel or for any mechanical purposes.
- The item is a green innovation and is eco-friendly, as though disposes of the utilization of ozone-exhausting refrigerants.

IX. COMPARISON BETWEEN LPG REFRIGERATION AND VCRS

| Parameters | LPG Refrigeration | VCRS |
|--------------|-------------------|----------------------------|
| COP | Higher | Lesser |
| Running Cost | Zero | Requires Electrical energy |
| Maintenance | Lesser | Higher |
| Eco-friendly | Yes | No |
| Noisy | No | Yes |

X. CONCLUSION

The point of the LPG refrigerator was to utilize LPG as a refrigerant and using the vitality of the high pressure in the chamber for creating the refrigerating impact. We have the LPG at a pressure of 12.41 bar in Domestic 14.5 kg cylinder outfitted with a high pressure controller and this pressure has diminished up to 1.41 bar with the assistance of capillary tube. Be that as it may, on the off chance that we utilize a low pressure controller similar to the practice in regular domestic LPG gas oven, the pressure of LPG

after the expansion device and before the burner would be extraordinary. So we have determined the refrigerating impact with the assistance of changes in properties of LPG (pressure, temperature, and enthalpy) when the evaporator utilizing high pressure controller and the measure of refrigerating impact is resolved. With this vitality input the COP of the LPG refrigerator is 5.08 and it is more prominent than the domestic fridge. However, later on scope the outcome may contrast if vitality contribution for 1Kg of LPG creation, would be taken from the vitality review report of any processing plant.

This framework is less expensive at starting just as running expense. It doesn't need an outside vitality sources to run the framework and no moving part in the framework. So support cost is likewise low. This framework is generally reasonable for lodging, enterprises, treatment facility, synthetic businesses where utilization of LPG is high.

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Applications Of Iot Based Systems In Healthcare (Pulse Rate And BP Monitoring) Using Raspberry Pi

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Abstract— The present era is completely associated with IoT which includes gadgets, sensors, machines, tools. IoT refers to connecting different devices whether medical, mechanical, electrical etc. to the internet. This paper is based on application of IoT based technology in healthcare sector for real-time monitoring of heartbeat and Blood Pressure of a patient. This paper is based on Applications of IOT based system in healthcare. The aim of the paper is to automatically monitor the heart rate & BP of the patient and check the patient's health status by making an interconnection between Healthcare & IOT. The proposed system consists of equipments & gadgets such as BP machines, Heart rate monitoring & these are connected to various sensors. The sensors are temporarily used on the patient's body & takes the readings. The readings taken are then sent to Raspberry pi & later on will upload the data of heart rate & BP on a database linked to a web UI. The readings then compared with the fixed one & if the patient's reading will be high or low the system will give information to the family members of the patient & the doctor about current health condition & also provide information in case any medical emergency arises. The process will be quite useful to detect chronic disorders such as Heart attacks in the preliminary stage. IOT technology is also very useful in open apps, insulin delivery, coagulation testing etc.

Keywords- Raspberry Pi; IoT; Heartrate Sensor; Architecture; Healthcare; Database; Prototype; Sedentary; Sqlite.

I. INTRODUCTION

The IoT is defined as the network of physical objects that are embedded with sensors ,other technologies for the purpose of connecting & exchange of data with devices & systems over the internet. It enables the devices to interact, collaborate and learn from each other's experiences as humans do. The heart is the most important organs in the human body that acts as a pump for circulating oxygen & blood all over the body .Heart rate & BP are intimately related nerves & hormones constantly monitor & balance the heart rate & blood pressure .Heartrate monitoring is a monitoring which is used to calculate to heartrate data while carrying out various types of physical exercises . Measurement of electrical heart rate data is known as ECG. BP monitor is used to measure BP, Heart rate and BP monitoring are generally used for cardiovascular exercises such as walking, hiking, running, climbing etc. Today, most of the people are losing their life due to heart attacks. When the flow of blood towards the heart is blocked, heart attack takes place. The normal heart rate of a children (6-15) is 70-100 bpm whereas adult (18 and above) has heart rate 60 to 100 bpm If a person's heart rate is constantly above 100 bpm, then person is said to have high heart rate. By using sensors, and corresponding modules BP and heart rate monitoring can be achieved. The blood pressure sensor is designed to measure systolic and diastolic pressure. The pulse rate is recorded by the sensor. The heartbeat sensor will allow checking heartbeat readings and Raspberry Pi can transmit them over the internet. Low land high limits of heartbeat are adjusted by the user as shown in figure 1

The limits are set once & the system starts monitoring the patient's heartbeat. When the heart beat reading goes above the limits set by the user, the system will set an alert above the high or low heartbeat as well as chance of heart attack. IoT in healthcare has several benefits also. IoT allows for accurate collection of data. It also decreases costs. With the help of IoT, the patient's monitoring can be done in a real time without even the presence of doctors & making visits. It allows for better patient experience. It also improves disease management. The development of IoT in healthcare should be in a positive way. However, one must be careful enough. Its misuse can lead to damage in people's privacy.

TABLE I. Reference Values.

| Component | Normal Value |
|----------------|----------------|
| Blood Pressure | 80/120mm of Hg |
| Pulse Rate | 60-100 BPM |

II. RELATED WORK

A Large number of scholars and Researchers have given many representations / frameworks for the application of IoT systems in the field of healthcare. This section emphasizes on the work done in the same field. Some notable works related to this field are given under: -

Ahn et al. gave the Execution of an arrangement to count the physiological signals sedentary posture such as ECG & BCG with the implementation of proper chair which means the non-compel bio-signals and can be watched using

monitoring arrangement like as the one they construct by giving a standard example of appeal of IoT in healthcare.

Xu et al. gave a fact representation to save and employ the IoT data. As they constructed and made a resource based ubiquitous data entrance type to gather and issue or print IoT data worldwide so that it would be applied everywhere, every time. They also showed an urgent medical service roots on IoT and how to gather and implement the IoT data on various plan of actions.

K Rhee, J Kwak, S Kim & D. Won gave an algorithm for authentication of challenge-based RFID authentication protocol for distributed database environment and built it more adjustable to IoT control system environment. They proceed towards three important conditions; add backup gadget to follow and monitor terminal gadget and it last add a press in alarm working for alarming for any fail genuine work.

I. Chiuchisan et al. suggested a framework to reduce the threat of patient in ICUS. The proposed method alerts the victim relatives and doctors to decrease any unpredictability in their health status or the body movement and to the atmosphere of room that is compulsory safeguard measures to be taken.

M.A. Jan, P. Nanda and others gave Light mutual authentic scheme which upholds the specification of IoT gadgets enrolled in the environment before involving in the network. They suggested to reduce connections overhead constrained application protocol has selected under coated protocol for giving connections between receiver & server is firstly recognized. Then it gives various resources to the receiver based on exist values determined in the request. This data transmission less the transmitted pocket numbers which finally less the energy in consumption and computation.

Barger et al. built a smart home using sensors connections to watch and track the mobility of the victim. A prototype of the related is also tested. The first objective work is to go through their system is able to outsmart the pattern of the home so the main precaution can be taken.

Gupta et al. proposed his work by using Intel Galeleo development board which combine several data & load it on the database from where it has been used by doctors & used to reduce the need of patient to approach hospital each and everytime by clarifying their health parameter.

Sahoo et al. Analyzed the health and medical system and for the big amount of patient's data that is made through various reports. They analyzed the various health limits to forecast the future health conditions of victims. The utilization of cloud based large data analytic platform which helps to achieve the same using mean of probability.

III. SYSTEM ARCHITECTURE

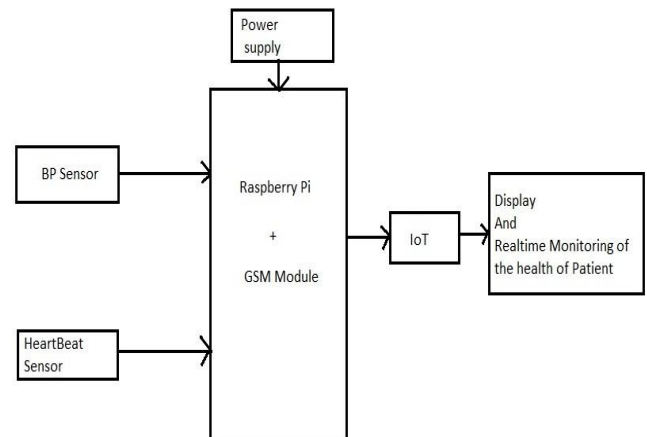


Fig. 1. System Architecture

IV. METHODOLOGY USED

In this paper we propose a system which can automatically detect patient's Heart Rate (Pulse Rate) & Blood Pressure and input the data of the sensors (Heart Rate And Blood Pressure Sensor) to a Linux based Raspberry Pi which with the help of a GSM Module (SIM900) which triggers an entry to an Sqlite Database linked to a Web User Interface for easy monitoring and interpretation by the concerned doctor.

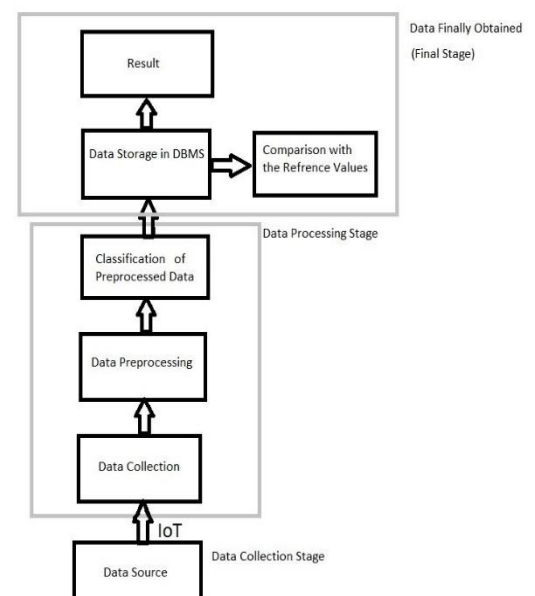


Fig. 2. Proposed methodology

The Above Figure 2 shows how to obtain the data about the health condition of the patient by observing the Various Parameters (Blood Pressure and Heart Rate in this case) and how the results are obtained for the real-time monitoring of the condition of the patient by the doctor concerned.

At stage 1, Data is collected from various sensors viz. Heart Rate and Blood Pressure Sensor. This data is actually unprocessed data and is stored on the web server. As these sensors give out analog data which can't be directly processed by the Linux Based Raspberry Pi, so an Analog to Digital (ADC) Converter IC first converts the Analog data into Digital form. The ADC IC then sends this Digital data to the Linux based Raspberry Pi, in which a code is already written in python which collects and uploads the Digital data to the database at the interval of 5 minutes each.

At Stage 2, the collected data stored into the Database is first filtered, Categorized and lastly Classified to get the relevant information which is actually the Realtime Readings of BP and Heart Rate of the patient suggesting the condition of the patient. This collected data may also be used for the future reference suggesting the medical history of the patient.

At Stage 3, the readings are compared with the information which is already existing on the database to automatically categorize the health status of the patient in various categories viz. Normal, Below Normal, critical etc. By the use of AI and Machine Learning techniques, we can make the system smarter and more efficient. Finally, the Realtime health status of the patient can also be simultaneous analyzed by a Doctor.

V. MODULES USED

A. RASPBERRY PI: -

It is a credit card sized and low-cost single board computer based on Linux OS. It is capable to do everything that a desktop computer is expected to do. It's very popular among the developers because it offers the entire Linux server and wireless peripheral device connectivity in the tiny platform at a very low cost i.e. it's a very cost-effective solution for the implementation of IoT in Healthcare management. Here the system is using a Raspberry Pi 3 Model B+.

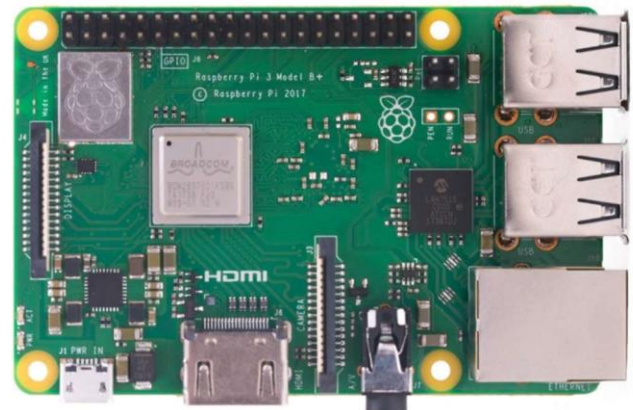


Fig. 3. Raspberry Pi 3

Key specifications of the Raspberry Pi 3 model B+ are: -

- > Broadcom BCM2837B0, Cortex A53, 64bit SOC @ 1.4 GHz
- > 1GB LPDDR2 SDRAM
- > 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2 BLE
- > Gigabit Ethernet over USB 2.0
- > 4×USB 2.0 ports
- > Extended 40-pin GPIO header
- > 1×full size HDMI port
- > MIPI DSI display port
- > MIPI CSI camera port
- > 4 pole stereo output and composite video port
- > H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30); OpenGL ES 1.1, 2.0 graphics
- > Micro SD format for loading operating system and data storage
- > 5V/2.5A DC via micro USB connector
- > 5V DC via GPIO header
- > Power over Ethernet (PoE)

B. HEART RATE SENSOR: -

The heart rate sensor we are using here is an optical pulse sensor which is easily available online and is a very cost-effective option. It is a reliable and cheap solution for pulse rate measurement.

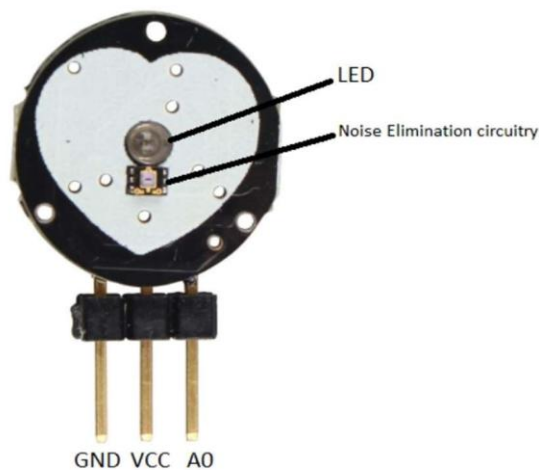


Fig. 4. Heart Rate Sensor

As shown in figure 4, there are three terminals of the sensor (- GND, +VCC and A0 for the signal), an LED and noise elimination circuitry. This sensor works by emitting an infrared signal in the form of an LED light from an IR-diode onto the body or skin of a person.

This sensor is put preferably on fingertips or earlobes. Whenever heart pumps, there is a small increase in the blood flow, which effects the reflected light from the skin. It has been observed that the light which is reflected, is high in between heartbeats and low during a heartbeat which has to do with the volume of the capillaries. The sensor detects the change in the reflected light and generates a corresponding analog signal which corresponds to the actual heart rate of an individual

C. BLOOD PRESSURE SENSOR:-

The Blood Pressure sensor used here is a simple sphygmomanometer coupled with a sensor which can measure the pressure. The blood pressure sensor used here is a manual instead of a digital as it gives more accurate readings and is way too cheaper than a digital one. The sphygmomanometer kit consists of an arm cuff, a squeezable bulb through which the cuff is inflated, stethoscope and a sensor which can measure the air pressure.



Fig. 5. Sphygmomanometer

The blood pressure that we measure is the output of the air pressure sensor. Here, also like the Heart Rate sensor, the readings are in the form of analog signals which can't be directly fed to the Raspberry Pi as it doesn't have an inbuilt ADC converter.

D. ANALOG TO DIGITAL CONVERTER IC: -

Since all the sensors used in this system give analog output and Raspberry Pi doesn't have an inbuilt Analog to Digital converter, so the signals from these sensors can't be directly fed to the Raspberry Pi. So, an Analog to Digital Converter (ADC) IC is required in this case. The ADC IC used in this case is MCP3004.



Fig. 6. MCP3004 ADC IC

The MCP3004 is a low cost and easily available 10-bit and 4-Channel Analog to Digital Converter IC. It provides high performance and low power consumption in a small package, which makes it ideal for IoT applications. This chip is a great option when there is a need to read simple analog

signal like the signals from the sensors used here viz. Heart Rate and BP sensors.

E. GSM MODULE:-

In this paper we have used a GSM Quadband module which works on the frequencies GSM/GPRS 850/900/1800/1900MHz and can be integrated into a large number of IoT projects. It can use any type of SIM card having its own unique number. It can be used to send SMS, make phone calls, receive phone calls and provide internet connectivity through GPRS, TCP and IP protocols.



Fig. 7. GSM Module

This module connects the whole system to the internet and by the means of which the Raspberry Pi is able to trigger an entry into the Sqlite Database linked to the Web UI using the Python code, so the concerned doctors as well as attendants of the patient can monitor the health status of the patient anytime and from anywhere in this world.

VI. CONCLUSION AND FUTURE WORK

In present time, the IoT has made the lives of people convenient & straightforward. In this paper, we have presented & proved the prototype for an automatic system that guarantee a constant monitoring of various health parameters (Heart rate & blood pressure) & disorder that prevents patients from the pain of paying frequent visits to the hospitals. The proposed system can be set up in the hospital & massive amount of data results can be obtained & stored in the online database. Even the results can be accessed through an application from mobile phones, laptops etc.

This system can be improved by adding AI system components to make the work of the doctors & patients easier i.e.; it can be made more smart by introducing the SMS/Email service which in case of an emergency will automatically send a SMS or an Email to the concerned doctors and the attendants of the patient. The data, consisting medical record of the many patients's parameters & corresponding results, are often explored using data processing, in search of consistent patterns & systematic relationships within the disease.

VII. RESULTS

As the title says, the applications of IoT based systems in healthcare (Pulse rate & BP monitoring) using Raspberry pi is of extreme use to patients & doctors as well. The attendants of the patient can check the health status anytime from the comfort of their homes & visit hospitals only when they really need to. This can be done by using our system whose result are brought online & can be seen from anywhere around the world. The doctors can use the log of the patient body condition to study & determine the effect of medicine or other such things. The smart prediction module predicts the disease that the patient is suffering from by asking them for various symptoms they may have and the options are based on the previous symptom. The final conclusion is made after at least 3-4 symptoms are identified. The result is more accurate if more & more symptoms are identified. A sample screenshot of the web interface can be seen in the figure 8.

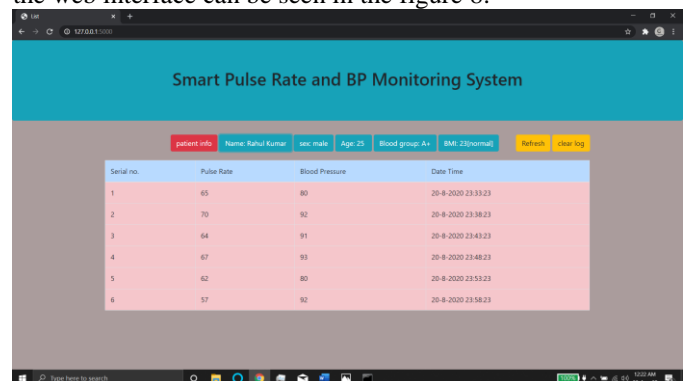


Fig. 8. Screenshot of the Web UI

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E-waste Management in India: A Review

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ABSTRACT:

E-waste or Electronic wastes can be mentioned as electronic goods that are dumped out or unwanted. Yearly, around 50 million tons of E-wastes are produced. Depending upon their nature of reaction, there are chances for dangers depending upon the circumstances. Discarded batteries, PCs and other electrochemical wastes may leads to undesirable results. Environmental deterioration and health risk due to inappropriate e-waste management has become an important topic in India. E-waste should be treated equally as compared to the other wastes. The situation is alarming as India produce about 20 lakh tones of E-waste yearly and almost all of it finds its way into the unorganized sector as there is no proper arrangement available at present. This paper discusses the present outline of e-waste management and possible e-waste plan of action in India.

KEYWORDS: Electronic waste; Environmental pollution; E-waste management and Physical wastes.

I. INTRODUCTION:

Electronic waste can be mentioned as unwanted or useless electronic and electrical products. It includes large range of electronics and electrical devices i.e. mobiles, computers, laptops, including household appliances like air conditioners, refrigerators etc. E-waste incorporates thousand substances several of which are noxious and unsafe for environment condition and human wellbeing. The current activity of e-waste management in India encounters numerous difficulties like the trouble in inventorisatation, inadequate guidelines, disgraceful and unsafe states of casual reprocessing, helpless attention to clients and averseness with respect to the investors to address the issue.^[1]

E-waste is a developing issue yet additionally a business chance of expanding noteworthiness, given the volumes of E-waste being produced and the substance of both toxic and important materials in them. Most E-waste is made out of a blend of metals like copper, aluminum, and iron. They may be secured with or even blended in

with different kinds of plastics and ceramics. In this manner, reusing of E-waste is an important subject from the purpose of waste administration and also from the recuperation part of important issue. Anyway the methodology of withdraw and removal of E-waste is extremely muddled, which includes different sorts of items, numerous individuals, broad regions, and long time range it is an immense and confounded framework. This paper examines the circumstance of e-waste in India, the troubles related with it and methodology utilized for e-waste the executives in India.

II. ELECTRONIC WASTE WORLDWIDE:

A record of 53.6 million metric tons (Mt) of e-waste disposed of items with a battery, for example, PCs and cell phones - is accounted for created worldwide in 2019, up 9.2 Mtin five years. Harmful and perilous substances, for example, mercury, brominates fire retardants (BFR) or chlorofluorocarbons (CFCs) are found in numerous sorts of electronic hardware and posture extreme danger to human wellbeing and nature

if not took care of in an ecologically solid way. The new report moreover predicts overall e-waste will show up at 74 Mt by 2030, for all intents and purposes twofold the 2014 figure, fuelled by higher electric and electronic usage rates, shorter lifecycles and confined fix options. ^[2]



Figure (a) Global E-waste generated in 2019^[3]

III. E-WASTE IN INDIA:

As indicated by the Global E-Waste Monitor 2019, India produces around 2 million tons (MT) of e-waste every year and positions 3rd among e-waste delivering nations, after the, China and USA. In 2018-2019, India treated just 20% of its e-waste. Around 95 percent of India's e-waste is reused in the casual segment and in a rough way. A report on e-waste introduced by the United Nations (UN) in World Economic Forum on January 24, 2019 calls attention to that the waste stream arrived at 48.5 million tons (MT) in 2018 and the figure is relied upon to twofold if no progressions presented.

E-waste is developing at a compound annual growth rate (CAGR) of around 30 percent in the nation. ASSOCHAM, one of the zenith exchange relationship of India, assessed that electronic-waste production was 1.8 MT per annum in 2016 and would arrive at 5.2 MT per annum by 2020. ^[2]

India presently has 178 enlisted e-waste recyclers, licensed by the state governments to deal with e-waste.

Yet, a large number of India's e-waste recyclers aren't reusing waste appropriately. While some are putting away it in risky conditions, others don't have the ability to deal with so much waste, according to the report of Union Environment ministry.

IV. SOURCES OF E-WASTE IN INDIA:

Electronic waste is being produced by different sources in the country like Govt. sectors, Commercial establishments, institutional areas, research and developments, household and manufacturing units of the country. Household and small businesses as far as PCs emanating from individual households are concerned; it is impossible to know the exact quantity. Households account for 22% of total computers in India. The remaining 78% comes from the business sector. Large business, institutions and government sectors were the earliest users of electronic products; today they account for 78 per cent of total installed computers. PC manufacturers and retailers are also major contributors to the e- waste segment in India. It also includes defective PCs under guarantee procured from customer as replacement items. It is estimated that around 1050 tons per year of waste comes from PC manufacturing unit. ^[1]

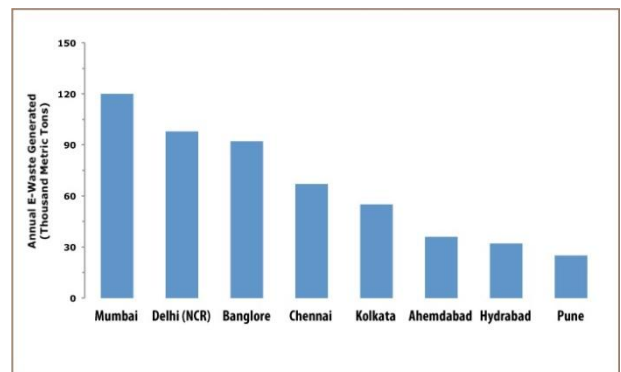


Figure (b) Major E-waste generating cities in India^[4]

V. CHALLENGES FACED BY INDIA IN E-WASTE MANAGEMENT:

India secured 168 rank in the 12th edition of the biennial Environment Performance Index (EPI Index) that measured the environmental performance of 180 countries and was released by the Yale University on June 4, 2020. India's rank was 177 (with a score of 30.57 out of 100) in 2018^[4]. This was linked to poor performance in the environment health policy and deaths due to air pollution categories. Also, India is positioned third among the top E-waste generating nations after the China and USA. These three nations together contributed 38% of absolute 53.6 million tons (Mt) of e-waste, created worldwide in 2019. This information is delivered by UN's Global E-waste Monitor 2020. Dumping in open dumpsites is a typical sight that offers ascend to issues, for example, groundwater sullyng, unforeseen weakness, and some more. The Associated Chambers of Commerce and Industry of India (ASSOCHAM) and KPMG study, E-Waste Management in India distinguished that PC and parts represent nearly 70 percent of e-waste, trailed by media transmission telephones (12 %), clinical gear (7%) and electrical hardware (8 %), with rest from household e-waste.^[6]

Electronic waste assortment, transportation, preparing, and reusing are constrained by the informal sector. The part is arranged and unregulated. Commonly, all the materials and worth that could be recuperated isn't recovered. Moreover, there are serious issues regarding leakages of toxic material into the environment and worker's safety and health.

In India, Seelampur in Delhi is the biggest e-waste disassembling area. Adults and children extract recyclable components and precious metals like gold, copper and other functional parts from the devices and spend 10-12 hours daily for this process. Recyclers use cycles, for example, open incineration and acid-leeching. This circumstance could be improved by making mindfulness and improving the foundation of

reusing units alongside the approaches. Majority of the E-waste collection is managed by the unorganized sector. Additionally, informal channels of reusing of hardware, for example, repair shops, utilized item sellers, web based business portal vendors gather a important parts of the disposed of materials for reuse and cannibalization of parts and components.^[7]

VI. STRATEGIES FOR E-WASTE MANAGEMENT:

One of the finest solutions for handling E-wastes is to decrease the amount. Electronic devices should be built for repair, reuse or enhanced while designing. Easily recoverable, recyclable and less toxic materials which can be used for disassembly, refurbishment, reuse and remanufacturing should be focused upon. The probable solution to end e-waste is recycling and reuse of material.^[8]

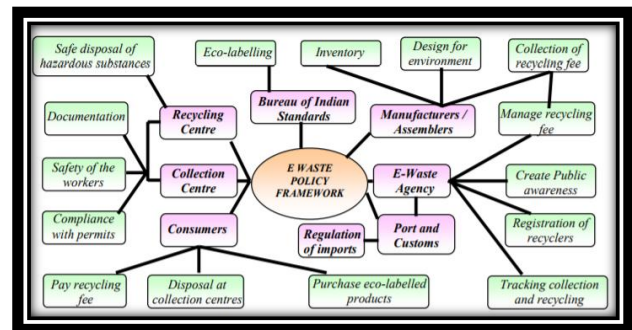


Figure (c) System for E-waste Management for Developing Countries^[9]

As shown in figure (c) the manufacturers, consumers, state agencies, government bodies and policy regulators has to understand the criticality of huge generation of E-waste affecting the global environment and certain measures should be taken so as to recycle the E-waste which can be the combination of certain integrated activities which can emphasize on e-waste-policy and national regulatory frame work where these government bodies can disseminate the proper usage of E-waste &

stress on how we can recycle the E-waste. With the consumer association some recycling systems have to be adopted which can plan out the strategies with the government bodies on how to handle E-waste^[10]. There is a need to educate the local vendors to stress on how to separate the E-waste in efficient manner. It is best for government to initiate E-waste policy development cooperatively to ensure effectiveness of E-waste management system.

In developed countries such as Australia, US forming an integrated e-waste recycling system are mandatory to prohibit informal e-waste recycling. Such recycling system must be adopted in the developing countries who lack in proper handling of E-waste may include this steps^[8].

The first step to set up and enhance the building of certain new scheme which integrates an extended producer responsibility and Advance Recycling Fee^[11]. The second step should be building an efficient E-waste assembling system, which can join informal curbside collectors and second-hand markets into it, and convert from informal E-waste recycling system into a formal E-waste recycling system with enhanced monetary support and technology enhancement. We can join curbside assembler into the official e-waste recycling system, with hostile e-waste generated into the informal recycling system, State-civic-business alliances: As mentioned above, there are multiple actors with diverse goals implicated in e-waste management in India. To devise and carry out a sustainable working model, there is a desideratum for across the board collaboration involving regime, NGO, informal sector, and formal recycling businesses. There is consequential evidence to suggest that immensely colossal scale transformation in subsisting consumption and engendering patterns would need collaborative efforts of actors with diverse objectives^[8].

VII. CONCLUSION:

It is actuality that the E-waste production is expanding quickly due to out of date quality of the electrical and electronic apparatus. People either sell the obsolete equipment to the local collectors for monetary benefits or store it in their home. There is no legislative binding framework for E-waste management, presently. E-waste collection, transportation, separation, disassembling, recycling and dumping are done manually by untrained labors in informal sector due to low awareness. With a view to bridge the digital divide, there is exponential growth in the use of electrical and electronic equipment and so there is an alarming effect on the environment as well as human health when the ICT wastes are not disposed properly. Therefore the awareness among the individuals about E-waste should be expanded and the standards ought to be appropriately actualized to control the ascent in E-waste in future. There is a urgent need to have an appropriate data framework through existing approaches, rules in accordance with the global guidelines and practices toward a sound E-waste management system.

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Application of SVD for Machine Anomaly Detection in IoT Environment

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Abstract— Internet of Things (IoT), a novel technology, promises to make our lives comfortable by imparting services by means of day-to-day objects. The physical objects present around us are connected to the internet and provisioned with capabilities of generating and sharing data, extracting information by assimilation of data and provisioning service through intelligent decision making, all, with minimum human intervention. Over the time, this technology has found a noteworthy usefulness in industrial sector, leveraging the profitability of pre-existing techniques in machinery maintenance such as asset management, fault diagnosis, detection of any malfunction, status monitoring and failure prediction. Owing to certain challenges faced by this new technology, we are unable use it to its full potential. One such challenge is that of the devices deployed for implementation of IoT being resource constrained. There arises a need to devise methods which would implement IoT effectively on constrained nodes and constrained networks. This paper discusses Singular Value Decomposition Technique as an approach to address the limitations imposed by constrained devices and constrained networks and lists advantages of using the same in machine anomaly detection in IoT environment.

Keywords— Constrained nodes; Constrained networks; Image Compression; Industries 4.0; Internet of Things (IoT); Low rank matrix; Machinery Maintenance; Predictive Maintenance; Singular Value Decomposition; Thermal Imagery

I. INTRODUCTION

Internet has become an indispensable part of our lives. The roots of internet have dug so deep into our daily lifestyle that our lives seem incomplete without it. Access of internet-in-hand (via ubiquitous devices such as smart phones, tablets, PCs etc.) encouraged social networking, by means of which the internet users were able to create social identities. Now the everyday objects are being made to connect to the internet, leading us towards a life changing technology called the “Internet of Things” (IoT).[1]-[3]

The advent of this technology has brought a shift of paradigm in terms of internet connectivity since the network connectivity is being extended to real world objects. The transformation of real-world objects into intelligent devices which are able to create, gather, exchange, analyze information[4][5] and act as per a set of pre-defined semantics,[6] has rendered this technology to offer a promising future[7][8].

It finds its applications in numerous domains such as aerospace, aviation, agriculture, automobile, environment monitoring, telecommunication, retail, logistics, industries, transport, manufacturing, remote monitoring, control of devices, infrastructure reliability, pharmaceuticals, smart homes, smart health care systems, product lifecycle, machinery management, traffic monitoring, structural health of buildings, waste management, disaster management etc.

Since this technology is still in its initial phase, it is faced with a lot of challenges such as lack of a standardized framework, effective integration of real world objects with

internet infrastructure, data privacy and security, effective communication between different kinds of nodes and so on[9].

One such challenge encountered by IoT is that not all devices implementing IoT are resource rich. The end devices such as sensors or low-cost processors, transmitters and receivers etc. have limited resources. These devices with limited memory and storage capabilities, limited computing and processing capabilities, limited power are known as constrained node[10]. Also, the network over which data transmission is taking place might have low bit rates, limited spectrum and limited bandwidth[10]. While designing any IoT based system, it is important to consider the limitations put forth by constrained devices and networks. This paper discusses Singular Value Decomposition (SVD) technique for addressing the issue of constrained nodes and constrained networks in IoT based systems

The outline of the paper is as follows: Section II gives overview of anomaly detection in machines and advantages of integrating it with IoT. Section III discusses the concept of Singular Value Decomposition Technique and advantages of using it in IoT based systems. Methodology used is discussed in section IV. This is followed by results. Conclusion of the paper is described in section V.

II. ANOMALY DETECTION IN MACHINES AND IOT

Detection of anomaly or irregularity in a machine's performance could indicate development of a fault. Such abnormalities in machines could be observed by continuously

or periodically monitoring the machine's condition. The technique through which a machine's status or condition is monitored for any deviation from its regular behavior is termed as machine health management[11]. Different methods such as infrared thermography[12], acoustic emission[13], vibration signature analysis[14]-[17], current signature analysis[18], ultrasonic testing[19] could be used to indicate a machine's status. The condition of the machine using aforementioned methods is compared to those of a healthy machine and the irregularities, if any, are analyzed for defects.

Advancement in MEMS technology has led to bulk production of semiconductor IC chips leading to reduction in cost and size of sensors, actuators and other system on chip devices. The availability of low cost sensors and actuators of different types for measurement of physical phenomenon such as vibration, temperature etc., their connectivity to internet and communication with each other has made it possible to integrate the machine health management techniques with IoT, provisioning numerous advantages such as early warning sign detection, real time alerts and notifications to the user, monitoring the status of machine from any place, monitoring the status of machinery located in far flung areas, timely detection of fault and hence increased lifecycle of machinery, scheduling of maintenance or repair at appropriate time and hence increased efficiency of the machine and so on.

III. SINGULAR VALUE DECOMPOSITION

Singular Value Decomposition is a matrix decomposition technique in which a high rank matrix is converted into a row rank matrix while preserving the essential features [21]. It is a factorization method in which a single matrix (S) is decomposed in product of three matrices, such that:

$$S = U\Sigma V^T$$

The matrix $S \in \mathbb{C}^{m \times n}$ is decomposed into the following matrices:

$$\begin{aligned} U &\in \mathbb{C}^{m \times m}, \\ \Sigma &\in \mathbb{C}^{m \times n}, \\ V^T &\in \mathbb{C}^{n \times n} \end{aligned}$$

$$\begin{pmatrix} S_{11} & S_{12} & \dots & S_{1n} \\ S_{12} & S_{22} & \dots & S_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ S_{1n} & S_{2n} & \dots & S_{mn} \end{pmatrix} = \begin{pmatrix} U_{11} & U_{12} & \dots & U_{1m} \\ U_{21} & U_{22} & \dots & U_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ U_{1m} & U_{2m} & \dots & U_{mm} \end{pmatrix} \begin{pmatrix} \sigma_{11} & 0 & \dots & 0 \\ 0 & \sigma_{21} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \sigma_{mn} \end{pmatrix} \begin{pmatrix} V_{11} & V_{21} & \dots & V_{n1} \\ V_{12} & V_{22} & \dots & V_{n2} \\ \vdots & \vdots & \ddots & \vdots \\ V_{1n} & V_{2n} & \dots & V_{nn} \end{pmatrix}$$

The matrix U and the matrix V are Unitary matrices, such that $U.U(\text{conjugate transpose}) = \text{Identity matrix of rank 'm} \times \text{'m'}$ and $V.V(\text{conjugate transpose}) = \text{Identity matrix of rank 'n} \times \text{'n'}$. These are both orthogonal matrices with orthonormal eigen values. The columns of U are called Left Singular Vectors and those of V are called Right Singular Vectors. Σ is a diagonal

matrix of rank 'm×n', containing non-negative diagonal entities arranged in decreasing order. These non-negative diagonal entries are called Singular Values.

The matrix S is approximated to a lower rank, r, to form a low rank matrix $\sim S$, such that:

$$\sim S = (\sim U)(\sim \Sigma)(\sim V^T)$$

This low rank approximate matrix is a product of three low rank matrices in which $\sim U$ matrix contains first r×m columns of U matrix; $\sim V^T$ matrix contains first n×r columns of V matrix; $\sim \Sigma$ matrix contains first r×r blocks of Σ matrix.

Eckart-Young [20], proposed a method to determine the value of suitable rank(r), to achieve a balanced trade-off between the memory space and information preserved. According to this paper, the optimal rank value for approximation matrix A is given as:

$$\underset{\sim S, \text{rank}(\sim S)=r}{\text{argmin}} \|S - (\sim S)\|_F = (\sim U)(\sim \Sigma)(\sim V^T)$$

In this equation, $\|S - (\sim S)\|_F$ indicates the Frobenius norm. Since $(\sim \Sigma)$ is diagonal, hence we can write the rank-r approximate matrix value as sum of r-unique rank-1 matrices[21]:

$$\sim A = \sum_{k=1}^r \sigma_k U_k V_k^T = \sigma_1 U_1 V_1^T + \sigma_2 U_2 V_2^T + \dots \dots \dots + \sigma_r U_r V_r^T$$

SVD provisions a systematic way to evaluate a lower dimension approximation to a higher dimensional data, while keeping the dominant patterns of the data intact.

Implementation of SVD in IoT based environment serves the following leverages for constrained nodes and networks:

1. Minimization of redundant information.
2. Solves issue of storage-memory constraint by saving space.
3. Lower amount of data needed for transmission of low size images, hence improvement in speed.
4. Lower power consumption during transfer of image due to reduced size, thus, increased lifetime of the node.
5. Low dimensional data, hence, reduction in processing power, thereby, saving energy.
6. Reduction in processing time, thereby, strengthening real time implementation.
7. Aids big data management and bulk data transfer.

IV. METHODOLOGY

SVD was applied to various thermal image of motor. The motor used for the experiment was a three-phased induction motor with wattage of 1.1 kW and speed of 2800 r.p.m. A healthy motor was taken and certain types of faults were deliberately introduced. The faults introduced were 10%, 30% and 50% fault in stator in single phase. The same experiment was repeated for faults in two phases and three phases

respectively. A thermal camera of resolution 384×288 was used to capture images of both healthy and faulty images.

SVD of original images were calculated using numpy library of python. Original images were split into their respective red, green and blue components and SVD was applied to these components resulting into matrices of size:

$$U=320 \times 320; \Sigma=320 \times 240; V=240 \times 240; V^T=240 \times 240$$

The resultant red, green and blue components were calculated at different rank values and then combined to obtain respective original images at different ranks. Final images were saved as bmp files. The experiment was conducted in Spyder IDE of Anaconda environment of python.

V. RESULTS

The experiment was performed on healthy as well as faulty motor. Following are the images for 50% fault in stator in one phase, for different values of rank r along with the amount of memory consumed by each of the image.

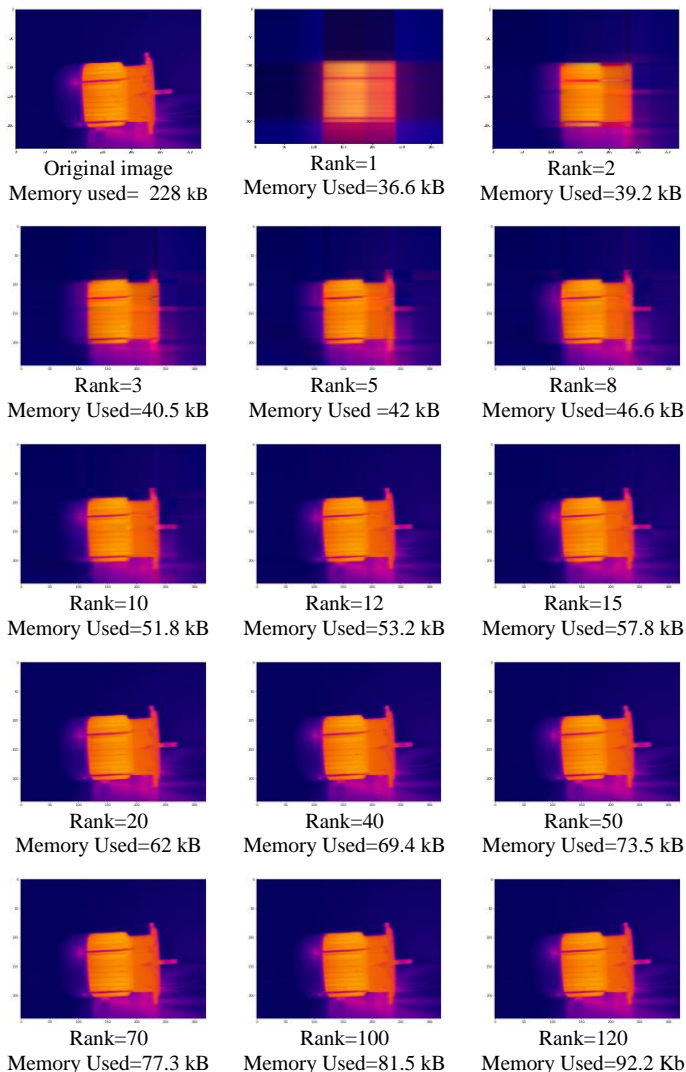


Fig. 1. Output obtained for 50% stator fault in one phase for different ranks and respective memory consumption

SVD provisions low-rank approximation of high dimension data by keeping the singular values till an optimal rank and discarding the rest. The following figure depicts a graph of the amount of information conveyed as a cumulative sum at various ranks.

'0' represents no information is preserved and 1 represents 100% information is preserved.

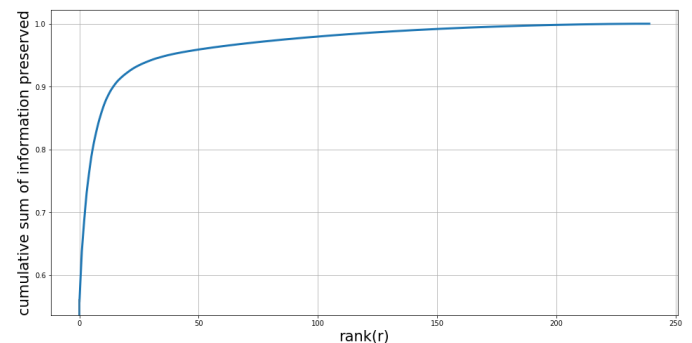


Fig. 2. Graph of rank vs information preserved

As evident from the graph, approximately 95% of information is preserved at rank=50. The amount of memory used at rank 50, as depicted in fig 1 is only 32.2% of original image resulting in reduction in memory utilization while preserving 95% of the information.

VI. CONCLUSION

This paper discusses the integration of machine anomaly detection technique with IoT along with application of SVD to it to address the limitations imposed by constrained nodes and constrained networks in IoT environment. IoT enhances the utility of machine anomaly detection and predictive maintenance, serving to be beneficial over conventional machine health monitoring systems. SVD provisions numerically stable matrix decomposition and is an effective technique for dimensionality reduction. It aids in saving storage space while preserving the desired information and hence serves useful for nodes and networks with limited storage, processing and bandwidth.

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Speech Recognition based Emotion-aware Health System

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Abstract— In the present pandemic scenario, healthcare industry is the prime focus of attention. As a result the research is now focussed on development of robust health monitoring systems. Recently, a marked rise in anxiety and depression has been reported within the general population. Depression is considered to be one of the most commonly found and severe mental health disorder which leads to high societal costs. However, its detection is not possible using conventional clinical methods. Studies have suggested speech analysis can be used as an efficient method for detection of emotional state of a person. This paper discusses the various speech features and classification methods which have been useful in speech emotion and depression analysis. Based on discussed methods, an automated architecture for health monitoring system is suggested. It integrates speech emotion analysis with systems for healthcare data collection using wearable devices with sensors, data transmission using high speed next generation network and cloud data storage. The analysis of the result is returned to the user or medical experts for rehabilitation advice or further treatment. The system is expected to improve the detection of psychological diseases and reduce the suicidal rates within the general population.

Keywords— Speech emotion recognition, health-care, clinical depression, classification methods

I. INTRODUCTION

Health-care is emerging as the most important research area in the present scenario. To improve the performance accuracy of medical experts, the focus nowadays has been on integrating intelligent systems with healthcare so that the can cater to individual needs of the patients. In this era of precision medicine [1], emotion detection could lead in early detection of critical illness. This would help in improving the success rate of disease prevention, detection as well as treatment within the general population. These intelligent systems involve large amount of medical data processing which require human-machine interaction environments [2], [3].

One of the prime health disorders the population is presently suffering from is anxiety, mood disorders and depression. It is a mental disturbance that leads to a state of negative thoughts, lack of energy, irritability, difficulty in concentrating in everyday tasks, guilt, and restlessness. It causes certain cognitive difficulties such as decrease of interest in daily activities. Depression in some cases may also lead to increase in physical ailments such as headaches, backache and stomach ache. The World Health Organisation (WHO) quantified depression as the second highest leading cause of disability in the global burden of disease ratings. The increase in clinical depression is directly linked to increase in number of deaths and suicide attempts. The only method to avoid this is early detection of depression tendencies. The most cost effective, remotely accessible and easy to monitor method would be processing speech signal of an individual.

Technological advancements in speech processing have largely revolved around applications related to content, i.e., what the user is saying and identification, i.e., who is speaking. However, an integral part of clinical interpretation is, how speech is communicated. The glottal analysis of speech of a person helps in determining their emotional

expression and its relation to the overall state of the speaker. The creation of a framework for performing real-time analysis of speech for detecting emotional states and assessing the quality of speech has been receiving considerable attention [4]-[6]. Objective classification of speech in terms of its affective content is a challenging task but would help in developing state-of-the-art health care technologies. A system named Pepper robot has been designed as a practical application of speech emotion recognition [7]. Although, it has not been used for any medical applications or clinical diagnostics.

There is a need of developing a system which integrates speech emotion recognition with the emerging communication technologies in order to come up with modern healthcare systems. Such systems may help in keeping the track of health of an individual by the medical expert or the any other user designated for the purpose. These systems may provide the benefit of real time and early diagnosis which can prove to be very effective in disorders like depression and may even lead to minimisation of risk of suicides [8]. The system described in this paper uses next generation network for transmission of data and cloud based system for data analysis and storage. The system can be monitored through mobile applications [9] by the users. For data collection, wearable devices with sensors are used which monitor user's body temperature, emotions through user speech, heart rate etc. The data is transmitted using high speed next generation network for data analysis and interpretation. This leads to correlation of other clinical parameters with emotional state of person and helps to diagnose degree of risk for a user to develop depression or other diseases. Hence, the suggested system can help in prevention, monitoring as well as treatment of various diseases in the users.

The paper presents a survey of various speech recognition techniques which can be used in healthcare systems. Further, a system for healthcare management has been suggested

integrating speech analysis with modern day technology. Section II contains a survey of various speech features and classification methods used in depression and emotion analysis. The overall architecture of healthcare management system is described in Section III. Section IV presents the conclusion and future scope.

II. SPEECH FEATURES AND CLASSIFICATION METHODS

The research in the field of speech processing suggests that analysis of speech can lead to the formation of objective analysis tools for the characterization of emotion and stress in the voice. The characteristics of speech signal are divided based on linguistics as well as segments as shown in Figure 1. On the basis of linguistic characteristics, speech features can be classified as linguistic, paralinguistic and non-linguistic. Linguistic features can be controlled by the speaker. They are present in words, syllables as well as phonemes. Paralinguistic features are the ones which are added deliberately to supplement the linguistic information. Non-linguistic features cannot be controlled by the speaker. These can be used to detect the age, gender, emotional state or health conditions of the speaker.

Speech features can also be classified as segmental and supra-segmental or prosodic features. Segmental features are local to a discrete segment of the speech signal. On the other hand supra-segmental features are distributed over several segments. These include features such as fundamental frequency, emotional characteristics, tempo, pauses and stress on a word.

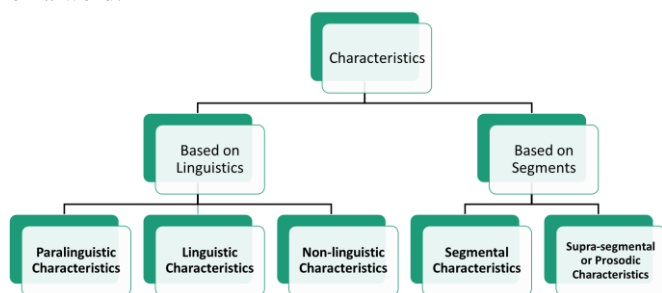


Fig.1. Speech Characterization

There are three primary categories of speech analysis including prosodics, vocal tract and glottal source. Prosodic measures are important in studies which are related to emotion and stress recognition. Depressed speech is also referred as monotonous speech which lacks in significant expression and can be interpreted using prosodic measures. An experiment was conducted in [10] using pitch and frequency for detection of emotions from speech in English and German which achieved an efficiency of 86.6%. Although prosodic features are capable in achieving maximum efficiency in speech emotion recognition. But their only drawback is that they are language specific and cannot be used universally. The work based on vocal tract analysis related to emotional and depressed speech have been studied in [9]. Glottal features are

mostly excluded from speech analysis mainly due to difficulty in their accurate extraction from speech signal in the absence of auxiliary devices such as electro-glottograph (EGG). However, when an individual is under emotional stress, there is an aberration in the amount of tension applied in closing, i.e., adduction as well as opening, i.e., abduction of vocal cords. This aberration can cause significant changes in volume-velocity air profile through the vocal cords as well as fluctuations in the fundamental frequency. Information in the movement of the vocal cords can only be measured through the evaluation of glottal waveform. [11] shows that glottal waveform plays important role in characterisation of emotional and depressed speech. Cepstral features have also been used effectively for emotional analysis of speech. Prosodic, glottal, cepstral and vocal track features come under physiological phenomenon. Whereas another feature which has been used is and Teager energy operator which comes under perceptual phenomenon. These features may also be classified based on linearity of airflow in speech production into linear and non-linear features.

The work related to use of speech processing in healthcare reflects that prosodic characteristics have proved to be most effective. Parameters including fundamental frequency, shimmer, jitter, formants, intensity, and speech rate have been studied. Other commonly used parameters were Mel Frequency Cepstral Coefficients (MFCCs) and power spectral density (PSD). Table I gives a summary of various useful features as well as classification methods used in speech emotion recognition.

Table I. Features and classifiers used in speech classification

| FEATURES | CLASSIFIERS |
|---|--|
| <ul style="list-style-type: none"> Fundamental frequency Formants Jitter Shimmer Pitch MFCC LPCC PSD ZCR Spectrogram TEO based features Spectral tilt Pause duration | <ul style="list-style-type: none"> HMM GMM SVM Fuzzy C-Means MLP HFS ANN DNN RNN CNN Hybrid classifiers |

Accurate detection of emotions from spontaneous speech would lead to development of an objective diagnostic tool to assist medical experts for better diagnoses. Many mathematical models are being used for efficient emotion classification. In [12], a method has been proposed to recognize stress level in speech using multi-dimensional HMM with average recognition accuracy of 94.41%. It discusses the use of N-dimensional HMM for recognition as well as classification of stress through speech. Other

mathematical models such as Gaussian Mixture Models (GMM), Support Vector Machines (SVM), harmonic plus noise model (HNM) [13], decision tree methods, Multilayer Perceptron neural networks (MLP) and Hierarchical Fuzzy Signature (HFS) classifier have also been explored for the purpose. They have used speech using microphones as well as galvanic skin signals response [14] using sensors to detect stress level. It was observed that SVM classifier gave the best results for classification of the features using both signals with an accuracy of about 92%. The accuracy of classification can be increased by using hybrid classifiers like a combination of GMM and SVM models.

Most of the present day applications require the systems to have self-learning capacity. This makes neural networks the most preferred choice for classification instead of mathematical models. Neural network models are efficient, have an adaptive mechanism, the ability to generalize and are much faster due to a parallel computational structure. In recent years, Artificial Neural Networks (ANN), Deep Neural Networks (DNN) [15], Recurrent Neural Networks (RNN) [16], Convolutional Neural Networks (CNN) [17] have shown good performance in extraction of discriminative features for emotion recognition. Compared with other hand-crafted features, different types of neural networks are capable of extracting hierarchical feature representations for any specific task such as emotion recognition given a large amount of

training data by the use of supervised learning. Hence, neural networks have proved to be the best classifiers for emotion recognition from speech signal.

III. HEALTHCARE SYSTEM ARCHITECTURE

The modern health system which could be used for healthcare monitoring is shown in Figure 2. It consists of a data collection system having various sensing equipment which could be either in the form of gadgets worn by the user or sensors embedded in the everyday objects in their surroundings. This may include biosensors, motion sensors, temperature sensor, microphone, smart phone, smart watch or smart clothes. All these would help in monitoring the biomedical parameters like temperature, blood pressure, ECG and other vital parameters. Along with the biomedical parameters, speech data is also collected for emotional state analysis. The data collected is transmitted using high speed next generation network and stored in data centre. The data is processed and analysed over time to find health state of user. The result of the processing can be accessed by the user or their family through a mobile application to monitor their parameters. The data could also be relayed to a designated health expert to give personalised treatment or suggestion for the healthcare improvement of the user.

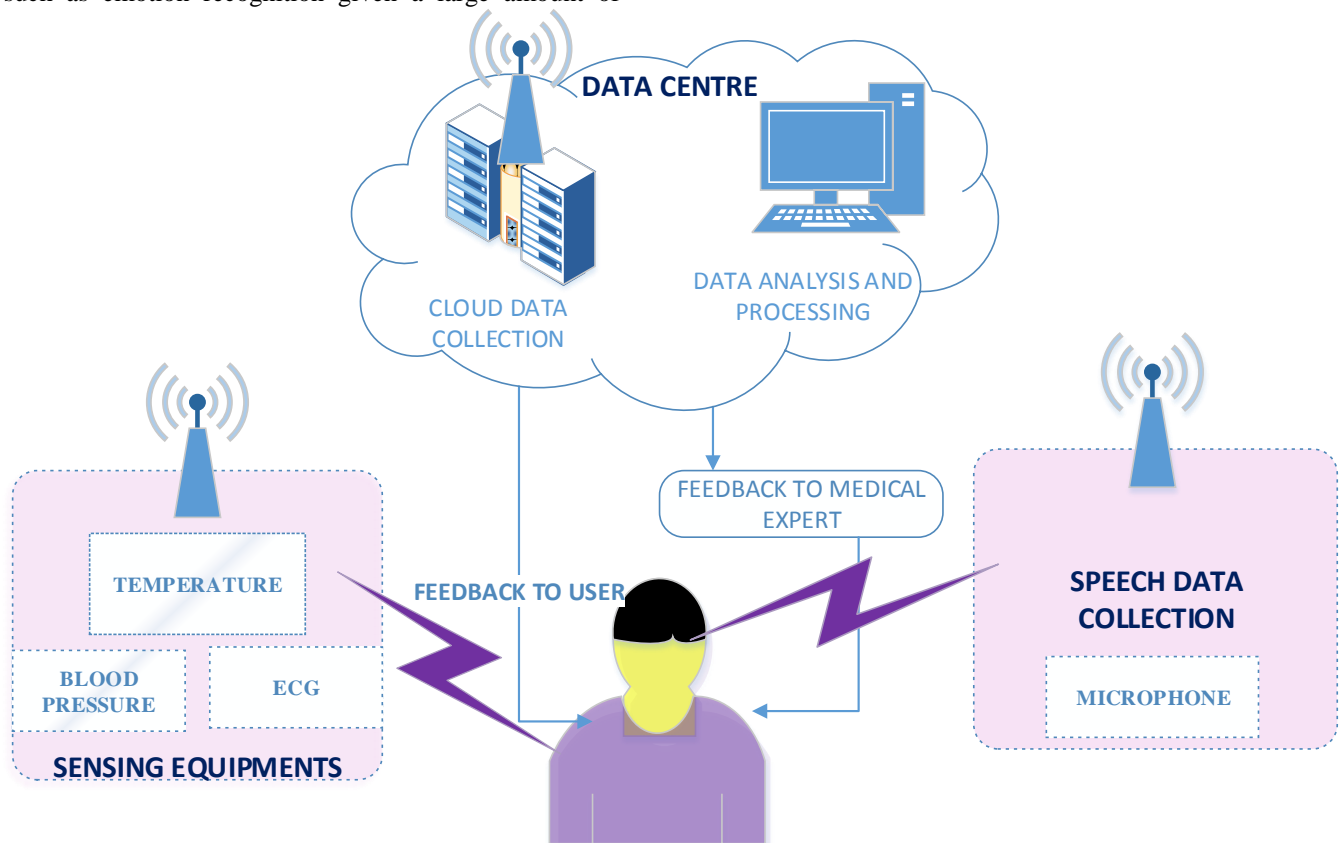


Fig.2. Emotion-aware healthcare monitoring system

The emotional states such as sadness, happiness, and anger are the most important as most vital changes in biomedical

parameters are caused by subtle changes in emotional state of user over time. This system could be very useful in predicting

psychological disorders like depression if all the changes in emotions are accumulated and studied over a specific duration of time. This could in future also help in developing a correlation between various chronic disorders and emotional state of the users. It may also be able to predict the pattern of occurrence of some disorders and hence act as a preventive measure. Certain disorders like depression cannot be diagnosed by biomedical methods. But such systems may help in their early diagnosis and hence provide timely treatment.

IV. CONCLUSION

In this paper a survey on various methods for emotion detection through speech has been conducted. The various speech features used for emotion detection have been discussed. Further, the classification methods used in emotion recognition have also been discussed. The paper also suggests the application of these methods in building a modern health-care system to cater to the present needs to the society. Integration of health care system with technology will provide early and cost effective diagnosis of psychological disorders like depression. This system could be further developed to find the correlation between various disorders and emotional state of the users.

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Wearable Technology

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Abstract— Wearable Technology is a collection of electronic technology developed into devices that are to be worn onto the body. These devices are used for tracking information based on the vital signals of the body like Pulse rate, Hypertension, Steps Taken, etc. These devices have motion sensors that measure the wellbeing and monitor your day-to-day activities. Devices like “Wearable Motherboards” or “Smart Shirt” are used for the patients.[1]

Keywords— *Wearable technology, smart watch, fitness tracker .*

I. INTRODUCTION

Wearable Technology is smart electronic equipment that is attired close to or on the exterior of the skin, where they check the information concerning body movements such as pulse rate. Wearable Technology has different applications that grow as technology grows. Aside from fiscal uses, wearable technology is used in navigation systems, healthcare, military, fashion, etc. Wearable Technology is mostly used to monitor a user's health including Pulse Rate, Strain, Calories burned, steps walked.[6]

II. HISTORY

Wearable Technology has developed a lot during the years starting with watches worn by people to tell time. “Peter Henlein”, a German Inventor created small watches in the year 1500. In the late 1600s, watches were worn as bracelets by women. The first wearable technology device was the “Calculator Watch” in the 1980s. Smartwatches began to be released in bulk by major electronic companies with the advancement over the years. “Samsung Galaxy Gear” in 2013 and “Apple Watch” in 2015 were the very first wearable devices.[2]

III. TYPES

Wearable devices can be classified by various factors. A few of them are documented below:

A. SMARTWATCHES

Smart watches are computerized devices or small computers designed to be worn on your wrist with advanced communication functionalities. Most smart watches are mobile-based models. Some also offer an additional screen to inform about the new notifications such as messages received, calling, etc. More features including waterproof frames, GPS, and fitness and health tracking capabilities are also added.[3]

B. FITNESS TRACKER

Fitness trackers are commonly used on the wrist, chest, and ear and are designed to monitor and track the outdoor activities and measure metrics such as running speed, running distance, pulsation, and sleeping patterns. Some trackers also examined and control their precision and reliability during counting.

C. SMART CLOTHING

Other types of wearables include a broad-spectrum of wearables starting from sportswear to chest straps, medical clothing, etc. Another product called “Intelligent clothes” includes a variety of items like t-shirts, socks, yoga pants, shoes, secret cameras bow ties, helmets, and caps with sensors and different features[5]

D. WEARABLE MEDICAL DEVICE

A wearable medical device usually comprises of surplus sensors to monitor data for disease prevention and early diagnosis. With the advancement in wearable technology and demand from customers has made the medical industry to produce healthcare devices such as Fitbits, wearable monitors, etc.[6]

E. SMART JEWELLERY:

With the invention of smart jewellery, it has been also helpful in researching how to include health tracking properties in small wearable's. The most leading kind of smart jewelry might be the smart ring. Exemplified by brands such as Oura, smart rings are worn on the finger-like standard rings, all the while obtaining health-tracking data that the user can later review on a Smartphone.[3]

IV. RECENT DEVELOPMENTS IN WEARABLE TECHNOLOGY

Here are some recent developments of wearable technologies:

A. HEALTH APPS WITH HEALTH MONITORING

With the increasing improvement in technology, the demand for health tracking applications has been increased. The range of remote health-monitoring allows better communication between the patients and the doctor. Wearable sensors can track medical history and information from the patient and send them to the respective doctors instantly. Nowadays, healthcare applications make it easier to view the patient's history, alter prescriptions, and receive a notification to take the medicine.[4]

B. WEABLES FOR OLD AGE AND DIFFERENTLY ABLED PEOPLE

With the huge growth in the old- age population, there has also been an enlarged demand for medical management, and wearable devices have the future to old adults and those with disorders in many ways.[2]

V. FUTURE ASPECTS OF WEARABLE TECHNOLOGY

Since nobody knows exactly what the new applications of wearable's and neurotech are going to be, people have plenty of ideas. Here are some of the applications:

A. MIND READING SMART GLASSES

Julia Brown, the CEO of MindX, said that her company plans to produce glasses that let you "access information with a single thought." She said that the company is using its technology licensed from the Johns Hopkins Applied Physical Lab to pick up signals from eye movement and from brain waves to know where you are looking and what you are thinking when you look there.[5]

B. SWEAT SENSING GLASSES

The director of the Centre for Wearable Sensors at the University of California, Joseph Wang said that for health-centric wearable's it is important to monitor chemical changes in the body, and not just activity levels and vital signs. Also, the applications developed by his team included chemical -sensing smart glasses.[4]

C. THE MIND CAR CONNECTION

A helmet with sensors that detects changes in brainwaves could be an invention. With the information obtained from the brain, it can connect drivers' minds with their cars. [4]

D. CARDIAC CONTROL TO PREVENT ARRHYTHMIA:

Arrhythmia is a disease that can have serious consequences, most of which are avoidable. To deal with these kinds of problems, a garment containing electrodes has been developed. It is less intrusive for patients and requires neither wires nor adhesives. [3]

E. LOCATING THE ELDERLY:

Elderly people in the early stages of Alzheimer's disease are at risk of becoming lost. To avoid these kinds of situations, a locating device has been developed with an SOS button to use to prevent an accident. [1]

VI. CONCLUSION

In conclusion, I would say that with the advancement in technology every field starting from education till healthcare, needs to have wearable technology.

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Eye Based Feature Detection using Object Identification Models

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Abstract— Identification of eye features is playing an important role in many areas like Biometric Purposes, Detection of Driver Drowsiness, Medical Imaging, etc. In this research, we extract eye features such as iris, pupil, corners, and regions exactly within different intensity levels of eye images, mostly with localization of determining interest objects and where the human is looking for. Nowadays everything is becoming virtual, hence this concept has a huge scope in e-learning, class room training, and analyzing human behavior. In this paper, we compare various object identification models for human eye based feature detection using facial features. We identify eye features such as iris, pupil, corners, and regions from the facial database by using parameters like shape, color, region, contrast, and texture. From the results we conclude that HOG is a robust eye identifier under variable lighting conditions and under various presence and absence of surrounding objects.

Keywords— Object identification; feature detection, HOG, illumination, texture, region, color.

I. INTRODUCTION

The expansion of technology made the researchers acknowledge the problems of designing computer Tvision as a medium of interacting & interfacing with computing systems. The challenge is to recognize from a few instances to an entire category of objects. Object identification is an essential part of the computer vision system that studies and analysis the various characteristics of the digital image. It is the process of detecting a specific object in a digital image or video [1]. The objective is to detect and allocate the object using techniques such as template matching, color processing, feature detection, and shape detection, learning (supervised, unsupervised, semi-supervised), and classification algorithms (SVM [2], K-means,[3], DBN, CNN [4]).

Feature detection is the process of determining the abstraction of the image information and making a local decision at every image point to see if there is an image feature of the given type existing at that point. Object identification using feature- based detection has been an important research issue in machine vision and robotics, and their applications continue to grow in various fields. An ideal feature detection technique should be robust to illumination, noise, occultation, rotation, scale, etc. Furthermore, a perfect feature detection model must be highly distinctive, such that a single feature to be correctly matched with high probability. For recognizing objects it is vital to determine the features. The diverse object types should be defined and unambiguous [5].

Eye based models require efficient identification of different periocular objects. Periocular objects consist of features surrounding or within the eye orbit. The eye based object model requires identification of features like iris, pupil, eye contour, or eye corners to enhance the accuracy of the model. The identification algorithms are divided as an appearance- based 3D model-based, and feature-based [6], [7]. These include artificial neural network Haar features, Histogram of gradients (HOG) [8], edge detectors using gradient operators [9], Speed up Robust Feature (SURF), SIFT [10], local binary pattern (LBP) have been used for eye-based modeling. An eye identification model has been shown in fig. 1.

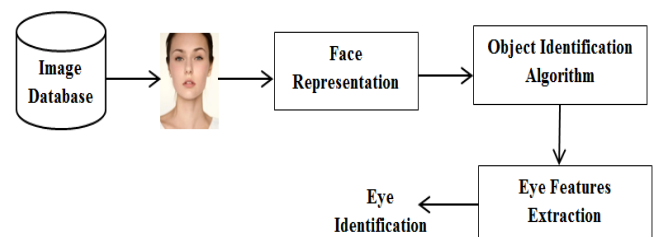


Fig. 1 Principle of an eye identification system

A facial image is selected and its facial features are determined and facial parameters are represented, followed by application of an object identification algorithm that uniquely classifies the various eye components and identifies the human eye using eye features like eye regions, the centre of iris, corners, etc.

In this paper, different features of the eye are identified using various models like HOG, SURF, Harris corner detector [11], Viola Jones, and LBP. Each of these models defines unique features of eye e.g., eye corners are recognized by Harris corner detector; Viola Jones [12] is used to find out the complete squared eye region by using Haar-cascade, the centroid of the eye can be detected using HOG. Geometrical circular shape blob identification is done by SURF. Textural and shape-based parametric eye detection is done using LBP [13] technique. These models are implemented on a facial database comprising 20 images for estimation of accuracy and efficiency of output.

The remaining parts of this paper are structured as follows: Section 2 briefly review of literature is put forth which includes various object identification models. Section 3 presents the research methodology employed. In section 4 the experimental results of the object identification system are discussed. Section 5 presents the conclusion of the findings.

II. LITERATURE REVIEW

F. A. Pourghahestani [5] conducted a study on implementing artificial neural network and improved binary gravitational search algorithm (IBGSA) for object identification. Watershed algorithm was used to segment images and extract the objects. Color, texture, and geometric features were extracted from each object followed by IBGSA for feature selection to find the best subset of features for classifying the desired objects.

Zhiming Qian et al. [14] proposed a novel eye detection method, which can locate the accurate positions of the eyes from frontal face images. Image enhancement, Gabor transformation, and cluster analysis were used to extract eye windows. It then localized the pupil centers by applying two neighborhood operators within the eye windows. The experimental results demonstrated the consistent robustness and efficiency of the proposed method.

M. Hassaballah et al. [15] presented a method based on two facts: eye regions exhibit unpredictable local intensity, therefore entropy in eye regions is high and the center of the eye (iris) is a too dark circle (low intensity) compared to the neighboring regions. For the detection of the eye center coordinates a score based on the entropy of the eye and darkness of iris is used. Lin et al. [16] developed a real-time system for eye detection and tracking in video sequences. The color-based approach is first used to extract similar skin color regions. This approach can filter out the background very quickly and effectively. An FCF (Face Circle Fitting) method using an adaptive circle to include the exacted region of the face is proposed. After the face is detected, a DPF (Dark Pixel Filter) method to detect the eye candidates is used. DPF is used to treat the eye as a small dark area Based

on the geometric features of these dark pixels; the eye positions can be extracted.

Monzo et al. [17] have presented a novel algorithm for eye detection. Adaboost algorithm is used to shortlist possible eye location regions followed by SVM using the HOG descriptor to select the best pair of eyes from the selected combinations. Ramezanpour et al. [18] have extracted facial region from the image by skin color information. Eye region is approximated by horizontal projection. The eye center is located by the Harris corner detector with a reported accuracy of 94%. Timm et al. [19] have proposed an approach for eye center detection using image gradients. The method is reported as being invariant to scale, pose, illumination, and contrast variations. The method is tested on the BioID database. Similarly Khan et al. [20] proposed a method for pupil and iris localization using eccentricity and gradient information around the eye region

Song et al. [21] proposed a 3 step eye detection method that extracts binary edge images from grayscale facial images, followed by eye region segmentation. Eye region localization is based on light dots and intensity information. An efficient eye detection method is explained by Chen et al. [22]. Discriminatory Haar features are extracted for eye detection and support vector machine is implemented to improve the accuracy of feature extractor.

Based on the understanding of the literature review one can summarize that for efficient detection of eyes, the appearance of an eye within the facial structure and different features associated with eyes can be taken advantage of. Various object detection algorithms are used for the identification of periocular objects. In section III we will discuss the methodology associated with the proposed techniques.

III METHODOLOGY

The framework of the proposed comparative analysis system is shown in fig. 2. Initially, the image database is created representing sharp facial features. Images are selected iteratively from the database and are processed. The first step is pre-processing which involves image enhancement through color image processing followed by the filtering process. The color image processing enables us to view the image appropriately in various coloring models like NTSC, Gray scale, HIS, etc. that are relevant to the system. Afterward image filtering is done that removes noisy elements from the image e.g. Gaussian noise, Impulsive noise, etc. Image scaling, cropping, and contrast adaptation are some of the techniques that are also used during pre-processing.

After preprocessing, when an image is presented to the system, to locate the rough face region face detection will be performed. The next step is the identification of parameters that divides the face region into non-facial

and facial regions. The subsequent stage is to determine the eye features e.g. the two regions of eyes in the face, centers of iris, etc. Based on the identified features, the eye is detected based on different criteria like eye corners, regions, centroid, blob, texture, and shapes, the desirable models are applied and are compared with each other. The Harris detector is based on eye corner detection; Viola-Jones is used to find out the complete eye region, the centroid of the eye can be detected using HOG, eye blob detection using SURF, and finally, texture and shape based detection is done by LBP.

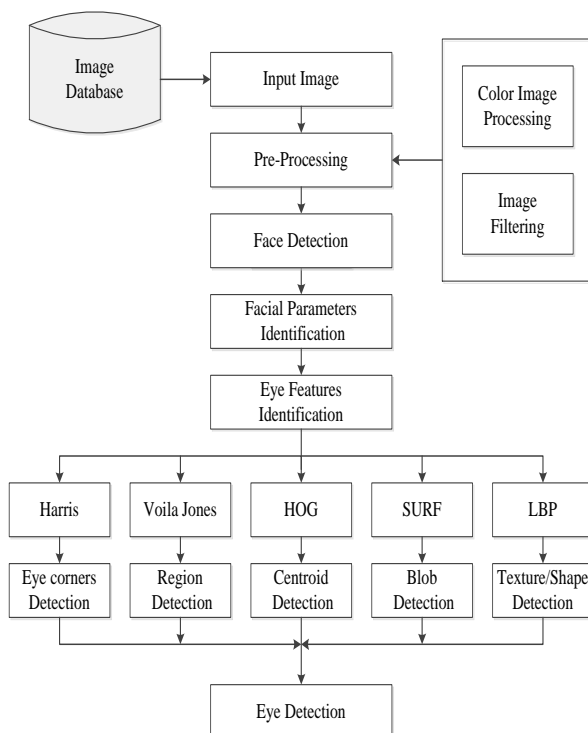


Fig. 2 Framework of the proposed system

Harris

Harris corner detector is a feature detection model that identifies differential values of structural variations in an object. The detector identifies junction of edges or sudden variations in an image for the identification of corners. The eye region is demarked by edges that separate eye contours from the inner area of eyes. The corneal area of the eye is also differentiated into different regions each with different edge strength; therefore corner detectors can be used for efficient detection of periocular objects.

Voila Jones

Voila Jones is another appearance-based object detection model that is based on a training system with templates of eye images of different poses and orientations, with different occlusion and illumination conditions. Viola – Jones technique is accurate and rapid for face detection. This technique is used to detect face and eyes in images

accurately. But, this requires analyzing the entire image to find the location with the highest probability of containing the feature. Once the system is trained, the images are tested for the accuracy of the system. The algorithm works by Haar feature selection followed by integral image training and classification. The Haar feature selection requires summing up pixels within rectangular areas. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the pixel groups are used to determine relative light and dark areas. Eyes being darker in comparison to the skin on the periphery of the eye region, makes it a dark-bright rectangular region, which is the first input to appearance-based algorithm. By increasing or decreasing the size of the pixel group being examined Haar features can easily be scaled.. This allows features to be used to detect objects of various sizes.

HOG

HOG is based on calculating gradient orientations in an image. The gradient of an image suggests a change in intensity levels of the image along with vertical and horizontal directions in terms of magnitude and orientations. Orientation differs from magnitude as it can be taken as the angle directed from the dark to the brighter part of the image. Since the eye region as a whole appears darker than the rest part of the face. Features like pupil and iris also differ in terms of intensity. The variations in intensity around and within the eye region make HOG one of the algorithms for efficient feature detector for gaze-based models.

SURF

SURF approximates the Difference of Gaussian (DoG) with box filters. Squares are used for approximation since the convolution with the square is far faster if the integral image is employed, instead of Gaussian averaging the image. Also, this will be wiped out parallel for various scales. The SURF uses a BLOB detector which is predicated on the Hessian matrix to seek out the points of interest. For orientation assignment, it uses wavelet responses in both horizontal and vertical directions by applying adequate Gaussian weights. SURF uses the wavelet responses for feature description also. To urge the SURF feature descriptor a neighborhood round the key point is chosen and divided into sub-regions then for every sub-region, the wavelet responses are taken and represented. The sign of Laplacian which is already computed in the detection is used for underlying interest points. The sign of the Laplacian distinguishes bright blobs on dark backgrounds from the reverse case. In case of matching the features are compared only if they have some type of contrast (based on the sign) which allows faster matching.

LBP

LBP describes the texture and shape of a digital image. This is done by dividing a picture into several small regions from which the features are extracted. These features contain binary patterns that describe the environment of pixels within the regions. The obtained features from the regions are concatenated into one feature histogram, which forms a representation of the image. Images can then be compared by measuring the similarity (distance) between their histograms.

The features identified by the following techniques are defined to determine the eye structure that detects the eye. The entire system works iteratively for all 20 images in the database. The results generated by the following techniques are then analyzed and compared to determine which technique is more appropriate in determining the features of the eye.

IV RESULTS AND DISCUSSION

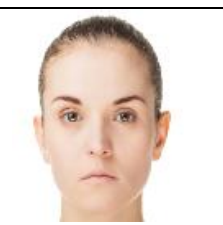

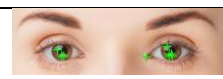








Experiments of human eye detection using facial images taken under certain constraints are shown in fig. 3. The proposed method is implemented in MATLAB R2017b, and all the experiments are conducted on a PC running Windows 10 with Intel Core i5 processor and 6 GB RAM.



Fig. 3 Facial database

The various models are applied on the following facial image database consisting of 20 images. Table I shows the output generated by Harris, LBP, SURF, HOG, and Viola Jones respectively. The output of three images is shown in the table where the images differ in terms of parameters like illumination, presence/absence of object, etc. Image I1 is a normal facial image with sharp facial features, image I2 includes surrounding object near the eyes i.e. spectacles and image I3 is exposed to highlighted illumination in the inner corners of the eyes. Various facial parameters like shape, texture, color, etc. are considered by the respective

model and identify the desired eye features and compare with each other.

| | |
|-------------------------|---|
| Input Image (I1) |  |
| Algorithms | Output |
| Harris |  |
| LBP |  |
| SURF |  |
| HOG |  |
| Viola Jones |  |
| Input Image (I2) |  |
| Algorithms | Output |
| Harris |  |
| LBP |  |
| SURF |  |
| HOG |  |
| Viola Jones | No output |






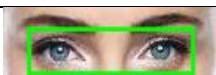
| | |
|-------------------------|--|
| Input Image (I3) |  |
| Algorithms | Output |
| Harris |  |
| LBP |  |
| SURF |  |
| HOG |  |
| Voila Jones |  |

Table I. Implementation of Harris, LBP, SURF, HOG, and Voila Jones techniques in different images.

The experimental results shows that the HOG technique is more accurate in identifying the iris and pupil. LBP technique also performed well but in the presence of surrounding objects such as eye glasses the efficiency decreases. Amongst Harris and SURF technique, Harris is slightly more precise since it identifies only the eye region; on the other hand, the SURF algorithm is affected sharply with the presence and absence of surrounding objects, the output also covers the adjoining regions near the eye. Whereas, Voila Jones technique gives the complete region near the eye and is efficient for image I1 and I2 but doesn't work in presence of other objects near the eye e.g. spectacles as shown in image I3. The vulnerability of the techniques to various environmental conditions such as lightening, presence, and absence of surrounding objects, shapes are all represented in the above- mentioned table.

CONCLUSION

This paper brings together various eye-based feature detection using object identification techniques. Various shape, region, texture, illumination, geometric parameters are applied to identify the feature sets of the eye components in the image. We have used Viola's conception, and with rectangle Haar features to construct a cascade classifier for rough eye detection. Texture based eye detection defined by the LBP technique

outperforms Harris corner detector but is still susceptible to surrounding objects. Geometric features such as circular shape determine the whole eye regions using SURF but are highly prone to environmental conditions such as lightning. HOG is a robust eye identifier under variable lighting conditions and less sensitive to presence surrounding objects as presented by the experimental work. The results and analysis of this research work shall be helpful for developing optimized object identification models for different applications like motion detection, occultation, feature-based identification, and detection, etc.

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A Review on the Image Processing Technique for Detection of Plant Diseases

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Abstract— The investigations of plant quality suggest the apparently noticeable instances of a specific plant. These days crops face various problems. Harm of the bug is one of the critical sicknesses. Bug showers are not commonly illustrated productive on the grounds that bug sprays might be poisonous to flying creatures. It additionally harms common creatures' evolved ways of life. A typical practice for plant researchers is to gauge the harm of plants in light of malady by an eye on a scale dependent on level of influenced territory. This paper gives propels in different techniques to consider herb characteristics utilizing picture handling. The strategies read are for expanding throughput and diminishing abstraction emerging from human specialists in distinguishing the plant maladies.

Keywords— Plant segmentation; feature extraction; leaf disease; classification.

I. INTRODUCTION

The study of diseases in plants refers to the studies of visually noticeable patterns of a specific plant. There are many diseases faced by crops these days. Damage caused by an insect is one of the prime diseases. Insecticides are not considered efficient because they are poisonous compound and may adversely affect many organisms. It also affects natural food chain of animals. A plant scientist estimates the damage of leaf, stem etc. Horticulture assumes a pivotal part in the financial development of a nation as it is one of the primary methods for resource. As of late, innovative techniques have been intended for the distinguishing proof of plants and recognition of their illnesses so as to address the new difficulties confronting ranchers and their adapting needs. This part gives a diagram of different strategies and procedures for include extraction, division and the characterization of examples for leaves so as to distinguish plant leaf ailments and the assessment of their seriousness. This part investigates different programmed evaluating frameworks and a boundary utilized in assessing the seriousness of various plant illnesses and examines an assortment of those plant maladies. The section too talks about the utilization of an outspread premise work (RBF) portion based on support vector machine (SVM) learning calculation for the discovery of infections, which incorporate mud fine and fleece mold.

Investigation is made for the variables that pressure plants; for instance, water, irritations and soil in nursery plants for detection of diseases. Leaf impact, earthy colored pigmentation and sheath decay identified in rice plants are talked about utilizing a bunch approval calculation. This section likewise manages the appraisal of seriousness of foliar infections found in soybean plants (utilizing division), rice impact ailment (utilizing a SVM) single sickness seriousness level of plasmopara viticola in grape leaves (utilizing a k-implies bunching calculation). Current holes in the innovation for accuracy horticulture are examined, and the necessities are introduced. The entire catalyst of this part is to propel specialists to center and create effective AI and arrangement strategies for leaf and its shape to address the new difficulties in the field of agribusiness.

As our India is a country; wherein about 70% of the general population depends upon agribusiness. Ranchers have a wide extent of arranged assortment to pick suitable fruit and vegetable harvests. In any case, the advancement of these harvests for ideal yield is significantly particular. It will in general be improved by the guide of mechanical assistance. The organization of suffering characteristic item crops requires close perception especially for the organization of ailments that can impact creation out and appropriately the post-accumulate life. The image getting ready can be used in cultivating applications for following purposes:

- *To identify sick leaf, stem, organic product
- * To measure the influence of a region by ailment.
- *To discover a state of influenced territory.
- *To decide shade of influenced territory
- *To decide the size and state of organic products etc.

II. LITERATURE REVIEW

a) EXTRINSIC FACTORS: [Image Background]

In Extrinsic factors, Leaf division is very initial step of most of the image based apparatuses for leaf investigation . Basically, in the event the board is put beyond the leaf, this assignment can ordinarily each of the frame naturally absent a lot of issues. In contrast on the other side, if the foundation includes plants, leaf, mud and other components, the division might be a test as appeared in Fig.1.



Fig.1: Example of busy Background

b) INTRINSIC FACTORS:

As we observed previously, many of the indications don't have well characterized edges. Rather, they steadily blur into sound tissue (Fig. 2). Thus, there is no unambiguous division. In the event that manual, visual depiction can't plainly decide the limits. It may influence precision of entrance and other favorable procedures, regardless of whether a versatile plan is embraced. The issue of emotionally bounded sick zones was introduced by Olmstead et al. (2001), and Moya et al. (2005), who expressed that an outside standard or reference ought to be made so as to appropriately approve strategies for infection discovery and distinguishing proof. The table 1 below defines the methodologies used in the literature.

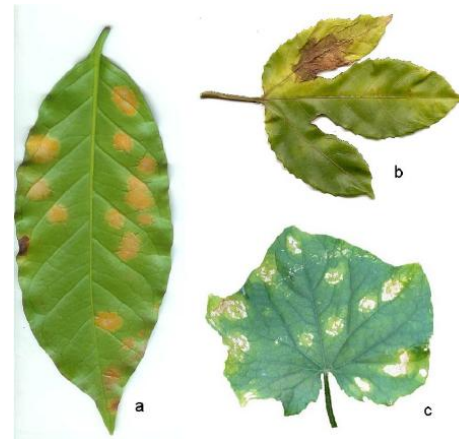


Fig.2 : Example of Symptoms without any clear edges.

III CHALLENGES

There are some different difficulties that influence programmed illness recognizable proof that can't be organized. The absolute initially is steady action. Notwithstanding the way that time restrictions, only two or three uses truly require veritable time action. Since the computational powers are available for creating consistent requirements. Regardless, the objective of the photos similarly extends for mentioning more computational resources. Moreover, helpful devices and negligible exertion PCs are also available. Many are dependent upon the normal application, diminishing computational intricacy and memory necessities which might be a significant concern.

| S.NO | Title | Objective | Technique Used(features) | Result(methods of classification) |
|------|--|---|--|--|
| 1. | Automatic Leaf Probing through Segmentation of Range Data Into Surfaces Patches. | To measure chlorophyll content in leaf. | Chlorophyll pigment , Infrared intensity reflected. | Chlorophyll content in each leaf through Graph based clustering. |
| 2. | Finely-grained annotated datasets for image-based plant phenotyping. | Leaf division, leaf following, leaf checking and limit assessment of various plants. | Leaf Area,leaf count, shape of leaf boundary. | SVM(Support vector machine). |
| 3. | Segmentation Method for Automatic Leaf Disease Detection. | Identify maladies in plant leaf through division. | Some spots may be in yellow color spots or in different color | Region based segmentation methods |
| 4. | High-Throughput Stress Phenotyping in Plants. | To Detect various stress and disease using machine learning. | Sugar beet, bacterial soft rot etc. | SOM(self Organizing map), Bayesian Classifier. |
| 5. | Diverse Temporal Response to Availability of water in Setaria. | To compute the Reactions of Setaria plant during water availability in a phenotyping structure. | Blue outline, Growth of plant, Response to water availability. | Scaling factor, stature of plant, biomass aggregation. |
| 6. | Segmentation of leaf in plant phenotyping | Compare several leaf segmentation methods. | Multi leaf alignment, overlapping. | Clustering based, k-means, Otsu method(Accuracy of method). |

Table 1: Methodologies for plant segmentation

IV CONCLUSION

Involved establishments, nonappearance of clear edges around reactions, afflictions making changing symptoms, signs conveyed by different issues showing simultaneously that notwithstanding everything accept a noteworthy activity .Altogether influence the amplexness of the image examination procedures proposed up to this point. The use of automated picture taking care of and PC vision in herb assurance is still new that suggests there are now various decisions to be explored with the likelihood to restrict in any event a bit of the issues raised in this. Finally, the types of progress in

imaging surmise that photos with unmatched quality would now have the option to be at low costs, and new advancement will totally be made. In this way, progressed pictures will be a more solid delineation of the scene they portray, which will unavoidably allow the headway of more exact and notable picture assessment.

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Analysis of Object Detection Techniques YOLO V3 and Mask R CNN in Traffic Videos

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Abstract—Object detection and tracking is one the important and popular concept used in computer vision. Object detection is a significant concept in image processing and deals with detection of objects in images and real-time videos. Recent years showed great attention to object detection in research field as it helps in analysis of videos and understanding of images. Neural networks gave object detection new platform in terms of efficiency and accuracy by shifting from traditional to deep learning techniques. Also, object detection is used in various fields such as pedestrian detection, autonomous driving, video surveillance, medical imaging, face detection etc. In this paper YOLO v3 and Mask RCNN are used for detecting objects especially in traffic videos which can be helpful in traffic monitoring. The paper defines how Mask RCNN and YOLO v3 work with their architecture and also shows the advantages and disadvantages of these methods. We collected real time dataset of traffic videos in different parts of city and then applied Mask RCNN and YOLO v3 to compare the results.

Keywords—Convolutional neural network(CNN) ; Computer Vision ; Deep learning ; Image Processing ; Machine learning ; Object detection ; Traffic monitoring.

I. INTRODUCTION

Object detection is a computer vision approach that permits us to recognize and locate items in an image or a video. Using object detection techniques we can classify the objects in the digital image or video i.e we can detect the class of the object to which it belongs like car, human, structures, materials etc. [1]. Object detection can be used to calculate object numbers in a location and demarcate and track their exact locations, all while accurately tagging them. In simple words the task of object detection can be summarized as to find the objects with bounding box (boxes which contain the object) and classes or categories of the located objects in an image or a video. Traffic control and surveillance [2] is essential now a days as the number of vehicles are increasing but the roads are same and this results in congestion in traffic. By the use of high power resources and surveillance cameras the task of vehicle tracking and detection has gained a lot of attention in the research field so that our cities become a safer place to live in [3] [4].

For the object detection various deep learning techniques are used like CNN, models based on Region proposal and models based on regression/classification. In deep learning CNN is the most desirable and typical model [5]. Tasks of image driven pattern recognition is solved by CNN even though they have simple and precise architecture. CNN has outstanding performance in deep learning problems especially applications that deal with large image classification dataset-ImageNet [6], natural language processing (NLP) and computer vision. It is composed of neurons and these neurons self-optimize via learning [7]. Region based CNN also referred as R-CNN are the regions with CNN features. This is the

innovative approach in the field of deep neural networks and has improved the task of the object detection and identification [8]. Mask R-CNN is a region based technique of object detection also denoted as two stage object detection. Mask R-CNN [9] generates a HQ segmentation mask for every sample and hence accurately perform object detection in an image. On the other hand, YOLO [10] is one stage object detection technique. YOLO architecture is used for the prediction of bounding box coordinates and the probabilities of each class in these boxes by passing the whole image through only one pass.

II. WORKING OF YOLO V3

“You Only Look Once” is an algorithm that uses CNN for object detection. One of the speedier object recognition algorithm present in computer vision is YOLO. However it is not the most precise object recognition algorithm, it is a great alternative when we need live detection not compromising too much precision.

In conventional computer vision methods, sliding window approach was used to examine for the objects at various places and scales. As it was such a resource-consuming procedure, the element ratio of the objects were usually considered to be clinched. R-CNN [11] and Fast R-CNN [12] which are the initial methods of deep learning for object detection employed a technique named Selective Search [13] for limiting the number of bounding boxes which has to be sampled by the algorithm.

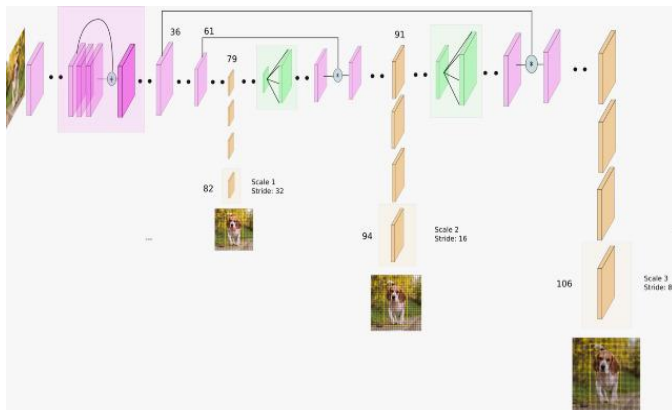


Fig. 1. YOLO v3 Architecture.

YOLO splits the input image into a 13×13 grid of compartments. The dimension of the resulting 169 cells differs relying on the dimensions of the input image. For a 429×429 input sizes that we used in our experimentation, the cell size was 33×33 . Every cell is accountable for indicating various boxes in the image. In YOLO v3 the detections are done at three different scales. With the detection at different scales YOLO v3 is able to detect small objects more accurately. For detecting large objects 13×13 layer is used, 52×52 layer is used for detection of small objects and for medium objects 26×26 layer is used. For each of the 3 scales YOLO v3 has 3 anchor boxes i.e 9 anchor boxes in total. YOLO v3 predicts more number of bounding boxes per image in comparison to YOLO v2 [14]. It predicts the object confidence and class predictions using logistic regression.

For every bounding box, the algorithm indicates the confidence that the bounding box really possesses an object and the possibility of the possessed item being an individual class. After that most of the boxes which have low confidence or if they are holding the exact item as another bounding boxes with an extremely high confidence score are removed. This process is named as non-maximum suppression. Finally the bounding boxes containing the objects are drawn and shows the recognized class of the object. The objects are recognized on the basis of training dataset i.e MS COCO which contain 80 object classes.

III. WORKING OF MASK RCNN

The main motive of Mask RCNN is to design an efficient architecture for the instance segmentation in machine learning. It can isolate various objects in images and videos which are fed to the network. This method gives the object bounding boxes, the labeled classes and the masks in the image or the video. Mask R-CNN adds some advancements in Faster R-CNN [15].

Mask RCNN works in two stages. Firstly, it develops region of proposals regarding the areas where there may be a presence of object based on the image fed to the network. Secondly, it shows the category of the object present, purifies the bounding boxes and renders a mask on the pixel tier of the

object based on the previous stage proposal. The stages of this network are linked to the structural backbone.

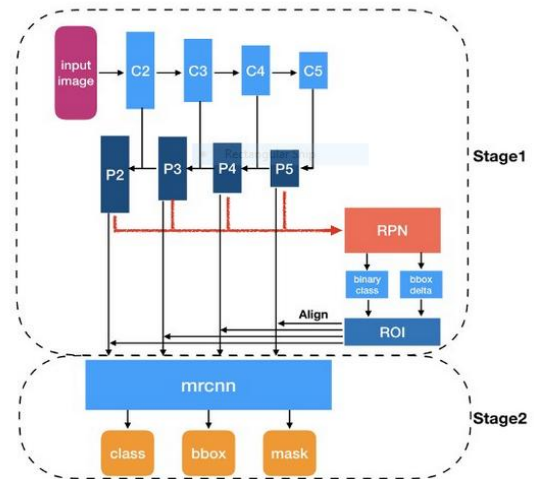


Fig. 2. Mask RCNN Architecture.

At the second stage, a different neural network brings presented provinces by the previous stage and allocate them to numerous distinct regions of a quality map level, examines these areas, and renders classes of the object, determining boxes and masks. The next stage uses ROI Align to discover the appropriate regions of the feature map, and there is a unit yielding masks for per object in pixel level. At last, various objects in the frame are segmented from the image (depicted with different color masks) and we get the object class with its confidence.

IV. RESULTS ON REAL TIME DATASET

The dataset we have used for the training purpose is MS COCO [16] and for the testing purpose we have used real time dataset of the traffic videos which are captured at different places of city. This can be helpful for video surveillance and traffic controlling.

Input: An image or a video containing objects.

Output: The bounding boxes (defined by a point, height, and width), and the class labels for every bounding box in YOLO v3 and mask with class labels and bounding box in Mask R-CNN.

Following are the output images from the three video sequences in which the inference on Mask R-CNN and YOLO v3 are shown.



Fig. 3(a). Inference on YOLO v3.



Fig. 5(a). Inference on YOLO v3.



Fig. 3(b). Inference on Mask RCNN.

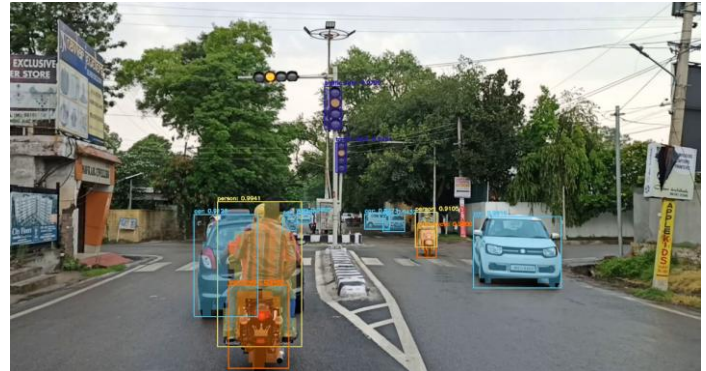


Fig. 5(b). Inference on Mask RCNN.

V. ANALYSIS

The constraints that are used for the assessment of the performance and accuracy of the methods used are as follows:

Precision: Precision can be defined as the ratio of true positive (true predictions) and the total number of predicted positives (total predictions). It can be represented by the formula;

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

Here, TP refers to true positive and FP refers to false positive.

Recall: Recall can be defined as the ratio of true positive (true predictions) and the total number of ground truth positives. It can be represented by the formula;

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

Here, TP refers to true positive and FN refers to false negative

Mean Average Precision (mAP): Area under the precision recall curve is referred as average precision. It combines precision and recall together. Mean Average Precision (mAP) is the mean of the AP calculated for all the classes.

Table I shows the backbone used and mAP achieved by YOLO v3 and Mask RCNN.



Fig. 4(a). Inference on YOLO v3.

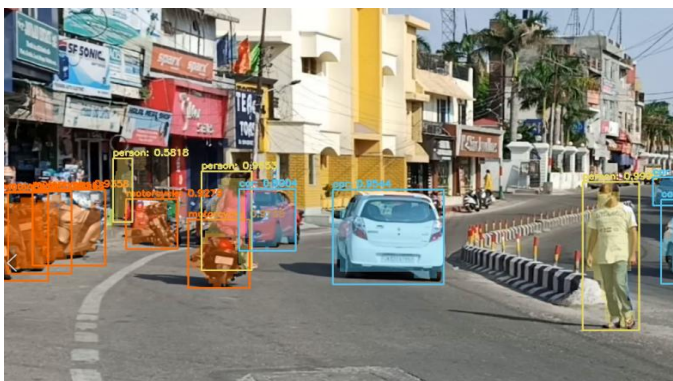


Fig. 4(b). Inference on Mask RCNN.

TABLE II. Comparison between methods based on performance measures.

| S. No. | Method | Backbone | mAP |
|--------|------------|----------------|------|
| 1 | YOLOv3 | DarkNet-53 | 33.0 |
| 2 | Mask R-CNN | ResNet-101-FPN | 35.7 |

Table II shows the advantages and disadvantages of the object detection methods used.

Table II. Advantage and disadvantage of methods.

| S. No. | Method | Advantage | Disadvantage |
|--------|-----------|---|---|
| 1 | YOLO v3 | YOLO is very fast and processes 45 frames per second which is one of the main advantages of YOLO. Due to fast speed it can be used in real time. | YOLO is not able to handle small objects that well especially when the objects are grouped closer. |
| 2 | Mask RCNN | It generates high-quality segmentation mask for every sample and hence accurately perform object detection in an image. The main motive of this method is to design an efficient architecture for the instance segmentation and give more accurate detections. Can handle small grouped objects. | Even if the mean absolute percentage error of Mask R-CNN is better than its competitive algorithms yet it is slow in speed in comparison to YOLO. |

Which method to be used?

If the dataset we are using consists of small and closely grouped objects then Mask R-CNN can be used instead of YOLO. If speed is the paramount then YOLO (YOLOv3) is better.

VI. CONCLUSION

The most challenging problem in computer vision is object detection but with the introduction of neural networks and various advancements in deep learning the efficiency of object detection is increased. Object detection is used extensively in surveillance systems. Various methods of object detection using convolutional neural networks, region proposal based models and regression/classification based models make the object detection task easier. In this work we have studied and analysed object detection methods like YOLOv3 and Mask R-CNN. Testing is done on real time dataset of videos and results are shown with the mAP achieved by each method.

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Image Feature Extraction Techniques

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Abstract—Feature extraction is a transformation of large input data into a low dimensional feature vector, reducing the number of resources required to describe a large set of data. It allows the representation of the content of images as perfectly as possible. Feature detection, feature extraction, and matching are often combined to solve common computer vision problems such as object detection and recognition, content-based image retrieval, face detection and recognition, and texture classification. Extracting features from input data is vital for successful classification and identification of objects. There are different methods of extracting features from an image like SURF (Speeded Up Robust Features), SIFT (Scale-Invariant Feature Transform), BRISK (Binary Robust Invariant Scalable Key points), FAST (Features from Accelerated Segment Test), etc. Various techniques have different domains of application. This paper provides a comprehensive overview of the state-of-the-art and recent advances in feature detection and description algorithms. Further, the impact of feature extraction on the output for image matching or recognition techniques have also been analyzed.

Keywords— BRISK, Feature, Feature extraction, FAST, Image processing, Harris, SIFT, SURF.

I. INTRODUCTION

Feature detection and description is an active area of research in the field of computer vision that refers to the process of identifying points in an image (interest points). The identified points can be used to describe the image's contents such as edges, corners, ridges, and blobs [1]. Different methods have been proposed to date for the extraction of features from images. Feature Extraction is the transformation of large input data into a low dimensional feature vector[2]. It is a type of data reduction technique. The aim is to reduce the data set of features which is valuable information present in an image. It is a necessary step to extract the informative features from an image for object recognition and segmentation. It lowers the computational cost and also helps in controlling the issue of dimensionality. The major goal of the feature extraction technique is to extract a set of features, which increase the recognition rate with the least amount of elements and to generate a similar feature set for a variety of instances of the same object [3]. The feature extraction phase is important as it has an observable impact on the efficiency of the system. Thus, becomes important to select a suitable feature extraction technique according to the input used.

In this paper, different feature detection and extractions algorithms have been discussed and implemented for extracting features from an image. Input images are acquired and features are detected using Harris corner detection, SURF (Speeded-Up Robust Features) [5], FAST (Features from Accelerated Segment) [6], and BRISK (Binary Robust Invariant Scalable Key points) [7] feature detection algorithms.

The rest of this paper is organized as follows: Section II presents an overview of feature extraction. In Section III, a brief review of the study of various algorithms is given. Section IV presents the implementation part and in section V conclusion of the paper is presented.

II. FEATURE EXTRACTION

Feature extraction methods apply a transformation on the original feature vector to reduce its dimension from n to m where $m < n$. Feature Extraction methods transform data to project it into a new feature space with a lower dimension [8]. The main challenge of feature extraction is to learn and extract knowledge from that data to make correct decisions. Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps. Feature extraction is finding the set of the parameter that defines the shape of an object precisely and uniquely.

Features are properties that illustrate the whole image. It is a crucial piece of information which is subjected to solve the computational task relevant to a specific application. Some significant and useful features from the digital image are extracted to be subjected to the selection and classification [9]. The main purpose of the feature extraction is to minimize the original dataset by deriving some properties which can be used to classify and to recognize patterns that are present in the input images. A feature vector resulted from the feature extraction process, whose dimension is equal to the number of extracted features, is derived [10]. These features should retain important information and should be different enough among classes for good classification performance. Consequently, the feature extraction process plays a decisive role in the classification performance and thus, in the overall segmentation process [11]. The main goal of feature extraction is to obtain the most relevant information from the original data and represent that information in a lower dimensionality space [12]. Features can have strong or weak relevance. Strong relevance means that a feature cannot be removed from the feature set without loss of classification accuracy whereas features with weak relevance can sometimes contribute to classification accuracy.

III. RELATED WORK

There are various methods in the literature that have been proposed for feature extraction. In this section, various feature detection algorithms are briefly described.

A. SIFT

D. G. Lowe introduced Scale Invariant Feature Transform (SIFT) in 2004, which is the most renowned feature detection-description algorithm. SIFT [8] detector is based on the Difference-of-Gaussians (DoG) operator which is an approximation of Laplacian-of-Gaussian (LoG). Feature points are detected by searching local maxima using DoG at various scales of the subject images. The SIFT descriptor extracts a 16x16 neighboring points around each detected feature and further segments the region into sub-blocks, rendering a total of 128 bin values. SIFT is robustly invariant to image rotations, scaling, and limited affine variations. High computational cost is the main drawback of the algorithm.

B. SURF

H. Bay et al. presented Speeded Up Robust Features (SURF) in 2008 [5], which also relies on the Gaussian scale-space analysis of images. SURF detector is based on determinant of Hessian Matrix and it exploits integral images to improve feature-detection speed. The 64 bin descriptor of SURF describes each detected feature with a distribution of Haar wavelet responses within a certain neighborhood.

SURF features are invariant to rotation and scale but they have little affine invariance. However, the descriptor can be extended to 128 bin values to deal with larger viewpoint changes. The main advantage of SURF over SIFT is its low computational cost.

C. FAST

Rosten Drummond presented Features from Accelerated Segment, a technique for recognizing interest points in an image in 2006. This technique adds an interest point indicator in the list of other interest point detectors, utilized continuously in real-time applications. Only a few points that fall inside the range are identified and processed whereas the points outside the scope of interest are rejected. The most promising advantage of the FAST [6] corner detector is its computational efficiency. With machine learning techniques, superior performance in terms of computation time and resources can be observed. The FAST corner detector algorithm is very suitable for real-time video processing applications because of this high-speed performance.

D. BRISK

Binary Robust Invariant Scalable Keypoints (BRISK) was proposed by S. Leutenegger et al. in 2011 [7]. This technique detects corner points and uses the FAST corner score to filter them as searching for maxima in the scale-space pyramid.

To cater illumination invariance BRISK relies on an easily configurable circular sampling pattern to form a binary descriptor string. Using sampling pattern, short pairs and long pairs are distinguished. Long pairs are used in BRISK to determine orientation and short pairs are used for the intensity comparisons that build the descriptor. Feature extracted using BRISK algorithm is invariant to scale, rotation, and some affine changes.

E. Harris

Harris corner detection algorithm works by using a local detecting window inside the image to detect feature points. The window is shifted in small amounts in different directions and average variation in the pixel intensity is observed. The point under consideration to be the corner is the center point of the window. As shown in Fig.1 [13], when the window is shifted, the flat region shows no change in pixel intensity in any direction. If there is no change in pixel intensity along the edge direction, the detected region is an edge in the image. But, when a significant change is observed by moving the window in all the directions, a corner point is detected. A large number of features are detected using this detection algorithm. Harris corner detection algorithm is found to be scale variant, but it is invariant to rotation.

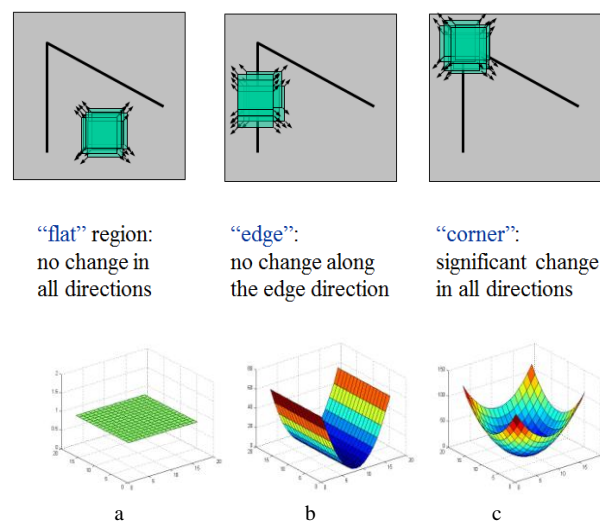


Fig. 1. Columns represent the graphical view of regions (a) flat, (b) edge, (c) corner.

F. ORB

Oriented FAST and Rotated BRIEF (ORB) was developed at OpenCV labs by E Rublee et al. in 2011. It is as an efficient and workable alternative to SIFT and SURF in terms of computation cost and matching performance. ORB [8], a combination of FAST keypoint detector and BRIEF descriptor with added modifications gives enhanced performance by firstly using FAST to find key points and then applying Harris

corner measure to find top N points. It is rotation invariant and resistant to noise [14] [15].

TABLE I. FEATURE EXTRACTION ALGORITHMS USED FOR IMPLEMENTATION

| | SURF | FAST | BRISK | Harris |
|-----------------|------------------------|---------------------|------------------|---------------------|
| Proposed by | Herbert Bay | Rosten and Drummond | Leutenegger | Harris and Stephens |
| Year | 2008 | 2006 | 2011 | 1988 |
| Based on | Histogram of gradients | Template | Template | Gradient |
| Feature pattern | Scattered | Corner points | Concentric rings | Points |
| Category | Blob interest point | Corner | Blob keypoint | Corner |
| Feature density | Dense | Low | Denser than SURF | Medium |

IV. EXPERIMENTAL ANALYSIS

The comparative analysis of feature extraction algorithms is done in MATLAB R2018a. Features are extracted from the input image ((a) Fig.1) using SURF, FAST, BRISK, and Harris. Table II gives the number of features extracted and corresponding time taken by each algorithm used in the implementation. The obtained results are shown in Figure 2.

As can be observed from Table II, BRISK detects the maximum number of features in the input image followed by SURF and HARRIS. Minimum features were detected by the FAST algorithm. Time taken to extract features was also observed. Minimum time was taken by the SURF algorithm whereas BRISK took maximum time. FAST is also a computationally fast algorithm as the time taken by it was comparatively less than BRISK and Harris.

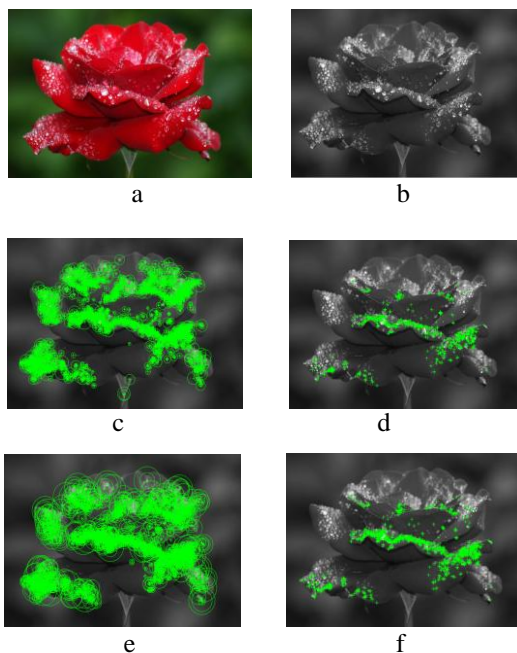


Fig. 2. (a) Input image, (b) greyscale image, Extracted features using (c) SURF, (d) FAST, (e) BRISK, (f) Harris

TABLE II. COMPARATIVE ANALYSIS OF FEATURES EXTRACTED AND TIME TAKEN

| Algorithm | Features extracted | Time taken (sec) |
|------------------|---------------------------|-------------------------|
| SURF | 694 | 0.070 |
| FAST | 117 | 0.095 |
| BRISK | 846 | 0.678 |
| Harris | 139 | 0.205 |

V. CONCLUSION

The work presented in this paper provides an overview of different feature detection and extraction algorithms along with their merits and demerits. It also provided a brief comparison of their performance and capabilities based on different metrics. SURF, FAST, BRISK, and Harris were evaluated for finding the number of detected features and execution time. The results revealed that BRISK and SURF performed better in terms of extracting more number of features whereas SURF and FAST have better execution efficiency.

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Electronic Health Record-Security Issues and Solutions

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Abstract - In last decade, information technology has played a major role in the field of healthcare. Many countries have introduced rules and regulations for the standardization of technology and administration to provide privacy and security to individual patient e.g. Healthcare Information and Portability Accountability Act (HIPAA) in US. In this paper we discuss different security and privacy issues in healthcare information system. We suggested for pseudonymization based technique to be more suitable for the healthcare information system.

Key Terms: EHR, PHR, Pseudonymization, Privacy, Security

I INTRODUCTION

As we know that security and privacy is primary concern in healthcare practices for online access of Electronic Health Record (EHR). EHR is gradually eliminating the use of paper and becoming more popular in healthcare organizations. This online accessing of patient record and transaction related to diagnosis have many benefits for patients as well as healthcare organization and professionals. But it also raises serious privacy issues related to private data of patient e.g. any patient would not like to expose some health information which may defame him or may create problem for his professional career [1]. Internet based EHR systems allow patient to remote access to their entire medical history anytime. Hence security and privacy comes in the picture. For adaptation of the EHR, the key factors are financial incentives and barriers, laws and regulations, the state of technology, and organizational influences [2]. There are three correlated records in healthcare information system.

- **Personal Health Record (PHR)** is typically a record that is maintained by patient. It includes complete summary of medical history by gathering information from many sources including EMR and EHR.
- **Electronic Medical Record (EMR)** is created, used, and maintained by healthcare practitioner to document, monitor, and manage healthcare delivery.
- **Electronic Health Record (EHR)** is a subset of EMR record maintained by each CDO and is created and owned by the patient. EHR has

patient input and can be used across multiple healthcare delivery organizations within a community. [2]

1. EHR systems are highly desired for efficient integration of all relevant medical information of a person and to represent a lifelong documentation of medical history. Several threats to confidentiality of healthcare information from inside the patient care institution, from within secondary user setting, outsider intrusion into medical information systems is crucial.

Security and Privacy Issues

Due to risk associated to EHR it is vital to assure privacy of the patients. The following security issues should be handled properly in any healthcare entity while accessing or transacting EHR.

- a. **User Authentication:** When any user is trying to access the health record then only authorized user will be able to access the record. Smart card based several solutions have been proposed [6]. Biometric based system is also in use for ensuring the authorized access of records
- b. **Confidentiality & Integrity:** It is related to the accuracy and reliability of healthcare record and integrity and reliability of physical computer and network systems. Hacking incidents on EHR systems may lead to altering patient data or destruction of clinical systems. [10]

c. **Access Control:** It is a fundamental security issue in shared computing environments where medical records stored in databases and exchanged through heterogeneous file system. As roles and privileges vary depending on the nature of the system and organization, so it requires controlling of user's right to use certain resources by granting or rejecting access to resources. It is easy for an unidentified user to access the network if the remote connection is not secure [12] Electronic systems should enable the core security features of role-based access, passwords, and audit trails. There are serious privacy issues related to genetic testing. Individuals are faced with a fear of employment loss and life insurance. Hence the refusal to use effective genetic tests hurts individuals, researchers, and physicians [12].

d. **Data Ownership:** It is also important when delegation of power to access of patient record is considered.

Who will own which data, delegation of authority over data? Also duties and responsibilities of data ownership should be handled transparently.[3]

e. **Data Protection Policies:** As several entities are involved in healthcare diagnosis system, crossing organizational and functional boundaries, so acceptable and consistent protection are required. Organizations require strict policies and procedures governing the use of physical media and portable devices to prevent theft or loss. EHR systems require continued development of functionality to manage security, add levels of security, block access to specific notes or lab results, track versioning, and mask sensitive entries for release of information [4].

f. **User Profiles:** Several entities are involved in healthcare system like patient, practitioners, healthcare organization, trusted third party, pharmacist etc. Hence issues related to defining user types and roles needed to distinguish the functional requirements and security levels of users [4]. There is great variability and incompatibility of patient identification systems in healthcare facilities, making it difficult to uniquely identify patients within one facility or between entities. A system of identifying patients between entities must exist for interoperability to occur. Currently, there is no record-to-record matching standard in the industry [5]

g. **Misuse of Health Record:** Some of the websites offering EHRs, mostly the ones that offer storage space for free, are not concerned

with privacy. They may sell the data to other companies, or advertise on the same page as the content uploaded by the patient [9]. In a multi speciality environment, security of health records can be challenging. Organizations must have the ability to segregate any records related to treatment of substance abuse, as treatment of these patients can encompass multiple medical specialties and document types [9].

II PSEUDONYMIZATION APPROACHES

Pseudonymization is a technique where identification data is replaced by pseudonyms which are identifiers of subjects. Pseudonym is a bit stream which is unique as identifier and suitable to authenticate the holder and his data. This pseudonym can only be associated with identification data by some secret value.

Pseudonymization can be used for handling the privacy issues, confidentiality as well as integrity. Another scope of pseudonym is **linkability** i.e. the knowledge of the relationship between the holder and his pseudonym. This information should be known to holder only (or trusted third party (TTP)). There are two ways to generate globally unique pseudonyms for holder. [3]

1. **Centralized generation:** A centralized third party may generate the pseudonym on the behalf of holder. Normally a hierarchical organized issuing party is used for large scale. The holder of the certificate has to trust on the issuer.
2. **Holder-based generation:** The holder generates his pseudonym locally. Only holder is aware about the relation between his identity and pseudonym. The holder locally generates globally unique random pseudonym. A mechanism is required to prove that holder generated a specific pseudonym without disclosing his identity and he can reveal his identity by disclosing the pseudonym.

2.1 Peterson approach [13]

- In this approach a unique Global key (GK) and server side key (SSID) is provided when user get registered at service provider's website.
- Also a unique personal encryption key (PEK) and a password has to provide. An ID card is used which includes GK. User retrieves data from database by entering GK and PEK.
- It consists of three database tables---Data table, User table and security table (used to links data in data table to appropriate entry in user table).

- Data is encrypted two times before storing in the database.
- By knowing GK or PEK or both, anyone can view medical data without knowledge of password. (As data does not contain identifying information). For modification/add/delete of medical data, password is needed.
- It have a fall back mechanism for lost of GK. It requires PEK and password to get new GK.
- Whenever patient's data altered a secret password known only to patient is needed and hence unauthorized access of data is prevented.
- Patient can access their data via internet by accessing medical records database. Although data is encrypted but it is invisible to user.
- For emergency access of patient data, patient select second unique identifier other than GK. This is sufficient to access patient data without need of any password. This is the point where attack is possible.
- Patients have control over their data as they can modify any data including password, GK, PEK.
- PEK is easy to remember but complex enough to guess as it can be choose by using native language character. These characters are entered by using special input method.
- This is menu driven system for data input, simplifies task of translation.
- Ability of immediate change of access keys, lock-out any identity thieves.
- Privacy is achieved; summaries of medical records can also be accessed any time from internal terminal.

The major issues with this approach are—

1. All keys used for decryption of medical data are stored in the database. By accessing database, data may be changed as password and keys are stored in the database.
2. Unique PEK is selected by user—security leak -- as it provides information about the existing keys.

2.2 Pseudonymization of Information for Privacy in e-health (PIPE)---

It is a solution, based on hull architecture instead of storing the relation between patients and their dataset in centralized manner [9].

- In this system all data are held persistently in the storage St, which consists of two separate databases. One hold plaintext pseudonyms and related medical datasets which are stored in plaintext for performance reasons. Other database is used to store user's personal information and their encrypted pseudonyms.
- The logic L is a centralized system for accessing St. This system is based on layered model, in which each layer comprises one or more secrets, like encrypted keys or hidden relations.
- To gain access to the secrets of one layer, any user will require secrets of the next outer layer.
- This model consists of three layers. The most inner layer consists of patients' diagnosis treatment and anamnesis datasets (ϕ_i). each of these entries is related to distinct pseudonym (ψ_{ij}). These pseudonyms are shared with healthcare provider's to authorize them certain medical datasets.
- For full control over datasets a root pseudonym ψ_{io} for each ϕ_i is used. This is only known to patient and ensures that nobody except he is able to delete all pseudonym of certain datasets.

| | Patient(A) | health care provider |
|-------------------------------------|------------------|----------------------|
| Unique identifier | Aid | Cid |
| Outer (public key , private key) | (K_A , K'_A) | (K_C , K'_C) |
| Inner (public key , private key) | (iK_A , iK'_A) | (iK_C , iK'_C) |
| Inner symmetric key | SK_A | SK_C |

- Pseudonym is encrypted in the next outer layer by SK_A . As SK_A is stored within the system, it is encrypted with iK_A . Furthermore iK'_A is encrypted with K_A .
- Only (K_A , K'_A) is available on smart card which is equipped with a logic chip to conduct encryption and decryption operations.

- For addition of a medical data by health care provider on behalf of patient both actor first of all authenticate against their particular smart card by entering a PIN. They use K_u to decrypt iK_u and subsequently SK_u .
- The patient and healthcare provider authenticate against the system and establish a secure channel between them and the logic L. afterwards A and C send their Aid and Cid to L respectively. L sends Cid to A and Aid to C.

now $A \rightarrow L \rightarrow St : E_{SK_A}(Aid, Cid)$ and $C \rightarrow L \rightarrow St : E_{SK_C}(Aid, Cid)$. subsequently storage replies with the particular iK_A iK_C to L. Now logic sends to store and C. $L \rightarrow St : E_{iK_A}(Cid, \psi_{io}, \psi_{ij})$ and $L \rightarrow C : E_{iK_C}(Aid, \psi_{ij})$. Then C replies to L

$C \rightarrow L : E_{SK_C}(Aid, \psi_{ij}, Cid, tag), \phi_i$

For integrity purpose C sends following m-

$C \rightarrow L : E_{SK_C}(fsign_{iK_C}(fhash(\phi_i))) \parallel fsign_{iK_C}(fhash(\phi_i))$

- It implements a secure fall back mechanism when smart card is lost.

2.3 Electronic health card (eGK)—

- It is a designed as service –oriented architecture (SOA) having some restrictions like local card access only, RMI communication, supported by ministry of health Germany.
- It provides application like e-prescription, EMR, EHR ,emergency data etc. its architecture consists of five layers.
 - A. Presentation layer--to provide communication interface to user
 - B. Service layer—to provide different services
 - C. Business layer---to combine different services
 - D. Application layer-manages data and user right
 - E. Infrastructure layer
- To authenticate a user, system encrypts a random number with public key of user and hence user has to decrypt with his private key which is stored in his card.

- Data is encrypted with a one-time symmetric key i.e. session key. This session key is encrypted with the public key of the patient which is decrypted by his private key. Finally the data is decrypted with this session key.
- A file has a default ticket toolkit and any number of private ticket toolkit(user defines for other user). This kit consists of a ticket building tool, a ticket verifier, list of access policy and encrypted link to file.
- eGK optionally provide permission to store private ticket toolkit for every entry which uses asymmetric key pair stored on emergency card. In case of card lost, this emergency card is used to decrypt the session keys of second ticket toolkit. At last, with the keys of new card the session keys are encrypted.
- eGK store data in the database after pseudonymization. So database access does not mean linking of identification with the data.
- Strong fall back mechanism

2.4 Thielscher Approach [14]

- Identification data and the anamnesis data of medical record are stored in two different databases. For the retrieval of health data requires data record identifier code assigned to each patient. This code is detached from patient identifying data. It includes a patient card code stored on patient card and patient identification code(PIN).
- Decentralized keys stored on smart cards which is used to link the patient identity to his data. To generate a unique data identification code (DIC), which is also stored in the database this key is used.
- DIC is totally independent to identifying data. It is shared healthcare entity and patient for limited period.
- When health data is requested by a profession like physician then electronic patient card and an identification code of that professional is required. So in this way system can have the usage history of the patient data.
- Transfer of DIC or patient data from centralized database is accessed in encrypted mode. Hence unauthorized interception of data record of identifier code is protected.

- Electronic health card contains picture of the patient to identifying him. The health professional can match at time of treatment.
- Pseudonymization computer physically separate from centralized database without any on-line connection, is used. It replaces person identifying data with the corresponding data record identifier code. Now this updated data is provided for online- access.
- Some part of stored health data in database is also stored on electronic card so that health professional can know the status of patient without directly.
- A fall back mechanism is provided.
- Offline storage of pseudonym hold by patient. It is the shortcoming of this approach that centralized pseudonym is centrally stored in the patient mapping list for recovery purposes which is open to insider abuse.

2.5 Pommerening Approach [15]

- Different approaches for secondary use of medical data are proposed.
- In the first approach secondary user access and merge the data of patient but can not identify. It is based on data from overlapping sources for one-time secondary use.
- A unique identifier (PID) is used to connect the data. A pseudonymization service encrypts the PID with a hash algorithm. With the public key of the secondary user the medical data is encrypted so secondary user can decrypt the medical data.
- The second approach is same as first but with the possibility to re-identify the patient. It stores a reference list of the patient's identity and the associated PIDs.
- The pseudonymization service decrypts the pseudonym and sends the request to the PID service, which permits notifying the data owner.
- The third approach is for many secondary users. A physician exports his local database to the central researcher Database.
- The identification data is replaced by a PID. Pseudonymization service is used for export of each secondary use of the data.
- The PID is encrypted by the by a project specific key to ensure that different projects get different pseudonyms.

2.6 Slamanig and Stingl Approach [16]

- This approach considers two sets. One is set of users $U = \{U_1, U_2, \dots, U_n\}$, U is a public user repository. Another is set of data objects represented as documents $D = \{D_1, D_2, \dots, D_m\}$, and D is document repository. Both repositories can be located in different locations.
- Centralized component which serves as a point of access to the set of documents. Document repository maps these references to respective documents.
- Stores the data in a centralized database and uses smart cards for authentication.
- A E-health portal implements an authorization concept which can be described by means of a relation R defined over $U^4 \times D$ where every 5-tuple $(U_s, U_r, U_c, U_p, D_j)$ $1 \leq s, r, c, p \leq n$ and $1 \leq j \leq m$ represents an access right for a document D_j user U_s (sender) grants user U_r (receiver) created by U_c concerning patient U_p .
- To ensuring unlinkability it uses a combination of pseudonym and anonymous authentication. The ehealth portal can be classified by means of personalization of their offered services.
- The system keeps the pseudonyms of a user secret. Each pseudonym realizes a sub-identity of the user and is encrypted with a public key.
- To access datasets of one of his sub-identities, user has to login into the system with his general pin code. Also he has to enter the pin code of the sub-identity to activate the private key on the smart card.
- Pseudonymized portals- it can be described by means of encryption of the content data and the additional protection of the metadata of the system. Metadata is protected via a mechanism, pseudonymization. Every user U_i choose randomly a second identifier P_{U_i} i.e. pseudonym which is used to identify his share.
- To prevent linkage between user and his pseudonym, it is stored in encrypted form $E_{U_i}(P_{U_i})$ in the user repository. The unlinkability holds since P_{U_i} is independently chosen. In order to hide links between

users and documents every elements of the tuple need to be pseudonymized

$$t_{Us \rightarrow Us} = (E_{Us}(Us), P_{Us}, E_{Us}(Uc), E_{Us}(Up), E_{Us}(Dj, k_{Dj}))$$

Here sender, receiver and creator are one, thus this share represents an access right which is given from the creator of a document to himself. In case of a share granted by user Us to user Ur for the document Dj every access right can be represented by pair of 5-tuple $(t_{Us \rightarrow Us}, t_{Us \rightarrow Ur})$.

$$t_{Us \rightarrow Us} = (E_{Us}(Us), P_{Us}, E_{Us}(Uc), E_{Us}(Up), E_{Us}(Dj, k_{Dj}))$$

$$t_{Us \rightarrow Ur} = (E_{Ur}(Us), U_R, E_{Ur}(Uc), E_{Ur}(Up), E_{Ur}(Dj, k_{Dj}))$$

Any other user is able to identify Ur as receiver of this share. Therefore Ur needs to modify the share and replace $t_{Us \rightarrow Ur}$ with $t'_{Us \rightarrow Ur}$.

$$t'_{Us \rightarrow Ur} = (E_{Ur}(Us), P_{Ur}, E_{Ur}(Uc), E_{Ur}(Up), E_{Ur}(Dj, k_{Dj}))$$

Since P_{Ur} represents a pseudonym of user Ur and is solely known to him, the unlinkability between the user and the share is guaranteed. Distributed key backup to N users using a (t, N) -threshold secret sharing scheme suggested as fall-back

III EHR STANDARDS

Every healthcare organization, clinic and hospital has its own information system to maintain patient data. Hence there is a need to provide standards for data exchange [4]. Thus, electronic health records should be standardized, incorporating semantic interoperability. EHRs must be designed to capture relevant clinical data using standardized data definitions and standardized quality measures. These will help in improving preventive care and in increasing physician efficiency. Several organizations are working to create EHR standards, such as

- openEHR Foundation [openEHR 2009]
- Consolidated Health Informatics Initiative (CHI) [EHR Standards 2009]
- Certification Commission for Healthcare Information Technology (CCHIT) [EHR Standards 2009]
- Healthcare Information and Management Systems Society (HIMSS) [EHR Standards 2009]
- International Organisation for Standardisation (ISO)
- American National Standards Institute (ANSI) [EHR Standards 2009]
- Canada Health Infoway [EHR Standards 2009]
- European Committee for standardization

The European Institute for Health Records, or EuroRec Institute, is a European certification body that defines functional criteria and provides the EHRs quality labeling (EuroRec, 2010). It has published a document that details the management and maintenance policies for EHR interoperability resources based on both ISO 13606 and OpenEHR [Kalra2008]. The standards created by these organizations are formalized, controlled, and documented [Lewis2008]. Standards provide a definitional basis for interoperability [Atalag2010]. The single-vendor, closed-data paradigm of commercial development is broken by the open-source software development sector promoting shared, universal standards.

The openEHR Foundation has proposed openEHR standards that support version controlled health records. Version control enables all past states of a health record to be investigated in the event of clinical or medico-legal investigations.

The openEHR stores the most frequently used information in a separate record for fast lookup and querying. Recently, Microsoft has also adopted the openEHR's approach for EHRs [Microsoft 2009]. Other organizations are also developing standards, such as HL7 version 3 and CEN13606, with similar goals [Eichelberg 2005]. EHR data quality should concern the various data issues like incompleteness (missing information), inconsistency (information mismatch between various sources or within the same EHR data sources), and inaccuracy (nonspecific, non-standards-based, inexact, incorrect, or imprecise information). Such inaccuracies in the attribute values of patient records make it difficult to find specific patient records. Data collected in various systems can be noncoherent or include contradictory information. The desired data may be completely missing. For example, the unit for temperature may not be entered definitively as degree Celsius or Fahrenheit, or may be outside the permissible range. So there is a need for a communication format and protocol for the purpose of standardization, since a patient's health information is shared in a multi-disciplinary environment. It is necessary to support interoperability between software from different vendors. Standardization will enhance the quality of EHR. Currently, there is no single universally accepted clinical data model. The major problem is the huge amount of different interfaces that are in use.

IV SECURITY AND PRIVACY SOLUTIONS

4.1 Smart-card-enabled Privacy Preserving E-prescriptions Systems: [6]

Smart cards play crucial role. The smart cards are implemented to be portable repositories carrying up-to-date personal medical records and insurance information, providing doctors instant data access crucial to diagnosis process. A number of parties are involved in the health care provision such as hospitals, General Practitioners (GP) business associates like insurance companies, Billing agencies, Pharmacists. This solution concentrates on smart card based portable personal information repository to simplify the process of drug prescription, enabling the doctor to bypass several bureaucratic procedures. Smart card not only work as repository device but also some intelligent task, like digital signature signing capability to sign the electronic pads, patient authorization. An extension in smart card role is to include the delegation of prescription signing capability among users, which they refer as **Delegated Signing**. It is intended for a designated person who uses his own smart card to sign the prescription on behalf of the patient in collecting the medicine. It provides flexibility to be carried by someone else than the owner himself. Moreover it does not complicate the system. The entities involved in this e- prescription system are Patient P, Doctor DR, Insurer I, Proxy Signer PxS - accepts delegation rights from Patient, Pharmacy PH, Group Manager GM- manages privacy issues of the doctor, Certificate authority CA- issues public key certificates to related entities. This system provides pseudonymity, linkability of patients/doctors, least data disclosure.

Advantage of this smart card enabled solution are-1. Authenticity of the patients is automatically ensured by holding cards. 2. It prevents multiple prescriptions from different practitioners. 3. It can be used as a tool for tracking public health initiatives.

4.2 A secure Architecture for the Pseudonymization of medical data [7] This architecture for the pseudonymization of medical data provides-

- Authorization to persons such as healthcare providers to access defined data of the EHR on encryption level.
- A backup mechanism that allows recovering the access to the health care records if the security token carrying the keys (smart card) is lost.
- To gain unobservability in data by eliminating data profiling by using different pseudonyms for every anamnesis case.

Pseudonymization architecture consists of following roles and components:

- A Central System (server) ST –provides access to a central storage which itself is divided into two separate databases (e.g. logically, physically). One is related to identification data

(AID) and other to data which should be pseudonymized (PMD).

- A central logic (Lo)- provides an interface between the central storage and the clients for the purpose of saving and loading data.
- Patient P - has full access to AID and PMD
- Relative (B) - shares the identification data with a specific patient.
- Health Care Provider (C) - shares one or more entries in the pseudonymized database with patient.
- Research Lab (R) - just access to the PMD on server system.
- Operator Team (O) - may hold secrets on behalf of the system

Architecture is based on layered model with minimum of three security hulls representing the authorization mechanism. Every hull includes one or more different symmetric keys asymmetric key pairs. A key K_n of a certain Hull H_n is encrypted with a key K_{n+1} of the hull H_{n+1} enveloping hull K_n .

Data itself does not have to be encrypted; security is done by securing the link between patient's identification data with the encryption of her identification data with a pseudonymization key. It is possible to share all pseudonymization keys, which are located in the most inner hull as well.

4.3 Trivial Disclosure Attack and Statistical Analysis of Metadata and a Pseudonymisation Solution

Here two additional threats are considered-trivial disclosure attack and statistical analysis of metadata besides traditional security properties of EHR. Disclosure attacks means if a person enforces another person to present her EHR. By applying statistical analysis on the metadata of an e-health portal it is possible to determine relevant information which could have negative effect on the patient. So to overcome these threat a concept of pseudonymization of medical data, identity management, obfuscation of metadata and anonymous authentication is used [9].

There are two types of EHR architectures. First, virtual EHR-the documents can remain in their respective information systems and the system provides an index which holds references to these documents. Second, documents can be collected in central repository. It must be emphasized that observation of the metadata of an e-health portal can violate the privacy of users and hence improvement is required. Since ehealth portals can be accessed via internet hence security and privacy have to be handled carefully. By means of transmission encryption protocols such as SSL/TSL which ensure the confidentiality of transmission data these attacks can be easily prevented. In order to protect

privacy documents additionally needed to be encrypted to prevent unauthorized access.

The ehealth portal can be classified by means of personalization of their offered services. Public portal which do not require explicit authentication procedure and hence privacy is important and can be achieved by anonymous communication system. Other portals are which offer a personalized management of person related data and interaction of several users. We can divide this class into three subclasses-

1. Plaintext portals- use challenge-response authentication (username/password) and access control lists as well as role based access control authorization purposes.
2. Encrypted portals- store their content in an encrypted fashion. Encryption can either be performed by client side or server side encryption. Server side encryption does not yield high level of security than plaintext portals. But improvement of security can be achieved by client side encryption.
3. Pseudonymized portals- it can be described by means of encryption of the content data and the additional protection of the metadata of the system. Metadata is protected via a mechanism, pseudonymization. Every user U_i choose randomly a second identifier PU_i i.e. pseudonym which is used to identify his share. To prevent linkage between user and his pseudonym, it is stored in encrypted form $EU_i(PU_i)$ in the user repository. The unlinkability holds since PU_i is independently chosen. In order to hide links between users and documents every elements of the tuple need to be pseudonymized.

The use of **identity management** can prevent disclosure attack. It can be described by means of dividing the identity of a person into sub-identities $I = \{ I_{pub}, I_1, \dots, I_k \}$ Whereas each of these is represented by a user chosen pseudonym e.g. PI_k .

4.4 Privacy Preserving EHR Linkage using Pseudonym

Architecture for linking electronic medical records in a way that patient will have control, what information is revealed about them, through indirect pseudonym identifiers [11]. Establishing EHR system introduces the problem of linking the information already accumulated about each patient, and possibly their relatives, in isolated databases. Hence it creates three distinct privacy issues. (a) The need to link only those records belonging to the same patient. (b) The need to allow patients to keep certain linkage private. (c) The

need to override privacy rule in special circumstances. Architecture for maintaining patient identifiers that satisfies all three needs. Assume the scenario where the patient has more than one EMR at different healthcare providers. All these EMRs are needed to link to allow them to be aggregated to form single EHR for viewing by authorized healthcare providers, but do so in a way that protects the patient's privacy wishes.

Each EHR will contain several aspects from the patient's distributed medical records. To achieve this, a unique identifier could be used among all the EMR system, making the patient identifiable in all databases via a single identifier. But the problem in implementations is related to severe data format interoperability. The concept of unique identifier may violate patient's privacy wishes to maintaining several distinct identifiers. Hence it is needed to access and aggregate the patients EMRs and same time ensuring that the patient's privacy concerns are satisfied. The following requirement is desired to consider-(a) must be constructed in secure and accurate way (b) patient's local identities should not be disclosed to any external party (c) patients should be only individuals who know about the location of their EMRs.

It consider existing federal identity management (FIM) techniques to allow users to make a link between local identifiers by creating a federated pseudonym identifier. It determines a set of intersections between an identity provider (IdP) and a service provider (SP) to facilitate services such as log-on, attribute exchange and account linking. IdP authenticate users and produces assertions of authentication and attribute assertion in accordance with security specification markup language (SAML). Healthcare provider works as IdP to SP. By this approach patient could link their local identities at different healthcare providers. This result a new link between patients's EMRs. Linking can be done through federated pseudonym identifier which is associated with each local identity. But this approach does not satisfy above (c) requirement. Above approach is extended to solve mentioned problem. This architecture consists of four functions:-

1. Identity linkage- it is core component of EHR system's identity management architecture. It provides authentication and linkage.
2. Access control- it is responsible for evaluating all access requests as per the access control policies set by the patient and the medical authority.
3. Auditing function- it registers (logs) all user requests and activities that occur within the EHR system.
4. Record aggregation – it is responsible for normalizing the received EMRs and

aggregating them in way that preserves data integrity and produces a comprehensive and consistent EHR. Furthermore data aggregation risks creating unintended channels of information flow, by creating links between separate of information.

V CONCLUSION

EHRs must be designed to capture relevant clinical data using standardized data definitions and standardized quality measure. Hence healthcare information system requires a well accepted solution which can handle all the security and privacy issues.

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AN OVERVIEW ON NEW GENERATION INTERNET CONNECTED AUTOMOTIVE CARS

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Abstract— IoT (Internet of Things) is emerging fast and becoming basic necessity in common life. With the advancements of technology, using it in our daily life is nothing new. The impact of technology in daily life of a person can be seen in almost all aspects. In today's world everything can be easily analyzed and monitored using information from connected devices. Using technological enhancements in IoT 'Connected Cars' can be implemented by various automobile industries. Present article overviewed reveals on the various types of intranet technology which are associated with connected cars and also highlighting the merits and future aspects of new generation internet connected automotive cars.

KEYWORDS: Internet of Things, New generation, Connected Cars, Technology.

I. INTRODUCTION

The Internet of things (IoT) is an arrangement of interrelated registering devices, mechanical and computerized machines furnished with one of kind identifiers (UIDs) and the capacity to move information over a system without expecting human-to-human or human-to-PC interactions [1]. IoT innovation is generally interchangeable with items relating to the idea of the "smart home", including gadgets and apparatuses that help one or more normal biological systems, and can be controlled by means of gadgets related with that environment, for example, cell phones and smart speakers. The impact of technology in daily life of a person can be seen in almost all aspects. In today's world everything can be easily analyzed and monitored using information from connected devices. Using technological enhancements in IoT 'Connected Cars' can be implemented by the automobile industries [2-3]. These are the cars which are associated with other vehicles and are capable of internet connectivity. In such car which communicates with other system outside the car bi-directionally. Connected cars offer a wider range of communication possibilities than many other connected devices. Apart from enabling their users to gain

real-time access to all sorts of information, they can facilitate contact between the car and the dealership and alert the emergency services which involved in case of an accident [4]. A connected car is one that has its own connection to the intranet, usually through a wireless local area network (WLAN) that allows the car to share internet access and data with other devices inside and outside the car. Connected car has eight function categories are mobility management, commerce, vehicle management, breakdown prevention, safety, entertainment, driver assistance and well-being [5]. Connectivity is accelerating in technological innovations in today's world. High-speed computers make the car aware of its surroundings, which further helps in self-driving. The Internet of Things will be used to provide mobile services in car with high-speed internet as shown in Figure 1 [6].



**Figure1. Shows an overview of internet of things
II DIFFERENT MODES OF CONNECTIVITY**

There are five different ways a vehicle can be associated with its environmental factors and speak with them:

- (a) **V2I ‘Vehicle to Framework’:** The innovation catches information created by the vehicle and gives data about the foundation to the driver. The V2I innovation imparts data about wellbeing, portability or condition related conditions.
- (b) **V2V ‘Vehicle to Vehicle’:** The innovation imparts data about speed and position of encompassing vehicles through a remote trade of data. The objective is to keep away from mishaps, ease gridlocks and positively affect the earth.
- (c) **V2C ‘Vehicle to Cloud’:** The innovation trades data about and for uses of the vehicle with a cloud framework. This permits the vehicle to utilize data from other; however the cloud associated ventures like vitality, transportation and savvy homes and utilizes IoT.
- (d) **V2P ‘Vehicle to Passer by’:** The innovation detects data about its condition and conveys it to different vehicles, foundation and individual cell phones. This empowers the vehicle to speak with people on foot and is proposed to improve security and portability out and about.
- (e) **V2X ‘Vehicle to Everything’:** The innovation interconnects a wide range of vehicles and framework frameworks with another. This availability incorporates vehicles, expressways, boats, trains and planes.

III CATEGORIES IN WORK

The associated vehicle portion can be additionally grouped into eight categories.

- **Mobility management:** The capacities that permit the driver to arrive at a goal rapidly, securely, and in a cost-productive way instance Flow traffic data, Parking area or carport help, Upgraded fuel utilization.
- **Commerce:** The capacities empowering clients to buy great or administrations while in a hurry example fuel, food and drink, stopping, tolls.
- **Vehicle management:** The capacities that guide the driver in lessening working expenses and improving convenience instance vehicle condition and administration updates, distant activity, move of use information.
- **Breakdown prevention:** It is associated with a breakdown administration, with a back end calculation anticipating breakdowns and an outbound assistance mediating by means of telephone, SMS or pop-up message.
- **Safety:** Its work that caution the driver of outer perils and inward reactions of the vehicle to risks example crisis breaking, path keeping, versatile journey control, vulnerable side article ID.
- **Entertainment:** The abilities including the amusement of the driver and travelers instance cell phone interface, WLAN hotspot, music, video, Web, web based life, versatile office.

- **Driver assistance:** The capacities including halfway or completely programmed driving exampleoperational help or autopilot in substantial rush hour gridlock, in stopping, or on interstates.
- **Well- being:** The capacities including the driver's solace and capacity and wellness to drive instance weakness identification, programmed condition acclimations to keep drivers ready, clinical help [7].

IV WORKING PROCEDURE

An associated vehicle can help with a wide scope of possibly valuable capacities. For instance, your vehicle's sat-nav framework may have a traffic checking highlight that can caution you if there's a hold-up on your course and offer an elective that keeps away from it. It can be likewise utilize a cell phone application to do things like turn over your's motor distantly minutes before you need to go out in it, with the goal that the windows are without ice and the inside is hot when you're prepared to leave as shown in Figure 2. It can be likewise distantly bolt the vehicle or make it streak its headlights or blare its horn to assist you with discovering it in a vehicle leave. Some vehicle applications can likewise park the vehicle for you, which is extraordinary in the event that you have to shoehorn it into a minuscule space or restricted carport. Numerous vehicles presently likewise have an attendant service that lets you converse with a client care supplier to get data and bearings. In case you're en route to a new city, for instance, you can request that the framework find and additionally book a parking spot near your goal. These frameworks can likewise be utilized to book your vehicle in for assistance and now and again to perform distant flaw analysis on the vehicle.



Figure 2. Shows cell phone application based features.

EMERGENCY ASPECTS Before all the most recent capacities opened up, vehicle producers were at that point utilizing far off availability to help drivers in crisis circumstances. In fact, Vauxhall's OnStar service, which was launched in the mid-1990s, was the first onboard system that could contact the emergency services in the event of an accident. Since March 2018, EU legislation has made it mandatory for all new cars to have a system that tells the police when a car has been involved in an accident. The frameworks use GPS information to pinpoint the vehicle's area so help can get to them as fast as could be expected under the circumstances [8].

1) PASSENGERS ASPECTS

2) *Present day associated vehicles can make wi-fi hotspots, empowering those in and around the vehicle to utilize its 4G. This improves the diversion for travellers, reducing the odds so frequently.*

V APPLICATION

Applications can be categorized into two classifications: Single vehicle applications in which such cars In-vehicle substance and administration applications executed by a solitary vehicle regarding a cloud or back office. The second application is Co-operative safety and efficiency applicationsit includes they give network between vehicles (or foundation) legitimately need to work cross-brand and cross-outskirts and

require principles and guideline. Some might be comfort applications, others wellbeing, which may require guideline.

FINDINGS

Associated cars connect not only with people and associated services, but these cars are also able to connect to similar connected cars as well as the infrastructure associated with the road's network. As the emergence of self-driving cars continues and use of these cars increases, the above mentioned attributes will become increasingly important. To create a digital map of their vicinity, these self-driving cars will use technology such as the likes of cameras, lasers and even radars. To decide for any particular action e.g braking, accelerating, or making a turn, these cars will be constantly communicating and exchanging information between themselves. In effect, this ability will let the self-driving car see through the ones around itself and therefore, anticipate their movements. These cars will also be able to get information from several sources associated with traffic management, such as traffic lights, road signs, lane markings and roadwork signs, as they are connected with high speed internet. This will, in real time, give you a heads-up about a potential traffic jam or a sharp bend in the road ahead before you can even see it, hence making the travel less risky and much more time saving as shown in Figure 3[9].



Figure 3. Illustrates the time saving and safe technology of connected car.

VI CONCLUSION

In such connected car have key feature which enables real time traffic control and interaction with the car manufacturer service for remote diagnostics. Furthermore, in the beginning of the self-driven car era, the internet will be used for information exchange between the cars for better accidental report and route selection. Many of the leading car companies, in association with technology companies are working on creating the fully functional prototype of a self-driving car. Some that not have been produced fully autonomous features, but do provide the user with some semi-autonomous capabilities that are linked with the user safety, such as cross traffic alert, emergency braking, blind spot monitoring, adaptive cruise control and lane keeping assistance.

6. FUTURE CHALLENGES

In spite of the fact that the associated vehicle offers bunches of advantages and energy to the drivers, it additionally faces downsides and difficulties;

- A significant issue with the associated vehicles is hack-ability. The more it is associated with the web and to the framework, it turns out to be more presented to being infiltrated from outside.
- Unwavering quality is additionally a significant concern. Vehicles, sensor, and system equipment will breakdown. The framework needs to manage off base information, just as defective interchanges, for example, refusal of administration assaults.
- Protection is another measurement, both with hacking and with different employments. Touchy information accumulated from the vehicle, for example, the area, driver's day by day course,

applications that are utilized, and so forth are on the whole defenseless to be hacked and utilized for unauthorized purposes.

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Image Enhancement and Classification Techniques for Motion Blurred Dermatological Images

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Abstract— Dermatological diseases are most common skin diseases amongst human beings. They can be highly infectious and may also lead to severe skin problems. Skin images when captured under poor lighting conditions, distortions introduced in the images due to the motion of either the capturing device or subject might result in misleading diagnosis of the disease. In such cases, the poor image quality should be improved with the help of image enhancement techniques before their classification into respective disease category. Therefore, genetic algorithm (GA) based approach used as an image enhancement technique has been proposed to improve the low quality of the dermatological disease images. This will be followed by using various convolution neural network for classifying these enhanced dermatological images in their respective classes and comparing the classification accuracy of the various CNNs for the blurred images with the GA enhanced images.

Keywords— Convolution Neural Networks, Dermatological diseases, Genetic Algorithm, Image Enhancement, Skin diseases.

I. INTRODUCTION

Skin protects human beings against injuries, infections, and various day to day hazards. Dermatological diseases are most common skin diseases amongst human beings. They can be highly infectious and may also lead to severe skin problems [1]. These days, dermoscopy, which is a high resolution visual imaging technique is used for the identification and diagnosis of the skin cancers [2]. The detection rate of the technique is of 75–84% and it mainly depends upon the expertise of the physician [3-7]. However, hypothesis is that machine learning based algorithms may enhance the accuracy of the detection and identification of the skin cancers reliably with minimum load on the expertise of the dermatologists in the field of cancer. Sometimes dermatological images might be distorted due to various factors like motion blurring while capturing the images, environmental factors, etc. In such cases, image enhancement technique should be adopted. Image enhancement transforms images to provide better visual representation of the hidden details of the image. It is an important tool for researchers in various fields including (but not limited to) forensics, medical imaging, atmospheric sciences, art studies, etc [8].

Enhancement techniques change the appearance of an image in such a way that the information contained in that image is clearly interpreted visually than the original image [9]. There are several methods which are used for the image enhancement like homomorphic filtering, multi-scale adaptive histogram, dynamic histogram equalization, homological transform techniques, unsharp masking etc. [10-15]. The main shortcomings of these techniques are under enhancement, and over enhancement. Therefore, for the enhancement of

dermatological images as their diagnosis should be accurate we have proposed Genetic algorithm (GA) methodology to be used for enhancement of motion blurred dermatological images. This is one of the best optimization approaches for enhancement of images [16-17].

GA was introduced by John Holland and it mimics the biological evolution process of the nature discovered by Charles Darwin [18]. It finds wide application in, feature extraction, classification, segmentation, etc. [19-21]. It was observed by Munteanu C. et al. [22] that better results could be obtained using GA in comparison to other methods like linear stretching. GA has found its application in developing input-output relation between their gray levels for enhancing the contrast of the given images [23-24]. When the dermatological images are enhanced these need to be classified into their respective classes. These days, Artificial Intelligence (AI), Machine Learning (ML), and particularly Convolution Neural Networks (CNN) are used for identification and classification of diseases from images obtained from different sources [25-30].

Yu et al. [31] carried out classification of skin lesions using CNN by taking dermoscopy images of acral melanoma and benign nevi. A total of 724 images were used in his investigations giving an accuracy of more than 80%. Accuracy more than 97% has been also reported by Albahar et al. Various CNN models like VGG, AlexNet, GoogLeNet, and ResNet models have been investigated for the classification of skin lesions [32-33].

In this paper, genetic algorithm (GA) based approach is proposed as an image enhancement technique to improve the low quality of the motion blurred dermatological disease images. This will be followed by using various convolution neural networks for classifying these enhanced dermatological images in their respective classes and then comparing the classification accuracy of the various CNNs for the blurred images with the GA enhanced images.

II. PROPOSED METHODOLOGY

Genetic algorithms are the heuristic search optimization techniques that mimic the process of natural evolution. Genetic Algorithm (GA) performs efficient search in global spaces to get an optimal solution GAs are basically the natural selection process invented by Charles Darwin. Initially, the children are formed from parent genes. The fittest individuals are only allowed to survive. GAs manipulates a population of potential solutions for the problem to be solved. Mostly solution is coded as a binary string that is equivalent to the genetic material of individuals in nature. Each solution is associated with a fitness value.

There are various operator associated with the GA which are represented in Fig. 1. These operators are selection, crossover and mutation to get the next generation which may contain chromosomes providing better fitness [34]. Selection stage specifies which solutions are to be preserved and allowed to reproduce and which are deserve to die out. There are various methods to implement selection in genetic algorithms such as, roulette wheel selection, rank selection, etc [35]. The next operator is crossover which is used to create new solutions from the existing solutions available in the mating pool after applying selection operator. Mostly crossover selects any two solution strings randomly from the mating pool and some portions of the strings are exchanged between the strings. Introduction to probability of crossover is done for giving freedom to an individual solution string to determine whether the solution would go for crossover or not .Last operation is the mutation which leads to the introduction of new features in to the solution strings of the population pool for keeping the diversity in the population [36].

In order to enhance the motion blurred dermatological images, we have proposed to use GA as the enhancement technique. We have proposed to generate ten random chromosomes for carrying our investigations. The chromosome structure used in GA enhancement will be having varied parameters. These will include filter size, radius representing influential filter, sigma specifying the standard deviation, length l , specifying the length of the motion, and θ defining the angle of motion in degrees in a counter-clockwise direction. The value of length will be varied in the range 9 to 80 and that of theta from 0 to 10 degrees. For

mutation, random candidate from the best 70-85% population will be randomly selected. The algorithm will be running for about 1000 generations for each blurred dermatological image. Fitness value (or image quality) naturalness image quality evaluator (NIQE) is proposed to be used for intermediate quality assessment [37].

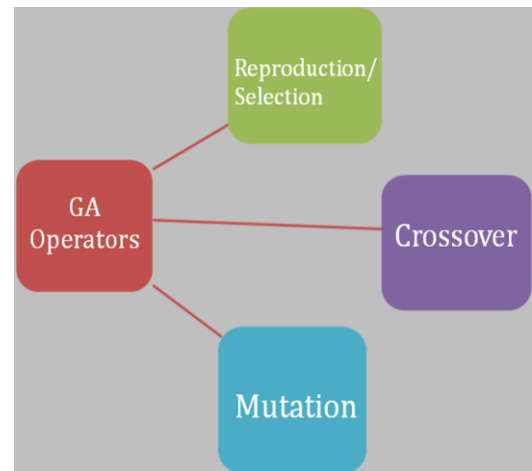


Fig. 1. Various operator of Genetic Algorithm.

In order to classify these enhanced images into their respective disease category, we propose to adopt CNN method as it provides high accuracy results. Convolutional neural networks are neural networks using mathematical convolutional operation instead of deriving parameters by simple multiplication as used in other simple neural network architectures. Fig. 2 shows the relationship between artificial intelligence, machine learning and deep learning.

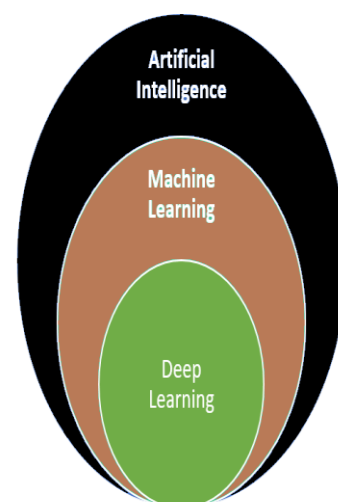


Fig. 2 Relationship between artificial intelligence, machine learning and deep learning

As seen from Fig. 2, we see that deep learning gives inner insight of the objects. Therefore, we propose to use various CNNs for the classification of the enhanced dermatological images using GA approach. In general, a CNN is a hierarchical neural network consisting of various layers such as the convolutional layers, pooling layers, and fully connected layers [38-40]. There are various available variants of CNN. These are AlexNet , GoogLeNet , VGGNet , and ResNet, etc., differing in depth, learning rates, and dropout rates, etc. [41-45]. There are a number of activation functions available for CNNs. Table 1 shows important activation functions used in CNN [46] .

Table I. Activation functions for classification

| Classification Tasks | Activation Function |
|----------------------------|---------------------|
| Binary classification | Sigmoid |
| Multiclass to single class | Softmax |

In our proposed methodology, the GA enhanced images will be randomly split into training and testing subsets . Training set will be augmented by incorporating distortions in the available images, thereby, increasing the images in the training set. The training and testing will be carried out by using CNNs [41-45]. After the classification using different CNNs, a comparative analysis will be conducted for selecting the CNN whose classification accuracy will be maximum. We also propose to compare the classification accuracy of the overall as well as individual classes when CNN is used for GA enhanced and motion blurred images.

For carrying out various investigations, Fig 3. shows the categories of various dermatological diseases. There are seven classes of diseases which we will be taking for carrying out our investigations. The input lesion images of the seven classes are taken from the HAM10000 dataset in which images were acquired from all anatomic sites (excluding mucosa and nails). The images are in JPEG format.

III. CONCLUSION & FUTURE SCOPE

This paper describes prevalence of dermatological diseases amongst human beings and utmost care should be taken care for their timely diagnosis as they can be highly infectious and may sometime even lead to skin cancer. Dermatological images may have distortions introduced in the images due to the motion of either the capturing device or subject resulting in misleading diagnosis of the disease. In such cases, the poor image quality should be improved with the help of image enhancement techniques before their classification into respective disease category. Therefore, we have proposed genetic algorithm (GA) based approach to be used as an image enhancement technique to improve the low quality of the dermatological disease images. This will be followed by using various convolution neural network for automatically classifying these enhanced dermatological images in their respective classes and comparing the classification accuracy of the CNN for the blurred images with that of the enhanced images obtained from GA Implementation of the complete proposed methodology for rural areas is on our future plan.

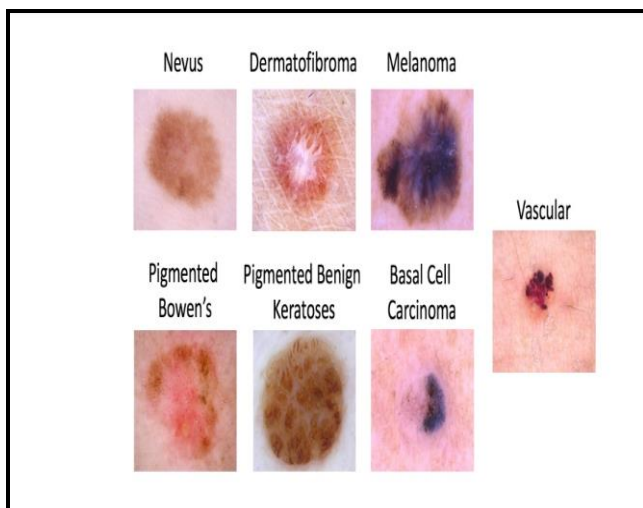


Fig. 3. Proposed categories of dermatological diseases to be taken for investigation

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