AIoT AND BIG DATA ANALYTICS FOR SMART HEALTHCARE APPLICATIONS

Editors:
Shreyas Suresh Rao
Steven Lawrence Fernandes
Chandra Singh
Rathishchandra R. Gatti
Harisha A.
Rohanchandra R. Gatty

Bentham Books

IoT and Big Data Analytics

(Volume 5)

AIoT and Big Data Analytics for Smart Healthcare Applications

Edited by

Shreyas Suresh Rao
Department of CSIS, BITS-PILANI, WILPD
Pilani, Rajasthan 333031, India

Steven Lawrence Fernandes
Department of Computer Science, Journalism and Design
Creighton University, NE, Omaha, USA

Chandra Singh
Department of ECE, Sahyadri College of Engineering &
Management Sahyadri Campus,
Adyar Mangalore Taluk, India

Rathishchandra R. Gatti
Department of Mechanical Engineering
Sahyadri College of Engineering & Management
Sahyadri Campus, Adyar
Mangalore Taluk, India

Harisha A.
Department of CS&E, Sahyadri College of Engineering & Management
Sahyadri Campus,
Adyar Mangalore Taluk, India

&

Rohanchandra R. Gatty
Department of Surgical Oncology, Father Muller Oncology Centre
Mangaluru, Karnataka 575002, India

IoT and Big Data Analytics

(Volume 5)

AIoT and Big Data Analytics for Smart Healthcare Applications

Editors: Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh,
Rathishchandra R. Gatti, Harisha A. and Rohanchandra R. Gatty

ISSN (Online): 2972-4155

ISSN (Print): 2972-4147

ISBN (Online): 978-981-5196-05-4

ISBN (Print): 978-981-5196-06-1

ISBN (Paperback): 978-981-5196-07-8

First published in 2023.

Bentham Science Publishers Pte. Ltd.
80 Robinson Road #02-00
Singapore 068898
Singapore
Email: subscriptions@benthamscience.net

BENTHAM
SCIENCE

CONTENTS

PREFACE

AIoT stands for Artificial Intelligence of Things, which refers to the integration of artificial intelligence (AI) technologies with Internet of Things (IoT) devices. The combination of AI and IoT is intended to create smarter and more efficient devices, systems, and applications. By using AI to analyse and interpret the large amounts of data gathered from IoT devices, AIoT applications can provide insights, predictions, and automations that can optimize performance, reduce costs, and improve user experiences. Some of the noted examples of AIoT applications include smart homes, connected vehicles, intelligent manufacturing systems, and smart cities.

On the other hand, big data analytics refers to the process of examining and analyzing large and complex data sets to uncover patterns, correlations, and insights that can be used to make better decisions and improve business outcomes. The term "big data" refers to the massive amounts of data generated by various sources such as social media, sensors, mobile devices, and other digital platforms. The primary goal of big data analytics is to extract useful information from large volumes of data that would be impossible or too time-consuming for humans to analyze manually. By using advanced analytical techniques such as data mining, machine learning, and natural language processing, big data analytics can uncover hidden patterns, identify trends, and extract valuable insights from massive data sets. Big data analytics has many applications across a wide range of industries, including healthcare, finance, marketing, retail, and more. It can be used to improve customer engagement, optimize business operations, reduce costs, and develop new products and services.

AIoT and big data analytics have a lot of potential for transforming healthcare by enabling the development of smarter and more efficient healthcare systems. AIoT devices can collect patient data in real-time from wearable devices, sensors, and other connected devices. Big data analytics can then be used to analyze this data to provide personalized treatment recommendations and to detect early warning signs of health problems. By analyzing large amounts of patient data, big data analytics can be used to predict potential health problems before they occur. This can enable healthcare providers to take proactive measures to prevent or treat these problems before they become more severe.

AIoT and big data analytics can be used to develop more accurate and effective diagnostic tools and treatment plans. For example, machine learning algorithms can be used to analyze medical images and other diagnostic data to identify patterns and make more accurate diagnoses. Big data analytics can be used to optimize healthcare resource allocation, such as hospital bed management, staff scheduling, and medical supply inventory management. This can help healthcare providers to reduce costs and improve patient outcomes. AIoT and big data analytics can be used to speed up the drug discovery and development process by identifying potential drug candidates and predicting how they will interact with the body. AIoT and big data analytics can be used to improve patient engagement and adherence to treatment plans. AIoT and big data analytics can be used to manage the health of populations, rather than just individual patients. By analyzing large amounts of data from multiple sources, healthcare providers can identify health trends, risk factors, and patterns of disease across entire populations. This can help healthcare providers to develop targeted interventions and preventive measures to improve population health outcomes.

AIoT and big data analytics can provide real-time insights and decision-making support to healthcare providers. For example, AI algorithms can analyze patient data in real-time to provide clinical decision support to doctors and nurses, such as recommending appropriate treatments based on the patient's condition. AIoT and big data analytics can be used to create smart hospitals that are more efficient and patient-centered. the integration of AIoT and big data analytics in smart healthcare has the potential to revolutionize the healthcare industry, enabling more personalized, efficient, and effective healthcare services. However, it is important to ensure that these technologies are used in a way that protects patient privacy and confidentiality, and that healthcare providers are equipped with the necessary skills and resources to effectively leverage these technologies.

This book discusses open principles, methods, and healthcare AIoT research issues. It also summarises AIoT research efforts and potential directions.

ORGANIZATION OF THE BOOK

The book is organized into 17 chapters discussing the wide range of **AIoT & Big-Data Analytics for Smart Healthcare Applications.**

The first chapter focuses on **semantic AIOT concepts and their applications in healthcare**. In this, the authors highlight some developments in semantic technology, its effects in the IoT area, and how they are seen in healthcare. Over the last several times, there has been much emphasis on using SWT to enhance the uptake of sensor networks, IoT, and WoT. Indeed, to tackle semantic interoperability and other issues in healthcare domains, there is a need to comprehend its means of construction.

The second chapter discusses **the IoT-based Sleeping Disorder Recognition System for Cognitive impairment Diseases**. This chapter focuses on This chapter describes the state of art technologies involved in sleep monitoring and also discusses the challenges and opportunities involved, from the initial step of acquiring the data to the applicability of the acquired data based on the consumer level and clinical settings.

The third chapter, titled **Recent Trends in Smart Health Care: Past, Present and Future information,** focuses on The essential technologies that underpin smart healthcare are briefly described, together with the successes and challenges they have faced, the current status of these technologies in important medical areas, and the possibilities for the future of smart healthcare.

The fourth chapter, **A Monitoring System for the Recognition of Sleeping Disorders in Patients with Cognitive Impairment,** briefly introduces the chapter and will review the advantages and disadvantages of the extant and novel sensing technologies, focusing on new data-driven technologies that include Artificial Intelligence.

The fifth chapter, titled **Early prediction in AI-enabled IoT environment,** discusses Intelligent sensing devices. These machines use internet facilities to communicate with each other. The devices have different capacities and capabilities. They communicate over a common platform.

The sixth chapter, titled **AI and Blockchain-based Solution for Implementing Security for Oral Healthcare 4.0 Bigdata** This chapters objective is to review data security applications in the healthcare domain using blockchain technology and present the highlights from selected survey papers and carried out compare the work & implement data security using a web-based prototype based on blockchain technology.

The seventh chapter, **An Artificial Intelligence-based method for detecting false news in Health Sector during a pandemic,** focuses on developing a Machine Learning model for deception detection using Natural Language processing techniques and machine learning algorithms. It detects fake news from non-reputable sources, which misleads people and distracts them from fraud messages and unnecessary texts, by building a model using count vectorize, TF-IDF and logistic regression algorithm.

The eighth chapter, titled **“Intelligent Framework for Smart Health Application using Image Analysis and Knowledge Relegation Approach**”, highlights Diabetic retinopathy and uses fundus images of the eys and used knowledge relegation approach. This chapter also illustrated five classes of retinopathy and classifier accuracy.

In the ninth chapter, titled **Brain Stroke Prediction Using Deep Learning,** The proposed system is contrasted with the existing system, showing an enhancement in the capability to anticipate the stroke. The proposed system achieved an accuracy of 89%.

The tenth chapter, titled **Secure Electronic Health Records Sharing System using IoT and Blockchain,** focuses on combining blockchain and cryptography to develop a secure platform for providing patients full control over their health records and maintaining data integrity.

The eleventh chapter, titled **Geofencing For Elderly** To Improve Surrounding Estimation in Automated Electric Vehicles, discusses applications built for older adults. Through this application, the person gets the direction to return home, or the alert message is sent to the family member or the caretaker. The alert message is sent while the person is out of the fencing area, oneself or the caretakers, and the person's location can be tracked.

The twelfth chapter, **I am the Eye-Assistive Eye,** describes this device's vision to design and construct the blind-friendly embedded device. The blind and visually handicapped have difficulty utilizing mobile phones because social media and online banking programmes on smartphones are difficult for them to use.

The thirteenth chapter, titled **Stage of retinopathy of prematurity using Convolution Neural Network and Object Segmentation Technique,** focuses on The utility of the Convolutional Neural Network was examined to localize ridges in neonatal photos that have been labelled. The KIDROP study and a dataset comprising 220 photos of 45 infants were used. With the segmentation of the ridge region as the ground truth, 175 retinal pictures were used to train the system. The system's detection accuracy was 0.94 with 45 images under test, proving that data augmentation detection in conjunction with image normalizing pre-processing allows accurate identification of ROP inside its early stages.

The fourteenth chapter, titled “**An Overview of Recent Medical Applications in Soft-Robotics**, ” discusses how soft robotics can be applied in MIS and Notes. This chapter focuses on robotics applications in the medical field, soft robotics challenges and future directions in the healthcare industry.

The fifteenth chapter, titled **“Applications of AI-enabled Robotics in Healthcare”,** describes the importance of AI-enabled medical robots in the healthcare sector and is intended to deliver good outcomes to assist people in doing complex tasks that need a significant amount of time, accuracy, concentration, and other routines that cannot be accomplished solely through human capability.

The sixteenth chapter, titled “**An Overview of Current and Future Applications of Robotics in Surgical Operations”**, aims to overview robotics’ current and future applications in surgical operations and the advantages and disadvantages of surgical robots.

The seventeenth chapter titled "**Healthcare Applications Centered on AIoT**" Provide interconnection between the AIOT and Healthcare system. It also focuses on issues in IoT Healthcare, remote health monitoring and wearable devices which can be used to take medical readings.

Shreyas Suresh Rao
Department of CSIS, BITS-PILANI, WILPD
Pilani, Rajasthan 333031, India

Steven Lawrence Fernandes
Department of Computer Science, Journalism and Design
Creighton University, NE, Omaha, USA

Chandra Singh
Department of ECE, Sahyadri College of Engineering &
Management Sahyadri Campus,
Adyar Mangalore Taluk, India

Rathishchandra R. Gatti
Department of Mechanical Engineering
Sahyadri College of Engineering & Management
Sahyadri Campus, Adyar
Mangalore Taluk, India

Harisha A.
Department of CS&E, Sahyadri College of Engineering & Management
Sahyadri Campus,
Adyar Mangalore Taluk, India

&

Rohanchandra R. Gatty
Department of Surgical Oncology, Father Muller Oncology Centre
Mangaluru, Karnataka 575002, India

ACKNOWLEDGEMENTS

First of all, we are grateful for the incredible opportunity provided to us by the publisher – Bentham Science and the series editor, Dr. Vishal Jain, for supporting us in realizing this book. We are also indebted to the contribution and support of our authors, who continuously helped us by timely sending the required information and coordinating with us. We would also like to thank our reviewers for their selfless service in conducting the reviews and providing sound advice to improve the accepted book chapters. Lastly, we would like to thank our students, family and friends, faculty fraternity and our respective organizations for their full-fledged support and motivation wherever required.

List of Contributors

Anita Chaware	P G Department of Computer Science, SNDT Womens University, Mumbai, India
A. R. Badrinath	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Abhishek Kamath	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Ambika N.	Department of Computer Science and Applications, St. Francis College, Bangalore, India
Abhishek Pathak	Department of Neurology, Institute of Medical Science, Banaras Hindu University, Varanasi 221005, U. P. , India
Akhila Thejaswi R.	Sahyadri College of Engineering & Management, Mangaluru, Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi, Karnataka, India
Blaren D'Silva	Department of Mechanical Engineering , Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
B. Hanumantha Rao	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
Bellipady Shamantha Rai	Sahyadri College of Engineering & Management, Mangaluru, Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi, Karnataka, India
B. M. Nischitha	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
B. Sahana	Electronics and Communication Engineering, RVCE, Bangalore, India
B. Sadhana	Electronics and Communication Engineering, RVCE, Bangalore, India
B. N. Shwetha	Nitte Meenakshi Institute of Technology, Bangalore, India
Gouda Shankar S.	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Harisha A.	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Habeeb ur Rehman	Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, India
Jyoti Kumar Barman	Department of Electrical & Electronics Engineering, Assam Don Bosco University, Assam, India
Jothimani K.	Computer Science and Engineering, Graphic Era Deemed to be University, Dehradun-248002, Uttarakhand, India
Jidynasa Patil	P G Department of Computer Science, SNDT Womens University, Mumbai, India
Kavya	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India

Kanagaraj Venusamy	Department of Mechatronics, Rajalakshmi Engineering College, Thandalam, Chennai, India
M. Pramod Rao	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Manoj	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Muadh Bin Mohammed Ali	Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, India
Mohammed Shayiz K. P.	Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, India
Mamatha Mohan	Information science and Engineering, Canara engineering, college Mangalore, Mangalore, India
Manish Poojary	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Mohammed Nouman	Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, India
Mohammed Thajuddin Sanad	Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, India
Nishan Rai	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
N.V. Maha Lakshmi	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
Niriksha Shetty	Manipal School of Information Sciences, Manipal, India
Nupur Choudhury	Department of Computer Science & Engineering , Assam Don Bosco University, Assam, India
Praveen Honavar	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Preethi	Manipal Institute of Technology, Bengaluru Manipal Academy of Higher Education, Manipal, Karnataka 576104, India
Priya Dev	Department of Neurology, Institute of Medical Science, Banaras Hindu University, Varanasi 221005, U. P. , India
P. C. Shrihari	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Permanki Guthu Rithesh Pakkala	Sahyadri College of Engineering & Management, Mangaluru, Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi, Karnataka, India
Pravinth Raja	Nitte Meenakshi Institute of Technology, Bangalore, India
R. Banupriya	Departement of Electronics and Communication Engineering, PGP College of Engineering & Technology, Tamilnadu, India
R. Nagarajan	Department of Electrical and Electronics Engineering, Gnanamani College of Technology, Tamilnadu, India

Rupesh Mandal	Department of Computer Science & Engineering , Assam Don Bosco University, Assam, India
Rahul Bhandari	NITTE (Deemed to be University)-ABSM Institute of Dental Sciences, Mangalore, India
Rathishchandra R. Gatti	Department of Mechanical Engineering , Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Sapna R.	Nitte Meenakshi Institute of Technology, Bangalore, India
Shreyas Suresh Rao	Department of CSIS, BITS-PILANI, WILPD Pilani, Rajasthan 333031, India
S. Kannadhasan	Departement of Electronics and Communication Engineering, Study World College of Engineering, Coimbatore, Tamilnadu, India
Sreekantha Desai Karanam	NITTE (Deemed to be University)-NMAM Institute of Technology, Nitte, Karnataka, India
Sindhu Rajendran	Ramaiah Institute of Technology, Institute of technology, Bengaluru, Karnataka, India
Sri Silpa Padmanabhuni	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
Shiji Abraham	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Srinivas P. M.	Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
T. Krupa Nandini	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
T. Sai Teja	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
U. Vamsidhar Reddy	Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India
Veerishetty Arun Kumar	Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India
Vidhya Banu	Sambhram Group of Institutions, Bengaluru, Karnataka, India

CHAPTER 1

A Survey on Semantic AIOT Concepts and Applications in Healthcare

Sapna R.[1], **Pravinth Raja**[1], **Vidhya Banu**[2], **B. N. Shwetha**[1] and **Shreyas Suresh Rao**[3,*]

[1] *Nitte Meenakshi Institute of Technology, Bangalore, India*

[2] *Sambhram Group of Institutions, Bengaluru, Karnataka, India*

[3] *Department of CSIS, BITS-PILANI, WILPD, Pilani, Rajasthan 333031, India*

Abstract: The incorporation of semantics and the necessary interoperability within these aspects is essential for the domain's proper operation as well as execution. Healthcare systems have become an ideal arena of IoT because they tackle the problems of humanity, especially of an older population whilst providing secure and high-quality home care and support. The use of IoT technologies in healthcare will improve the quality of human life, chronic illness monitoring, hazard detection, and life-saving measures. To get more useful information from biomedical big data, it must have interoperability. In the latest times, an increasing count of organizations and businesses have expressed interest in combining semantic web technologies alongside healthcare big data to transform data into knowledge and understanding. Even though we can see a systematic acceptance of semantic technologies-based applications in the IoT domain and across the Internet, the cumulative actual implementations are insufficient to provide real-world rooted standards and guidelines to follow. This sets the stage for this work, which attempts to describe current developments in the application of semantic technologies in the IoT domain. This motivates the authors to examine and highlight some of the developing developments in semantic technology, its effects in the IoT area, and how they are together seen in the health-care. Over the last several times, there has been a lot of emphasis on using SWT to enhance the uptake of sensor networks, IoT, and WoT. Indeed, to tackle semantic interoperability and other issues in health care domains, there is a need to comprehend its means of construction.

Keywords: Health-care, Internet of Things, Ontology, Semantic Web, Semantic Web of Things.

* **Corresponding author Shreyas Suresh Rao:** Department of CSIS, BITS-PILANI, WILPD, Pilani, Rajasthan 333031, India; Tel: +91 9591782068; E-mail: shreyassureshrao@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

1. INTRODUCTION

1.1. The Importance of Healthcare and its Digitization

Healthcare is one of the most important sectors in any nation, both in monetary value and facilities available to humanity, as well as offering job opportunities to millions of individuals. Healthcare has been recognised as an important factor to economic opportunity, not only for general human well-being and happiness but also because healthier individuals live longer and are more productive, saving greater money. On a continuous basis, a health care system creates massive data from clinical practices, health treatment, apparatus, studies, and other sources, resulting in massive data to manage. In addition, established health services are running out of medical resources to meet people's expanding expectations. As a result, the healthcare system has been steadily moving in the use of electronic medical records with information and communication technologies.

1.2. Internet of Things

In the latest days, the virtual representation and connectivity of the internet with real items, gadgets, or things has grown at an accelerating rate. It has prompted society to create new IoT solutions to accommodate retrieving data and intelligent applications by capturing, accessing, storing, sharing, and communicating data. Moreover, the IoT's related dynamic nature, resource constraints, price, and structure necessitate design duties for it to be impactful, creating a barrier to the community. It is a thorny issue to grasp web data from machines as per the respective jargon in many disciplines. It brought different problems to researchers because, in this digital era, quite an attempt necessitates the use of semantically defined, relevant information resources. The proliferation of smart objects and IoT service providers, all of which are susceptible to time-consuming and sequences of events, as well as a lack of proper technology and development, has resulted in increased specificity [1].

The Internet of Things (IoT) age stands at this time, with a massive amount of IoT devices now in everyone's lifestyles. IoT technology, such as sensing devices, cell phones, and actuators, is used in a diverse range of products in Smart City applications, E-health, Defense, and other areas. The interconnectivity of things, which provides an integrated web of different access technologies, is among the important components of IoT. Huge volumes of data are gathered daily in all domains, and these records constitute incredibly important knowledge banks. The IoT sought to measure a scenario related to data understanding so that applications can think strategically.

A wide range of individuals especially with medical concerns is willing to integrate everyday life objects into the network in information technology in ensuring a comfortable existence. This integration is made possible with sensors, actuators, and RFID tags. Users now can view real-time data collected by linked objects during any specified moment. The IoT arose from the progress of using the internet with real-world things. The International Telecommunication Union (ITU) describes the IoT as a worldwide platform of information sharing that provides enhanced services to link things using current as well as developing interoperable telecommunications and information technology [1]. Furthermore, Perera *et al*. [2] stated, "The Internet of Objects enables users as well as things to be interconnected Anytime, Anywhere, with Anything and Anyone, preferably *via* Any path or network as well as Any service."

1.3. Internet of Things and Health Care

Rapid innovations in sensing technologies, behavior detection in smart homes, also of Ambient Assisted Living (AAL) assure folks who need technological assistance in residence, particularly those who require medical care. However, it is unlikely that ambient sensors capable of detecting whether people are healthy or begin to develop an illness will be widely *via*ble shortly. Indeed, various health care besides other domain devices and node sensors are increasingly interconnected, with the potential to perceive, transmit, and exchange information regarding their surrounding environments.

System components, including sensing devices and actuators, are coupled to gateways, intermediary computing nodes, and the cloud in healthcare, smart agriculture and other domains. An IoT ecosystem is created utilizing notions rooted in edge, fog, cloud, mist, and dew computing, as well as programmed networking, network virtualization, and streaming analytics, based on the associated methods. Presumably, machine learning and data analytics aspects should be included on top of it.

The IoT is typically focused on the Wireless Sensor Networks (WSN) field, which has taken shape amongst the most effective applications. WSN is widely used in various technology areas to promote easier supervision, owing to the sensing devices placed. For the IoT to be of meaningful use to patients, medical practitioners, customers, organizations, and urban designers, the data given by advanced devices must have meanings, because many applications can read it and react accordingly. The IoT is embracing and integrating numerous disciplines and the range of smart objects grows tremendously. It's becoming impossible to think of a space where IoT-based concepts have not been studied.

CHAPTER 2

IoT Based Sleeping Disorder Recognition System for Cognitive Impairment Diseases

Nupur Choudhury[1,*], **Rupesh Mandal**[1] and **Jyoti Kumar Barman**[2]

[1] *Department of Computer Science & Engineering, Assam Don Bosco University, Assam, India*

[2] *Department of Electrical & Electronics Engineering, Assam Don Bosco University, Assam, India*

Abstract: In the present scenario, healthcare has made significant progress with the assistance of smart devices involving effective sensors and Internet of Things devices. In context to this, the combination of IoT and cloud architectures are rigorously exploited in order to process the large amount of data that would be generated by the wearable sensor networks in near real-time applications by making use of Artificial Intelligence supporting smart healthcare systems. In the current scenario of globalization, in addition to the increased facilities, a wide variety of other challenges are worked upon for providing quality and efficient healthcare benefits and facilities by making use of cost-effective instruments and world class technologies.

An important factor for the physical and mental health of a human being, the performance throughout the day as well as safety is the sleep quality. Effective quality of sleep can help avoid the risk of mental depression and chronic diseases. Sleep promotes the brain to actively get associated with the activity that is being performed and helps in preventing various accidents that might be caused due to falling asleep. For the analysis of the sleep quality, a continuous monitoring system is necessary which generates effective results. With the aid of rapid improvisation of mobile and sensor technology as well as the emerging trends of Internet of things technology, there is a good opportunity of development of a reliable and effective sleep quality monitoring system. This chapter effectively describes the background and applicability of Internet of things for such systems involved in sleep monitoring. The study begins with the review of the quality of sleep, the importance related to the monitoring of sleep quality, the employability of Internet of things in this and its relevant field, as well as the open issues and challenges in this and its related fields.

The IoT technology supports the preamble which would promote a cost effective and consistent system in order to monitor the quality of sleep-in individuals. There are several existing systems for the same purpose which involves a large amount of cost and are cumbersome to implement. To overcome the same issue, the chapter narrates an inventive system for monitoring and analyzing sleep patterns by making use of eff-

[*] **Corresponding author Nupur Choudhury:** Department of Computer Science & Engineering, Assam Don Bosco University, Assam, India Tel: 9836136993; E-mail: nupur.choudhury@dbuniversity.ac.in

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

ective parameters. In this domain, a combination of clinical medicine, bioengineering, neuroscience, epidemiology, mHealth, Computer Science, as well as Human Computer interactio,n in order to approach the challenge of digitization of sleep from a multidisciplinary perspective. This chapter describes the state of art technologies involved in sleep monitoring and discusses the challenges and opportunities involved from the initial step of acquiring the data to the applicability of the acquired data based on the consumer level and clinical settings.

Keywords: Sleeping disorder, IoT in healthcare, Sensor technology, AI in healthcare, *etc*.

1. INTRODUCTION

Over several years, the human community has been experiencing changes in their bodies and their lives. One of such changes is the sleep alteration which would occur as and when age progresses. Particularly, one of the most dangerous and common respiratory disorders is the Obstructive Sleep Apnea Syndrome (OSA). These disorders work generally occur during sleep. In OSA, partial blockage or obstruction of the upper respiratory tract occurs for at least 10 seconds, which would prevent the proper oxygenation of the blood [1] for a maximum of 20 times to 30 times/hr of sleep. By making use of the apnea/hypopnea index (AHI) and counting the number of such instances, OSA is designated into three different classes having a severity range from high-low. Hence 5-15 times the occurrence of sleep disturbance in an hour of sleep means mild OSA, moderate OSA ranges from 15-30 times in an hour, and more than that is categorised as high OSA. These interruptions are also accompanied by clinical outcomes that are associated, which include emotional imbalances such as depression and irritation, deterioration of intellectual capabilities, decreased performance in psychomotor activities, personality disorders, as well as problems in behavioural aspects [2].

Therefore, the range of 5-15 times/hour is categorised as “mild”, “moderate” if the range is between 15-30, and “severe” is the interruptions occurring more than 30 times/hour [3]. This results in lower Quality of Life (QoL), As a result of the Quality of Life (QoL) and would multiply the related health problems and inclusive medical expenses. OSA generally affects 21% of the USA population and involves an account for an expense of around $16 million in health care each year [4].

During any stage of life, sleep apnea is a primary concern for health-related problems that it might cause. It is even more difficult for older people who are much more prone to respiratory problems during the night which are not easily diagnosed (which is more than 80%-90%) or are diagnosed in a simple manner as snoring. Some of the researches report that around 13-32% of the people who are above 65 years generally a victim of OSA [5], which is ever growing in various advanced countries in which there is an increase in the average life expectancy. The problem of having difficulty or having some trouble in falling asleep along with the lack of uninterrupted sleep resulted in a low QoL and has an increased risk of health for old people. Moreover, there are implications which occur in the long term as chronic disorders of sleep that include a parameter for having increased death risk [6].

Hence, the primary identification and diagnosing tool of OSA is an approach which is known as conventional polysomnography (PSG). PSG is a test which is performed throughout the night in a clinic which is specialized or in hospitals which are under constant support from the medical department that would unnecessarily increase the workload of the hospital. In addition to this, the method makes use of different sensors which could be considered intrusive and in context to this, it may also interrupt sleep [7]. Moreover, the increased PSG expenses would make it an extremely practical option for monitoring, which could be implemented in future.

Moreover, there would be several processes which are present for the treatment of OSA that would include the loss of weight, techniques related to sleep hygiene position, base and continuous open airway therapy (COAT), surgical intervention and continuous positive airway pressure (CPAP). CPAP is used for effectively treating OSA [8] and it is considered as a suboptimal measure as the risk is low when it is considered. This on the other hand, might bring in a requirement of providing an unobtrusive system which would function in real time for the identification of OSA and could support the treatment in a closed environment such as homes.

Multiple researches were proposed that would comprise of a variety of systems in order to identify the OSA episodes, generally by making use of sensors which could be worn and are incorporated in smart devices like various bands, bracelets, watches as well as telephones. These systems could identify OSA in almost real time by monitoring of physiological parameters, especially the respiratory rate, heart rate, and the saturation level of oxygen wirelessly through various technologies such as Wi-Fi [9], Bluetooth [10] as well as ZigBee [12] which has shown promising outcomes.

However, these systems are not capable of supporting syndrome treatment in the long term. Moreover, a smartphone, which is used for receiving and processing the data, is a necessary in order to make things work with the current system [11, 12]. Hence, all of these proposals are not suitable for monitoring the OSA patients

CHAPTER 3

Recent Trends in Smart Health Care: Past, Present and Future

S. Kannadhasan[1,*], **R. Nagarajan**[2], **R. Banupriya**[3] and **Kanagaraj Venusamy**[4]

[1] *Departement of Electronics and Communication Engineering, Study World College of Engineering, Coimbatore, Tamilnadu, India*

[2] *Department of Electrical and Electronics Engineering, Gnanamani College of Technology, Tamilnadu, India*

[3] *Departement of Electronics and Communication Engineering, PGP College of Engineering & Technology, Tamilnadu, India*

[4] *Department of Mechatronics, Rajalakshmi Engineering College, Thandalam, Chennai, India*

Abstract: Electronic gadgets, actuators, sensors, and software link every element of an active network. The Internet of Things is the name of this network (IoT). AI technology may help networks, sensors, and users create a large quantity of data by assisting in the collection of data and the development of applications. The combination of AI with IoT may advance fields including public safety, education, healthcare, energy, transportation, and other value-added services. Smart health care makes extensive use of the Internet of Things (IoT), notably in the areas of emergency services, intelligent computing, sensors, security, and remote monitoring. Data privacy, integrity, and freshness are just a few of the security issues that must be resolved in a smart hospital. Additionally, there are privacy risks for patients, data eavesdropping, data integrity, and unique identification. IoT technology may be used to monitor a patient's health as well as their data. A patient's status might be tracked remotely and in real time using the internet and other technologies. Additionally, it enables the early identification and treatment of diseases that pose a danger to life. Medical records may be gathered and statistical information on a patient's condition may be provided via an IoT-enabled gadget.

With the correct software, huge amounts of data may be handled quickly and without errors. As a consequence of these advancements, which strive to fulfil patients' unique requirements while simultaneously enhancing treatment effectiveness, modern medicine is on the verge of a renaissance. The essential technologies that underpin smart healthcare are briefly described, together with the successes and challenges they have faced, the current status of these technologies in important medical areas, and the possibilities for the future of smart healthcare. Sensors gather data, which is subseque

[*] **Corresponding author S. Kannadhasan:** Department of Electronics and Communication Engineering, Study World College of Engineering, Coimbatore, Tamilnadu, India; Tel: 9677565511;
E-mail: kannadhasan.ece@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

-ntly sent over the internet of things (IoT) to supercomputers and cloud computing for processing and analysis.

Keywords: Smart Health Care, Artificial Intelligence, IoT, Cloud Computing and Sensors.

1. INTRODUCTION

The problems associated with traditional hospital administration techniques include overworked medical staff, long wait times, and a deluge of paperwork. All of these constraints may be eliminated if IoT is used in the medical setting and unnecessary paperwork is swapped out for a centralised, automated database. It is feasible to monitor patients from a distance. The system is being used despite its many technical issues, idiosyncrasies, and shortcomings. Technology is promoting chatty hospital beds, Fitbits, and emergency drones. According to a recent analysis, IoT and AI may now be combined in a safe, clever, and effective way. Digitization has become common place in the contemporary period. As a consequence of technological advancements and changes in scientific theory, traditional medicine, which is largely dependent on biotechnology, has started to digitalize and informationize. New information technologies are now being used in healthcare. Smart healthcare is a multi-tiered conceptual change rather than merely a technology advance. In order to create a dynamic and intelligent administration in human civilization, social activities may be coordinated and integrated. Wearable technology, the internet of things, and mobile internet are used in smart healthcare to link people, resources, and institutions in the healthcare sector, dynamically access information, and then intelligently regulate and react to medical ecosystem needs. Smart healthcare may encourage dialogue among key players in the industry, ensuring that participants get the services they need, assisting parties in making educated choices, and easing resource allocation. In essence, smart healthcare involves collecting more data for medical reasons [1–6].

In order to provide intelligent healthcare, hospitals, research organisations, physicians, and patients must all work together. This complex organism encompasses a variety of functions, including disease prevention and surveillance, diagnosis and treatment, hospital management, health decision-making, and medical research. The basis of smart healthcare is modern biotechnology and information technology, including the Internet of Things, mobile Internet, cloud computing, big data, 5G, microelectronics, and artificial intelligence. These technologies are heavily used by smart healthcare in all of its components. Patients may employ wearable technology and virtual assistants to continuously check their health, while clinicians can use improved clinical decision support systems to speed up diagnosis [7, 8].

Surgical robots and mixed reality technologies may enable surgeons to carry out more accurate operations. In hospitals, integrated management systems that make use of RFID technology may collect data and assist decisions. The use of mobile medical platforms may enhance the experiences of patients. Big data can be used to find people who qualify, and techniques like machine learning can replace human drug testing at scientific research facilities.

The Internet of Things (IoT) is a crucial part of modern information technology. This is a network that spans the Internet as a consequence of the recent, significant growth in wireless communications. By linking various data-gathering gadgets to the Internet, the “Internet of Everything” may eventually become a reality (such as RFID, infrared sensors, and laser scanners, for example). Smart cities, smart homes, smart logistics, and smart transportation are just a few of the numerous Internet of Things applications now in use. One of these most important areas of application is smart health. Tens of thousands of individuals pass away each year as a result of different illnesses or medical conditions. Around 60% of fatalities worldwide are brought on by chronic illnesses. The physical health of more and more individuals is a worry. Smart health experts are concentrating on IoT technology because it may be utilised to address health issues. The Internet's digital and physical worlds are entangled with the IoT. The physical environment is in addition to household items, cars, business equipment, construction tools, and the human body. The Internet of Things (IoT) has the potential to enhance people's quality of life, manage chronic diseases, identify risks, and provide cures that might save their lives [9, 10].

There are several IoT applications in the healthcare industry. Take care of your physical health. Wearable technology can now track fundamental body processes, study behaviour, and spot health problems. Patients who use smart wearable devices may feel less stressed and save money (such as a smart watch). This kind of monitoring equipment is not used in conventional hospitals (2) Support and education for patients. IoT devices may be used by healthcare institutions to remind patients to take their prescribed medications on schedule. Ongoing evaluation, supervision, and support of patients' and caregivers' Networked equipment may enhance the monitoring capabilities of ECG, blood oxygen, and blood pressure devices. Enhancements to the level of service The Internet of Things may make it easier to integrate cars into current network infrastructures (IoT). The on-board computer system of a vehicle may assess the impact's severity and transmit an alert to traffic authorities and medical institutions informing them of an accident. As a consequence, those who have been harmed will be able to get assistance more quickly. Data resources are gathered for big data analysis. IoT in health has the potential to generate massive volumes of data

CHAPTER 4

A Monitoring System for the Recognition of Sleeping Disorders in Patients with Cognitive Impairment

Priya Dev[1,*] and **Abhishek Pathak**[1]

[1] *Department of Neurology, Institute of Medical Science, Banaras Hindu University, Varanasi 221005, U. P. India*

Abstract: Sleep is one of the most important biological processes acknowledged as a vital determinant of human performance and health. Sleep has been acknowledged to promote healing, restore energy, improve the immune system through interactions, and affect human behaviour and brain functions. To this end, even the transient alteration of sleeping patterns, including severe sleep deprivation, can impair one's cognitive performance and judgment, even as prolonged aberrations have been associated with the development of disease. The existing global sleep trends indicate a decrement in average sleep durations. Owing to such trends and the various implications of sleep on human well-being and health, enhanced characterisation of the sleep attributes indicates a public health priority.

Further, the advancement and use of multi-modal sensors with technologies to monitor physical activity, sleep, and circadian rhythms have increased dramatically in recent years. For the first time, accurate sleep monitoring on a large scale is now possible. However, there is a need to overcome several significant challenges to realise the full potential of these technologies for individuals, medicine, and research. In this chapter, a review of the present levels of the sleep-monitoring technologies in patients with cognitive impairments, in addition to assessing the difficulties and potentials lying ahead, from data gathering through the ultimate execution of findings within the consumer and clinical contexts.. Further, the chapter will review the advantages and disadvantages of the extant and novel sensing technologies, focusing on new data-driven technologies that include Artificial Intelligence.

Keywords: Advanced sleep phase disorder, Artificial Intelligence, Big data, Circadian rhythms, Cognitive Impairment, Consumer sleep technology, COVID-19, Data-driven technologies, Dementia, Deep learning model, Delayed sleep phase disorder, Healthcare, Polysomnography, Psychomotor vigilance test, Sleep,

* **Corresponding author Priya Dev:** Department of Neurology, Institute of Medical Science, Banaras Hindu University, Varanasi 221005, U. P. India; Tel: 7499904491; E-mail: priyadev8090@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

Sleep Deprivation, Sleeping patterns, Sleep-monitoring technologies, Sleep monitoring system, Sleep-Wake Homoeostasis.

1. INTRODUCTION

1.1. Artificial Intelligence of Things (AIoT)

The Artificial Intelligence of Things (AIoT) refers to the amalgamation of Artificial Intelligence technology and the internet of things infrastructure to attain effective IoT operations, enhance machine-human interaction, and improve data analytics and management. One of the notable AI technologies, machine learning, offers the IoT systems and networks the aptitude to learn from different kinds of data and change assets that are IoT enabled into learning machines [1]. Moreover, AI is capable of transforming IoT into important information, thereby facilitating enhanced decision-making. Thus, the IoT, AI and Big Data are correlated fields of research with considerable impact on the development and design of improved personalised health systems. Also, machine learning alongside AI have been perceived as transformative technologies of the future; from imaging and diagnostic technologies to robotics and therapeutic apps, the AI and machine learning technologies' potential have reached nearly all corners of the medical technology world [2]. The aptitude to offer accurate diagnosis of the patient's challenges can substantially impact patient care outcomes. Fortunately, some of the recent advancements in the fields of AI have enabled healthcare service providers with an increasingly accurate diagnosis within a shorter timeframe [3]. In recent times, researchers have utilised deep learning technology to detect molecular changes occurring within tumour tissue, which is a breakthrough capable of enabling timely detection of less invasive cancers. A review of recent studies has also disclosed that the present emergent application can be grouped into three key categories, including chronic diseases management. Thus, chronic disease management entails organisations making use of deep learning in monitoring patients through the use of sensors and automation of the treatment delivery using associated mobile applications. The other category entails medical imaging and regards incorporating various AI-driven platforms into devices used in medical scanning to enhance the clarity of images alongside clinical outcomes by reducing radiation exposure. Further, the IoT and AI is another category and are currently being incorporated to enable enhanced monitoring of patient compliance and adherence to various treatment protocols and enhance clinical outcomes.

1.2. Big Data Analytics

The faster development of AI and IoT has led to the colossal explosion of data derived from sensors and ubiquitous wearable devices. The exceptional increment in the volumes of data related to the advancement of analytical tools and methods empowered by AI has resulted in big data's emergence. In healthcare, big data refers to the term used in the description of immense volumes of data or information developed and acquired through the adoption of different digital technologies used in the collection of patient data and aid in the management of healthcare organisation performance, otherwise increasingly complex and big for the conventional technologies. Thus, the use of big data analytics in healthcare presents several positive impacts and life-saving outcomes. Big data implies the immense quantities of data developed through digitisation, which are consolidated and subsequently evaluated using certain technologies. At present, big data is employed in a broader array of industrial applications that include the healthcare sector, where various EHRs have been exploited through intelligent analytics to facilitate medical services. For instance, in healthcare, big data has been used to support the patient's health assessment, diagnosis, and production of drugs. Further, big data analytics cover the gathering and evaluation of larger amounts of data from different sources in medicine and healthcare. The sources may include sensor and machine derived data, electronic health records, medical imaging, biomedical research, medical literature, physician notes, lab reports, and prescriptions, among other sources.

Still, when applied within the healthcare contexts and with certain populations' health data, big data analytics is vital in preventing potential epidemics, reducing healthcare costs, offer a cure for diseases. Also, the application of big data in healthcare is fast growing throughout the globe, even as its benefits and potential remain undeniable. Such data may be utilised to improve diagnosis, inform the practice of preventative medicine, and minimise the negative impacts of treatments and medications [4]. The effects of big data analytics are perceptible throughout an array of clinical contexts and fields that include the emergency department, oncology, mental health, intensive care, psychiatry and dementia, among others. The algorithms increasingly regulate human lives, as they support and enable decisions and have become important to human freedom and welfare.

2. THE METHODS AND APPROACHES TO USING TECHNOLOGY IN PANDEMIC SITUATIONS LIKE COVID-19

Artificial Intelligence of Things and Big Data technologies offer potential tools for fighting against pandemics like COVID-19. In this regard, scientists have developed deep learning (DL) model used to identify extant and commercial drugs for use in medicine repurposing, which will lead to the discovery of apt drug strategies using extant medications capable of being used in the treatment of infected individuals [5]. In the case of the COVID-19 pandemic, the structures of COVID-19 protease generated using the DL model has been employed further in

CHAPTER 5

Early prediction in AI-enabled IoT environment

Ambika N.[1,*]

[1] *Department of Computer Science and Applications, St. Francis College, Bangalore, India*

Abstract: IoT is intelligent sensors and actuators which assemble to form an IoT device. The algorithms employed make the system make up a wise decision. These systems can use artificial Intelligence algorithms to make intelligent decisions. The previous work employs devices that compute normal from abnormal heart rates. These devices are intelligent machines that are carried with the individual. They are also used to calculate the ECG of the personnel. This information understands the behavior of the personnel. The knowledge is sensed and passed to the devices using the Bluetooth technique. This data segment into healthy or unwell being sections. The processing amalgamates transformation, conversion w.r.t format, and section labeling. The iforest approach excludes the outliers from the data set. The suggestion improves the previous work by predicting the abnormality before in hand by 17.5%. Many lives can be saved, and will help improve their lives by adopting this method.

Keywords: IoT, Wearable, Healthcare, Artificial Intelligence, Early prediction.

1. INTRODUCTION

Intelligent sensing devices assembly makes the Internet-of-things. These machines use internet facilities to communicate with each other. The devices have different capacities and capabilities. They communicate over a common platform. The instruments are used in many applications:

• Healthcare - The detector embedded in the victims in the IoT-based healthcare practice [25 - 27] has very inadequate battering stores. The constant charging of these machines and portable accessories may weariness the sufferers and need the assignation of the attendant, which influences the client involvement. The IoT healthcare scheme presents well-organized intensive care and aims to increase the supply administration of characters. Cloud computing manages the wellness facts and gives source-sharing abilities like adaptability and knowledge assistance in

* **Corresponding author Ambika N.:** Department of Computer Science and Applications, St. Francis College, Bangalore, India; Tel: 9900966852; E-mail: Ambika.nagaraj76@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

combination with scalable data warehouse, lateral processing, and protection queries.

• Environment surveillance - The primary objective of this growing number of IoT gadgets is to provide valuable knowledge about environs [24] to make them smarter. It implements the learning it needs by gathering and reviewing history, today, and prospective data. The information allows optimal decisions to perform in surroundings in real-time. Partition and collaboration of data is the solution to sustainable situations such as active townships and communities. It is an amalgamation of different representations and methods of data. The data blending improves knowledge essence and decisiveness, making excellent consequences in omnipresent settings.

• Industry monitoring - The design consists of assistance that is products and addressed. It gives a practical foundation [11]. for business computing. It combines monitoring accessories, warehouse machines, analytics engines, visualization programs, and consumer offerings. The cost-based standard facilitates the preparation of end-to-end assistance for companies. The users can locate requests from any place. It is a developing worldwide Internet-based technological structure promoting the replacement of assets and amenities in universal stock connection systems. It has an impression on the protection and concealment of the affected stakeholders.

• Elderly supervision - It detects the wanted parameters without conflicting with the user's movements. The parameters more fitting for monitoring [10] the user's performance is placing and mass movement. Significant guidance is modern improvements in dynamic and wearable accessories. The advanced machines have sensors such as an accelerometer, gyroscope, and Global Positioning System (GPS). It identifies user states and movements.

• Agriculture – The system [23, 30] is deployed in the field under surveillance. The device calculates the manure required for soil quality and soil humidity. The readings help the farmer to analyze the soil and take appropriate measures.

The previous work [14] employs devices that compute normal from abnormal heart rates. These devices are intelligent machines. An individual is capable of doing the act. They are also used to calculate the ECG of the personnel. This data set understands the behavior of the personnel. The data undergoes sensing and is passed to the devices using Bluetooth. The data segments into the healthy or unwell being. The processing is an amalgamation of transformation, conversion w.r.t format, and labelling of the sections. The Iforest technique used excludes the outliers from the data set. The suggestion improves the previous work by predicting the abnormality before in hand.

The contribution maintains a hierarchical tree. Each suffering is considered a unique entity in the database. The current status of the patient is the origin of the shrub. Each vertex in the tree represents the next observed state. The state includes vital parameters measurement of the patient. The edges contain the medication and various tests performed on the sick. Each case shows its symptoms to the prescription given.

When a patient arrives, his history of allergies and diseases is collected. This subset of data is compared with the stored dataset. The method helps the doctors to analyze and prescribe medication for the sick for his betterment. The initial data is used to create another hierarchical tree. The outcomes are added to the main hierarchical tree as a case study.

The work is divided into six sections. The second segment narrates the drawbacks of the previous work. The third division jolts down the various contributions done in the domain. The proposed work is explained in the fourth segment. The analysis and imitation consequences are defined in the fifth unit. The result is concluded in the sixth division.

2. DRAWBACK OF THE PREVIOUS SYSTEM

The previous work [14] employs devices that compute normal from abnormal heart rates. These devices are intelligent machines. An individual is capable of doing the act. They are also used to calculate the ECG of the personnel. This data set understands the behavior of the personnel. The data undergoes sensing and is passed to the devices using Bluetooth. The data segments into the healthy or unwell being. The processing is an amalgamation of transformation, conversion w.r.t format, and labeling of the sections. The Iforest technique used excludes the outliers from the data set. The system is unable to predict an early stage.

3. LITERATURE SURVEY

Healthcare [22] is a growing domain where devices are used as wearables. These devices measure the patients' vitals and transmit the data to the personnel equipment. This section lists the contribution made by various authors.

The sensor [15] discloses and forecasts disorders in a person. The outpatient knowledge is managed, such as demographic information, features of the tumor examination, heart ailments, diabetes, and hemoglobin stress. The collection of attributes is the answer to physiological essentials, build progress, and natural elements. Learning administration views it as a pipeline of progressive moves. An original sign from the vociferous beacon is improving in the pre-processing block. The repetition and space-time region in the flag are studied. Characteristic

CHAPTER 6

AI and Blockchain-based Solution for Implementing Security for Oral Healthcare 4.0 Big data

Sreekantha Desai Karanam[1,*], **Niriksha Shetty**[2] and **Rahul Bhandari**[3]

[1] *NITTE (Deemed to be University)-NMAM Institute of Technology, Nitte, Karnataka, India*

[2] *Manipal School of Information Sciences, Manipal, India*

[3] *NITTE (Deemed to be University)-ABSM Institute of Dental Sciences, Mangalore, India*

Abstract: The patient's medical data is very valuable and sensitive. Hackers are always trying to steal or tamper with this patient's data. Cyber-criminals can misuse or sell this patient's data. Protecting medical data, and ensuring security and privacy of data is a statutory and ethical mandate for healthcare services providers. Implementation of blockchain technology enhances the security, confidentiality, and traceability of patient data. Secure sharing of patient data among all stakeholders of healthcare ecosystems ensures quality and high speed in services.

Objective: This paper's objective is to review data security applications in the healthcare domain using blockchain technology and present the highlights from selected survey papers. The second objective is to implement data security using a web-based prototype based on blockchain technology.

Method: This blockchain technology enables secure online sharing of data using open, distributed, denationalized, and immutable ledgers. Blockchain-based online transactions are taking place between sender and receiver directly. Blockchain-based transactions eliminate the need for third-party intermediate agents. Data. Authors applied blockchain technology for the implementation of oral health big data using a web portal.

Results: The taxonomy of concepts applied in blockchain and EHR, Smart Contracts, and Healthcare 4.0 systems in healthcare from the literature are mapped. To identify research gaps, a comparative study of curated survey papers is conducted with specific variables. The results of web portal implementation are discussed.

Conclusion: At the out, the authors tried to provide a holistic view of blockchain applications and presented insight into systems design by discussing algorithms, techniques and methods applied. Authors conclude that intelligent systems integrated

* **Corresponding author Sreekantha Desai Karanam:** NITTE (Deemed to be University)-NMAM Institute of Technology, Nitte, Karnataka, India; Tel: 7204724359; E-mail: sreekantha@nitte.edu.in

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

blockchain systems are going to play a vital role in the healthcare industry and enhance the quality and efficiency of services.

Keywords: Smart city, Bitcoin, Multi-chain, Cryptography, Ethereum and Monax.

1. INTRODUCTION

Healthcare 4.0 revolution is a derived version for the healthcare industry from Industry 4.0 revolution. Healthcare 4.0 services are implemented by integrating disruptive technologies such as AI, blockchain, Internet of Things (IoT), 5G and data science into existing healthcare systems. The Healthcare 4.0 standards enforce patient-oriented healthcare services to the doorsteps of the patients. The healthcare domain generates a large size of medical data on daily basis. This medical data is generated because of operations such as patient registration, diagnosis, tests carried out, interventions, progress recording, billing and health insurance *etc*. The healthcare data of patients are very sensitive, and valuable and should be protected by law by the healthcare service providers. The author's study revealed that millions of patients' records are stolen, tampered and sold for commercial purposes. So providing fool-proof security, and the privacy of this data is essential. These findings related to critical security issues motivated the authors to explore high-security solutions for healthcare data. Authored proposed Blockchain technology for the healthcare domain. Blockchain is an emerging technology that combines cryptography, immutability, decentralization and data control replication to prevent participants in a distributed system from misbehaving with defined protocols. Blockchain implements standard cryptographic algorithms to permit everyone to carry out trusted transactions. Blockchain technology provides open distributed shared ledger records of P2P transactions which cannot be tampered with. The authors reviewed the blockchain solutions in the health sector and carried out a comparative analysis of the many solutions proposed.

1.1. Motivation - National and International Issues

In the recent five years, data breaches in the healthcare domain have been growing in number and rate across the globe. The frequent data theft and breaking of the rules in the healthcare domain are exposing highly sensitive and personally identifiable data such as names, addresses, social security numbers, health insurance information, Medicaid identification numbers, and patients' medical data histories. U.S. Department of Health and Human Services (HHS) reported a minimum of 477 healthcare data breaches in the year 2017 alone, impacting more than 5 million patients' data. These medical data breaches in the healthcare industry also continued in the year 2018. Breach Barometer 2019 report revealed that over fifteen million patient records were breached in 2018 alone. Around 80 million people had a considerable impact because of these major data breaches. The lack of a central controlling authority and an established set of rules, as well as a reluctance to divulge data, are all contributing factors to the fall in online sharing of healthcare data. The majority of healthcare service providers in developing countries do not want to share and disclose patient healthcare data. There are no well-established regulations on the exchange of healthcare data in developing countries. The media reported hacking and phishing attacks on sensitive patient data showing the vulnerability of this valuable data. The lack of information about distributed ledger technology and its application in the healthcare industry is a key impediment to the expansion of blockchain technology. The healthcare domain is afraid of the high cost of implementing blockchain technology vs the benefits.

1.2. Futuristic Solutions of Blockchain Solutions for Healthcare Industry

The transparency, immutability and open distributed ledger features are provided in blockchain as a service (BaaS) for driving the growth of this market. The potential applications of blockchain technology in healthcare are sharing of medical data across the hospitals, reducing the risk of counterfeit drugs, integrity in the drug supply chain, clinical data exchange, clinical trials, interoperability, claims adjudication, management of billing, cybersecurity and IoMT. The end-users of data security products are pharmaceutical companies, healthcare product companies, health insurance and healthcare service providers *etc*. Blockchain technology implementation would lead to increased efficiency in data management and user empowerment, with interoperability resulting in streamlined operations, allowing users to retain ownership over the data they generate.

1.3. Market-size for Blockchain Solutions in the Healthcare Industry

Healthcare expenditure has increased from US$ 7.1 trillion to US$ 8.7 trillion during the period 2015 to 2020. The US healthcare market size was $3.55 trillion in 2017, and it is estimated to increase up to US$ 5.5 trillion by 2025. The number of people above 65 years of age is estimated to double by the year 2050. By the year 2022, the market size for blockchain-based solutions is estimated to exceed US$ 500 million. By 2022, the Indian healthcare market is anticipated to be worth $372 billion. The worldwide healthcare blockchain market is expected to grow at a 72.8 percent CAGR from USD 53.9 million in 2018 to USD 829.0 million in 2023.

CHAPTER 7

An Artificial Intelligence-based Method for Detecting False news in Health Sector During a Pandemic

B. Sahana[1,*], **B. Sadhana**[1], **Mamatha Mohan**[2] and **Sindhu Rajendran**[3]

[1] *Electronics and Communication Engineering, RVCE, Bangalore, India*

[2] *Information Science and Engineering, Canara Engineering, College Mangalore, India*

[3] *Ramaiah Institute of Technology, Institute of Technology in Bengaluru, Karnataka, India*

Abstract: Recently, fake news has become a serious problem in our society majorly due to the cheap and easy availability of social media at every corner of the world. The widespread dissemination of false news has the potential to have a variety of harmful consequences for people and society. Hence, many researchers are finding different ways to detect fake news in a given news corpus. So here we came up with the idea of fake news detection using machine learning that detects fake news over the real news. During pandemic, fake news detection played an important role. Detection and identification of fake news in the social media, or any related news channels has played a major responsible sector to avoid unnecessary panic situation in mankind.

This paper is aimed at developing a Machine Learning model for deception detection using Natural Language processing techniques and machine learning algorithms. It detects fake news that comes from non-reputable sources which mislead people and distracts them with various fraud messages and unnecessary texts, by building a model using count vectorise, TF-IDF and logistic regression algorithm. Using this algorithm, the proposed technique identifies and rectifies real and fake news and this is an important sector during the pandemic situation.

However, there is difficulty in choosing the right metric for the evaluation of the model. Classification accuracy is one of the most used metrics to detect the performance of the model, in this paper we consider the parameters such as F1 score, confusion matrix, precision and recall. *Abstract* environment.

Keywords: Fake news, Machine learning, Accuracy, Pandemic.

* **Corresponding author B. Sahana:** Electronics and Communication Engineering, RVCE, Bangalore, India; E-mail: sahanarvce.edu.in

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

1. INTRODUCTION

Fake news is news designed to deliberately spread hoaxes, propaganda, and misinformation. It is different from satirical sites or a humor-based website. Fake news stories typically spread through social media sites like Stagram, Facebook, or Twitter, *etc*. As social media has become a major part of many lives right now, and is a phenomenon that has a major influence on our social lives, particularly in the political realm. And hence makes it difficult to distinguish between fake news and real news.

Because social media has taken over our lives, it is now more important than ever to discern false news from true news occurrences. This Project comes up with one of the solutions for detecting 'fake news' that is, misleading news stories that come from non-reputable sources [1, 2].

The misleading information in everyday access through social media and online news has made it difficult to determine which news sources are reliable. This project comes up with a machine learning program that identifies fake news over the real news. And furthermore, a website (deploying this machine learning program) is developed which gives tells the given news is fake or real when the news is provided in the form of text [3, 4].

Fake news will have a detrimental influence on individuals and society, hence data scientists are increasingly interested in detecting fake news. Attempts to use artificial intelligence technologies, notably machine learning (ML) and deep learning (DL) methods, as well as natural language processing (NLP), to automatically detect and prevent the spread of fake news are being actively studied. Many large technical corporations have started to respond to this trend. Google, for example, has blocked sites with a history of disseminating false information and shifted its news rankings to favour well-known sources. Facebook has integrated fact checking organizations into IFDTS platform.

1.1. Existing Problem

Fake news alters people's perceptions of and reactions to actual news. For example, some false news was manufactured solely to arouse people's suspicions and perplexity, obstructing their ability to discern what is genuine from what is not. Fake news can create conspiracy theories. Hence, it is a necessity to detect and eliminate such unwanted fake news [5].

2. ALGORITHMS

2.1. Logistic Regression

Logistic Regression is a method for supervised learning and is the most popular algorithm in machine learning. If a given set of independent variables are given, then it can detect categorical dependent variables which are discrete .It can be either true or false, 0 or 1,yes or no and it gives the probabilistic value which are in between values of 0 and 1. Logistic Regression algorithms can be used in situations where there is a need to predict if the cells of the tissue are cancerous or not, based on its weight, or if, a mouse is obese or not, *etc*. Logistic Regression has the power to provide probabilities along with classifying new data into continuous and discrete datasets. It is used to classify observations because it can identify the most efficient variables which are used for classification given the different types of datasets. The logistic Regression curve is shown in Fig. (**1**).

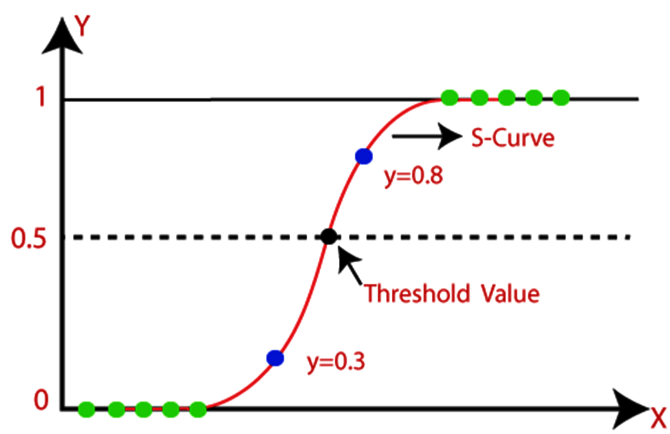


Fig. (1). Logistic Regression curve.

Logistic Regression Equation: The Logistic regression equation is derived from the Linear Regression equation. The m steps to obtain the Logistic Regression equations are:

$$y=b_0 + b_1 \cdot x_1 + b_2 \cdot x_2 + \ldots\ldots + b_n \cdot x_n$$

In Logistic Regression, y should be between 0 and 1 only, therefore dividing the above equation by (1-y):

$$label\frac{y}{y-1} = \{0\ if y = 0 \infty if y_{= 1} \quad (1)$$

CHAPTER 8

Intelligent Framework for Smart Health Application using Image Analysis and Knowledge Relegation Approach

Akhila Thejaswi R.[1,*], **Bellipady Shamantha Rai**[1] and **Permanki Guthu Rithesh Pakkala**[1]

[1] *Sahyadri College of Engineering & Management, Mangaluru, Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi, Karnataka, India*

Abstract: The future direction of modern medicine is toward “smart healthcare,” which incorporates a new generation of information technology to meet patient needs individually while increasing the effectiveness of medical care. This greatly improves the patient experience with medical and health services. Nowadays, due to people's lifestyles, diabetic retinopathy is one of the most serious health issues they confront. A deviation from the norm in which long-term diabetes affects the human retina is called diabetic retinopathy (DR). Diabetes is a chronic condition related to an expanding measure of glucose levels. As the degree of glucose builds, a few adjustments happen in the veins of the retina. Patients' vision may begin to deteriorate as their diabetes progresses, resulting in diabetic retinopathy. It is exceptionally far-reaching among moderately aged and older individuals. Thus there is a need to detect diabetic retinopathy at an early stage automatically. This study aims to build an intelligent framework that uses fundus images of the eye (retina) and performs image analysis to extract the features. Images are trained by the knowledge relegation approach, and the severity of the DR is classified using K-nearest neighbors. The proposed model achieved a test accuracy of 99%, 61%, 100%, 94%, and 88% for each of the five classes of diabetic retinopathy: proliferative diabetic retinopathy, no diabetic retinopathy, mild diabetic retinopathy, moderate diabetic retinopathy, and severe diabetic retinopathy.

Keywords: Smart Healthcare, Diabetic Retinopathy, Intelligent Framework, Image Processing, Knowledge Relegation, K-Nearest Neighbor.

[*] **Corresponding author Akhila Thejaswi R.:** Sahyadri College of Engineering & Management, Mangaluru, Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi, Karnataka, India; Tel: +91 89517 86202; E-mail: akhilathejaswi@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

1. INTRODUCTION

Long-term vascular damage to the retina is a characteristic of the diabetes condition known as diabetic retinopathy (DR). DR has got one of the significant reasons for visual impairment and vision disability worldwide since 0.4 million instances of visual deficiency and 2.6 million instances of extreme vision hindrance internationally can be ascribed to it in 2015. As a result, early detection and treatment are necessary to keep a strategic distance from serious visual problems. The issue with diabetic retinopathy is that the patient doesn't become aware of the condition until the retinal changes have advanced to the point where treatment will no longer be helpful [1].

DR is categorized into two kinds: nonproliferative retinopathy (NPDR) and proliferative retinopathy (PR). Micro aneurysms, hemorrhages, hard exudates, and cotton fleece are all symptoms of NPDR, a kind of diabetic retinopathy that produces abnormalities in the eye. The appearance of red spots on the retina is known as micro aneurysms, which are caused by blood vessel dilatations. Hemorrhages arise as a result of the bursting of micro aneurysms [2]. As the condition progresses, veins get occluded, and blood flow ceases. When trying to find new blood supply routes, new unexpected and delicate veins grow on the exterior of the retina. This is known as neovascularization, and it occurs during the Proliferative Diabetic Retinopathy phase.

The principle of machine learning depends on how people learn and procure information and arrive at some decisions [3]. Human behavior and critical thinking to a great extent, are repeated in designs across time and areas. Machine learning techniques in diabetes are highly concerned from the standpoints of decision-making, executives, and other clinical firm viewpoints. It used to foresee the clinical informational indexes at the beginning period of safe human life. Huge clinical informational collections are available in various information storehouses used in reality applications [4].

The proposed study uses fundus images of the eye (retina), and attributes are derived from these images using an image processing technique. Using the K Nearest Neighbour (KNN) algorithm, images are trained using the knowledge relegation approach, evaluated, and diabetic retinopathy's severity is categorized.

2. BACKGROUND

Using a color fundus picture and a CNN-based model, 94.5% of diabetic retinopathy cases were automatically classified [5]. Methods for feature extraction included hard exudates, red lesions, micro-aneurysms, and blood vessel identification. The gradient boosting trees-based (GBM) classification method and the CNN-based approach were the two types of classifiers that were trained for the classification job. To automatically identify diabetic retinopathy, a deep learning diagnosis model is provided. A new CNN model with a Siamese-inspired topology is created using a transfer learning technique [6]. The proposed method, which incorporates binocular fundus images and determines their association to aid in prediction, produced a kappa score of 0.829.

For automatic DR detection, a deep learning model is being developed [7]. The designed model analyses colour fundus images and assign a grade of no retinopathy or having DR. On 5-fold cross-validation, the model had a 0.97 AUC with 94% and 95% sensitivity and specificity, respectively. A diabetic diagnosis model based on convolutional neural networks (CNN) is proposed [8]. The study relied on the electronic medical records of 301 diabetic patients who were hospitalized between 2009 and 2013. To reduce gradient dispersion, speed up training, and enhancing model accuracy, the CNN model is combined with the BN layer. This model uses an adaptive learning rate technique to optimize the model, resulting in training and testing accuracy of 99.85% and 97.56%, respectively.

A dataset of DR fundus pictures is created and labeled using the appropriate treatment approach [9]. Using this dataset, a deep convolutional neural network model is created to assess the severity of DR fundus images. For a four-degree classification test, this model had an accuracy of 88.72%. The models are hosted on a cloud computing platform and have been used to deliver DR diagnostic services to several hospitals. The system has a 91.8% consistency rate with ophthalmologists during the clinical evaluation. For diabetic retinopathy categorization in retinal pictures, a robust hybrid probabilistic learning model is developed [10]. Kernels that take the distribution of the gathered attributes into account are constructed using the scaled Dirichlet mixture model. To deal with the reliance on starting and conjunction to local maxima, the learning strategy could be completely Bayesian.

Diabetic retinopathy is detected automatically using computer vision algorithms [11]. The CNN ensemble-based approach aims to identify and categorize all stages of diabetic retinopathy at a preliminary phase. The multiple instance learning (MIL) system was created to take advantage of the implicit knowledge included in image annotations [12]. The integrated refinement of the stage for instance encoding and picture classification is the main contribution of the suggested technique.

CHAPTER 9

Brain Stroke Prediction Using Deep Learning

N.V. Maha Lakshmi[1], **Sri Silpa Padmanabhuni**[1,*], **B. Hanumantha Rao**[1], **T. Krupa Nandini**[1], **T. Sai Teja**[1] and **U. Vamsidhar Reddy**[1]

[1] *Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India*

Abstract: A brain stroke is a disruption of blood circulation to the cerebrum. As per recent analysis, adult death and disability are primarily brought over by brain stroke. The World Health Organization (WHO), reports that the primary cause of death and property damage worldwide is brain stroke. Early detection of the signs and symptoms of a stroke can help to reduce risk factor of death by up to 50%. A stroke is more likely to occur in adults over the age of 55. An increasing number of people are experiencing this crippling and frequently fatal form of stroke, which results in cerebral hemorrhage. Various machine learning (ML) models were developed to predict the possibility that a brain stroke would occur. To predict the brain stroke, the proposed system used the CNN algorithm. The existing approaches are k-NN, Support Vector Machine (SVM), Genetic Algorithm (GA), Naïve Bayes classifier, J48 algorithm, Logistic Regression (LR) and Random Forest (RF). This requires more time to train the model and it is difficult to debug. And these are not suitable for large datasets. The proposed system makes predictions using CNN algorithm, a deep learning technique. It includes a multilayer perceptron for the prediction task and an autoencoder for eliminating and capturing non-linear correlations between parameters. The proposed system is contrasted with existing system and it shows an enhancement in the capability to anticipate the stroke. The proposed system achieved an accuracy of 89%.

Keywords: Convolution Neural Network and Convolution layers, Deep learning, Machine learning, Stroke.

1. INTRODUCTION

Artificial intelligence (AI) incorporates the machine learning (ML) as a subset which enables a model to learn from experience task and enhance the model without being explicitly programmed. The machine learning models rely on time stamped data, quantitative data, qualitative data and textual data. Supervised learning and unsupervised learning are the two fundamental types of machine

* **Corresponding author Sri Silpa Padmanabhuni:** Department of CSE, PSCMR College of Engineering & Technology, Vijayawada, A.P., India; Tel: 9966104060, India; E-mail: Silpa.padmanabhuni@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

learning. Deep Learning is a technique of machine learning. The deep learning models learns by finding sophisticated in the data. It can be used to solve any recognition pattern problem without human intervention. When the brain's blood circulation is disrupted, a brain stroke occurs. Lower blood supply may cause the death of brain cells. And when your brain isn't getting enough oxygen, your body will send you certain warning signs. Some stroke risk factors are unaffected by medications or changes in lifestyle. Age, gender, race and a family history of stroke are one of factors. Some brain stroke risk factors have potential therapies. Obesity, heart disease, smoking and hypertension are risk factors for brain stroke.

A potentially fatal medical condition called a stroke can occur when the blood flow to a part of the brain is cut off. Strokes require immediate medical attention since they constitute a medical emergency. The sooner a person is treated for a stroke, the less damage is likely to happen. Blood and oxygen cannot reach the brain's tissues because of the break or obstruction.

The brain seems to be the organ that regulates how we move, remember things, and produces thoughts, emotions, and communication. In contrast, the neural impulses had number of physiological functions, such as digesting and digesting and breathing. For proper operation, the brain requires oxygen. Blood vessels carry oxygen-rich blood to all parts of the brain. Within minutes, brain cells start to die, if something blocks the blood flow because it can't obtain enough oxygen. This leads to the brain stroke. Convolution neural networks (CNNs) are one kind of Deep Learning neural networks (DNNs) used for image processing, recognition, classification and a model prediction. The hidden layers of CNN are used to make predictions more accurate. We used the two-activation functions that is sigmoid function and ReLu function are used to assist the machine in discovering intricate data patterns.

2. LITERATURE SURVEY

In [1], Tasfia Ismail Shoily *et. al.,* utilized four machine learning (ML) algorithms to recognize the stroke. The data is gathered from hospitals and utilized them to figure out the problem. The WEKA toolkit's Naïve Bayes classifier, J48 algorithm, k-NN and Random Forest classifier are the four machine learning algorithms. In the beginning, importing the necessary libraries and data from the stroke database. Data preprocessing, visualization of data along with attribute selection, then the data is split into test set, train set to build and evaluate the classifier model. In terms of accuracy, the naïve bayes classifier produced better classification results for the brain stroke. As a result, the evaluation of the classification result indicates that J48, k-NN and Random Forest successfully fulfilled the obligations in the identification of stroke disorders.

In [2], Hyuna Lee *et al* identifies the patients with severe ischemic stroke within 4.5 hours after the onset of symptoms using three machine learning (ML) models. On the basis of a reasonable request, the information was collected from the appropriate author and is used to support the authors of the study conclusions. The MRI Protocol, Image Processing, Infract Segmentation, and Co-registration are used to manipulate the collected data, which is then divided into test and train sets for feature extraction and feature selection to train the machine learning model. The best machine learning is then placed to the test, and later, it is assessed by every top machine learning algorithm to spot test subjects who are examined within 4.5 hours of the commencement of symptoms. Random Forest, Support Vector Machine, and Logistic Regression were the three machine learning techniques that were utilized. Each patient in the independent test set was identified using one of these three ideal machine learning models. Finally, ML approaches may be practical and helpful in finding medication prospects among patients with a stroke onset that is ambiguous. Korean Health Technology R&D Project, through the Korea Health Industry & Welfare, provided funding for the author's research.

In [3], Jeena R S *et. al.,* worked with Support Vector Machine (SVM) models, which are well-known for their capacity to simulate complicated systems, are frequently employed in classification tasks. The International Stroke Trail Database was used to get the data for this project. Information about the patient, the hospital, risk factors, and symptoms are all included in the database. The 300 data samples are under goes for training set and 50 data samples for testing set. The classification accuracy of different kernel functions had been compared. MATLAB was utilized to implement SVM. It is used to determine the parameters sensitivity, specificity, accuracy, precision, and F1 score to evaluate the effectiveness of various SVM classifier kernel functions. The outcome was assessed across a range of patients in various age groups.

In [4], Grant C *et. al.,* applied the Genetic Algorithm (GA) and k-NN algorithm to find a pattern of gene expression in peripheral circulation that might be enhanced to recognize Androgen Insensitivity Syndrome (AIS) during the early phase of treatment. 24 neurologically asymptomatic controls and 39 AIS patients make up the data. The genetic algorithm, k-nearest neighbors (GA/k-NN) machine learning method was used to find a pattern of gene expression that can clarified the groups. It was evaluated for its ability to identify between 20 acute stroke models and an additional 39 AIS patients, 30 neurologically asymptomatic controls.

In [5], Minhaz Uddin Emon *et. al.,* employed the Base Algorithm, which consists of the base 10 methods. LR, SGD, DTC, AdaBoost, Gaussian, QDA, MLP, k-NN, GBC, and XGB are the 10 base algorithms. The vulnerability predictors are built

CHAPTER 10

Secure Electronic Health Records Sharing System using IoT and Blockchain

Harisha A.[1,*], **Shiji Abraham**[1], **Srinivas P. M.**[1], **Praveen Honavar**[1], **Kavya** [1], **B. M. Nischitha**[1] and **Manish Poojary**[1]

[1] *Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India*

Abstract: The Electronic Health Record (EHR) is used for maintaining patients' medical records in the hospital. The EHR contains the details of clinical related data of the patients under a particular provider. The EHR contains information on a patient's demographics, medications, previous medical history, laboratory results, and reports like X-rays. The EHR system is introduced in order to share the details with other health providers such as laboratories, pharmacies, emergency facilities, and clinics so that they will have all the medical history of the patient's health conditions. These can be accessed from anywhere *via* any smart device. A single record for one patient across all departments. Sharing EHR with different health care providers is a major challenge since this health record is stored on centralized servers patients cannot share this information when required. To overcome this issue we have come up with an approach of using IPFS (Inter Planetary File Systems) to store this EHR in a decentralized manner and an RSA algorithm to encrypt the Health Record. By using the combination of blockchain and cryptography a secure platform can be developed for providing the patient with full control over their health record and also maintaining data integrity.

Keywords: EHR, IPFS, RSA, Blockchain.

1. INTRODUCTION

An Electronic Health Record (EHR) is a method in order to store all the patient's health-related details from the further medications that hospitals maintain. EHR has demographics, progress notes, problems, medications, vital signs, past medical history, laboratory data, and reports such as X-Rays. EHR's are more efficient compared to the papers that help in accessing patient information from any region by using condition-specific queries. Digital recording of the patient's health details helps in tracking and more standardized documentation of patient

* **Corresponding author Harisha A.:** Department of CS & E, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India; E-mail: airbail89@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

interactions that reduce errors [1]. EHR supports time-saving. All the hospitals will have their own software for maintaining their own record. Some of the hospitals use local databases or may use a cloud service provider. Since the data is stored on a centralized server, patients will not able to have control over their own medical details. And sharing the details of patient's health data from one hospital to another hospital is a major task. The patient's medical details are confidential and should always maintain in a secure manner. if the data is not stored in a secure way then there will be a chance of manipulation of data, leaking of data and sometimes hospitals will misuse by selling the information of the patients to companies for the hospital management profit.

In order to solve these issues, a blockchain technique is used. Blockchain is growing widely a list of records known as a block which is attached to cryptography.

The term “blockchain” refers to a growing collection of data known as blocks that are connected through encryption. Each block includes transaction information, a timestamp, and a cryptographic hash of the preceding block [2]. Here to store the digital health records in a decentralized way Inter Planetary File System (IPFS) is used. IPFS is known as protocol and has peer-to-peer networks used for the purpose of storing and used for sharing data into different file systems. IPFS utilizes content address for the identifying each file onto global namespace connecting for all computing devices [3, 4].

Since contents of health records are confidential, these data must be encrypted before uploading to IPFS. For this, we are using Asymmetric Key Cryptography. Thus a combination of blockchain and cryptography can provide a secure system that ensures data integrity of electronic health records and patients can share Electronic Health records having full control over their data [5].

2. SYSTEM DESIGN/ ARCHITECTURE

In Fig. (**1**) the data will be either stored in database from lab or data will be collected from IoT Device. To share the data a blockchain enabled system is needed.

2.1. Flow Diagram of EHR Sharing System

Fig. (**2**) shows the Electronic health record sharing system. Electronic Health Records are given as input. Encryption of the EHR is done using the receiver's public key. Both private and public keys are generated using the RSA technique. All the public keys are recorded in blockchain. The encrypted file is uploaded to the IPFS. IPFS returns a hash for the uploaded file and it is saved in the blockchain. When the receiver wants that file, he will search the hash value in the blockchain. Using the hash, download the file from IPFS. The receiver will decrypt the file using his private key. Fig. (**2**) shows the flow diagram of EHR sharing system.

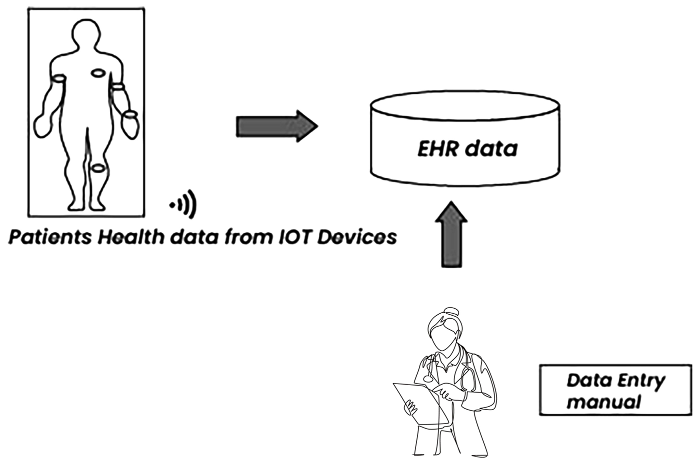


Fig. (1). Regular Flow of EHR data from IoT Device or Lab.

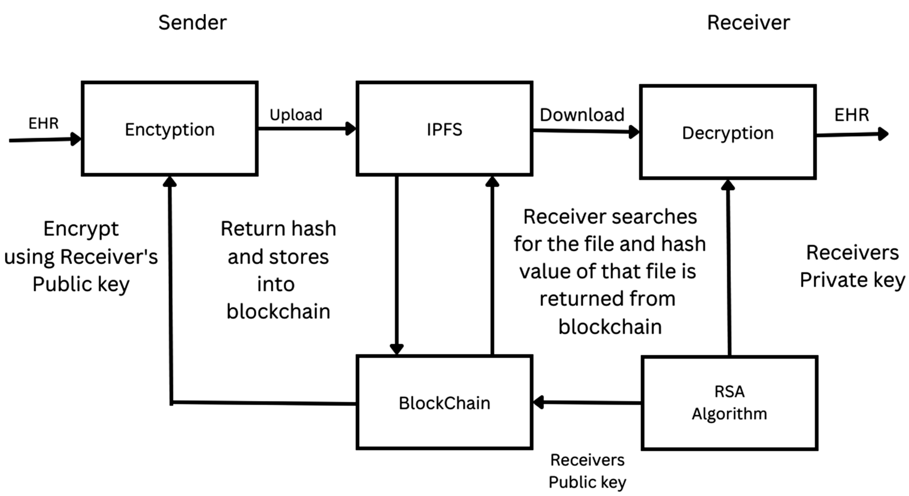


Fig. (2). Flow chart diagram for EHR sharing system.

3. GENERATING PUBLIC-PRIVATE KEY PAIRS

The RSA algorithm is known as the asymmetric cryptographic algorithm. RSA algorithm depends on 2 varieties of keys one is a public key another one is a private key If contents are encrypted using a public key then we can decrypt them

IoT and Big Data Analytics, 2023, *Vol. 5*, 191-208

CHAPTER 11

Geofencing For Elderly

Jidynasa Patil[1,*] and **Anita Chaware**[1]

[1] *P G Department of Computer Science, SNDT Womens University, Mumbai, India*

Abstract: This century has witness a substantial increase in elderly population. Health issues like depression and dementia are more prominent in these elderly populations which demand Assisted Living environment. The engagement of technology is seen as a solution for the Assisted Living environment. With the help of technology, Ambient Assisted Living (AAL) has become a field of research. As AAL strives to seamlessly connect information technology with people's daily lives, the buzz word called Internet of Things (IoT) exhibits significant promise for developing technical solutions in this field. Geo-fencing is one such location sensing tool that uses IOT and GPS for defining geographical boundaries and is used for putting e-fences to the needy people in their ambiances. This article aims to provide a safe tracker environment that allows the elderly people to continue with their daily activities. In this article, application built for elderly people is explained. Through this application, the person gets the direction to reach back home or the alert message is sent to the family member or the caretaker. The alert message is sent while the person is out of the fencing area to himself or to the care takers and the location of the person can be tracked. This app can also be modified for different users like person with disability, game like pub-G players *etc*. for the situations where the device sense that the person is in a danger zone or out of the geo-fencing.

Keywords: AAL, Elderly population, Geo-fencing, GPS, Alert message, Cloud computing, Real time location system.

1. INTRODUCTION

Aging is similar to the evening of life, that cannot be avoided, nor is desired, and is a phase of life that is troubled. Even while it's true that no stage of life has ever been easy and every stage has problems associated with it, old age is harder than other phases of life since it takes more physical stamina and mental strength to deal with life's challenges. The elderly are heavily dependent on others at this point in their lives because of their ailments. They require someone who can meet

* **Corresponding author Jidynasa Patil:** P G Department of Computer Science, SNDT Womens University, Mumbai, India; Tel: 9967673305; E-mail: patiljidnyasa18@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

their demands and with whom they can communicate their emotions. However, everyone in this capitalist society is struggling with their own issues. Nobody has the time to devote to them. More and more nuclear households are emerging as a result of shifting socioeconomic patterns, including women's increased economic independence and participation in the workforce as well as increased mobility, which is changing social norms of family elderly care. Despite the critical need, elder care in India is still largely disregarded, and the ecosystem is still in its infancy. This needs to change. In order for them to feel safe and secure, there should be some protection and care required. The phrase "assistive technology" is used to refer to "any instrument or system that enables people to carry out actions that they would otherwise be unable to carry out [1]". Ambient assisted living (AAL) is a field of study that assists people with any type of impairment in keeping their independence in their homes for as long as is practical with the aid of information and communication technology (ICT). AAL address safety requirements include recognising a person's mobility and fragility, preventing accidents, and supporting them and their caretakers, if any, with daily activities. Many sensor based devises are used in AAL [2]. With the advancement in the IOT – internet of things and the GPS technologies there is significantly effective research in the area of AAL.

A geo-fence is a virtual border that is created around a specific geographic place using GPS, RFID, Wi-Fi, or cellular data by devices such as mobile, desktop, or cloud-based apps or other software. A structure, residence, mile, or even a zip code can be geo-fenced, depending on their size. However, geo-fencing can only function if the precise placement of that designated boundary is made. Further it's the placing of that defined boundary that should be accurate that makes geo-fencing work possibly. This article explains the use of Internet and GPS technology in mobile phones, to build general application that can be used to put fencing around any needy person. By creating a mobile app it is easier for senior/needy people get connected to themselves or to their caretakers.

Caretakers or family members can view alerts when someone enters or exits the defined region using geo-fencing technology (also known as "geo-fences"). This is set up to monitor the user's activities in secure locations. However, geo-fencing is only likely to be effective when that precise defined boundary is placed. This technology is seen working in many different fields like time tracking, automating time cards, and even keeping track of company property such as vehicles, fleets, tractors, *etc*. By using the Geo-fencing app one can get the following benefits like:

1. Mobile push notifications: This is a small pop-up message that appears on the cellular / mobile device of the user even when the software isn't open.

2. Trigger text messages or alerts: This is the alert message that immediately triggers from the software.

3. Forced commercials through more than one digital: These are the commercials sent to the selected group of audience, as in the case of any e-commerce applications.

4. Permit monitoring of asset: This is a control device that works on GPS to monitor the activities of the a assets like any vehicle *etc*.

5. Reach or Target one's pets or even one's spouses: The tool containing GPS and mobile indicators is linked to a collar or body of the pet to keep track of them.

6. To find lost smartphones and other assets: This facilitates discovering the area of lost cell phone when misplaced. Any lost object in IoT can be tracked by using the concept of Geo-fencing.

7. Collection of location-based data.: One can target customers and track their behaviour within a specific range using geo-fencing. This data is used for the R&D purpose in marketing/Advertising *etc*...

2. RELATED WORK

2.1. Cloud-Based Framework Using Digital Twin

In this paper [3], a cloud healthcare system's framework is built on the concept of digital twin. (Cloud DTH). Using wearable medical devices, for instance, is based on a universal and extendable framework in the cloud environment for monitoring, diagnosing, and predicting elements of a person's health with the aim of achieving personal health management, particularly for the elderly. Cloud DTH attempts to achieve human and technological interaction between virtual worlds and medical physics.

In general, geo-fence scenarios can be classified based on their dynamics, delivery, and time constraints [4]. Each category has different implications for the architectural design of a Geo-fencing system. Its scope is expanding rapidly. Currently very few applications deal with geo-notifications, which are intended to alert mobile/stationary users to location-specific information in advance. Geo-fencing is the technology enables proactive location-based services'.

CHAPTER 12

I am the Eye - Assistive Eye

Muadh Bin Mohammed Ali[1,*], Mohammed Shayiz K. P.[1], Habeeb ur Rehman[1], Mohammed Nouman[1] and **Mohammed Thajuddin Sanad[1]**

[1] *Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, 590018, India*

Abstract: The vision of this device is to design and construct the blind-friendly embedded device. The blind and visually handicapped have difficulty utilizing mobile phones because social media and online banking programs on smartphones are difficult for them to utilize. For quick bank transactions, ATMs are used. If blind individuals use the ATM and it isn't designed with visually impaired persons in mind, there will be privacy concerns. Using mobile phones with the assistance of others may jeopardize their security and privacy. Touch screens were not designed with visually impaired persons in mind. They are uneasy using cell phones in public due to current technologies. When visually impaired persons walk, they use a stick, which can be replaced as well. By gaining access to all capabilities of smart phones, the developed system would assist visually impaired persons in making their lives much easier.

Keywords: GSM, SMART, EYE.

1. INTRODUCTION

There are a total of 285 million people around the world who are visually defect as stated by the World Health Organization (W.H.O). The number of visually faulty people on the planet is believed to be 39 million. Over 1.3 million persons in the United States are completely blind, and the number of people who are visually defect goes up to 8.7 million.

As stated by the American Foundation for Blind and the National Federation for Blind 100,000 of them are students. As a result of the success of public health program, disease-related blindness has decreased in recent years. Over the age of 60 the number of visually faulty people, on the other hand, is increasing at a rate of 2 million every decade All of these figures, however, are predicted to rise by 2020 [1].

* **Corresponding author Muadh Bin Mohammed Ali:** Department of Computer Science Engineering, PA College of Engineering & Management, Mangalore, VTU Belgaum, Karnataka, 590018, India; Tel: 9845119468; E-mail: mkhanmanzil@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

I am The Eye' is a device that allows visually impaired people to use their cellphones without even touching them. In today's world, there are a plethora of smartphones to choose from, but none of them are totally accessible to visually impaired persons. 'Am the eye' is a hybrid system that combines hardware and software. Smartphones are one of the most important technologi of current generation [2]. Almost all communication and transactions, such as current news, financial transactions, social/family updates, and so on, are done through mobile phones. The blind and visually handicapped have difficulty utilizing mobile phones because social media and online banking programs on smartphones are difficult for them to utilize. They are unable to fully utilize smartphones. Using mobile phones with the assistance of others may compromise their security and privacy. For quick bank transactions, ATMs are used. If blind individuals use the ATM, there will be privacy concerns, and it is not properly designed for visually impaired persons. Touch screens were not designed with visually impaired persons in mind. They are uneasy using cell phones in public due to current technologies.

Am the Eye is a device that enables blind people to use their phones without having to hold them. The microcontroller-based system will be linked to the phone through Wi-Fi. then the user gets calls or texts, he will be notified and will have the option to return the call or text. Text from social media apps and text messages will be converted to Braille. Six LRA motors will be grouped in a braille dot pattern. It will vibrate to the beat of the music. It can express approximately five words in a single second. With this apparatus, he can walk without requiring a cane. The system will include a sensor that will detect road impediments. With this method, he can walk without needing a cane. A sensor in the glove will detect ground obstacles. By pointing to his hand, he can walk. They can recognize and communicate with the people in front of them with the help of AI. The use of ATMs is straightforward. The device will read the display and offer the user with information. Through this method, he will be able to use social media and ATMs. They can use it to text someone at any time using gloves that are already in their hand. The alphabet and number system will be included in the gloves. There will be notification mode, call mode, text mode, walking mode, and other applications that use mode. Notification mode: In this mode, the user will only get notifications from the Instant Messages App. They are not able to respond to text messages. They can switch to this mode if they want to use their hands freely. None of the switches are functional in this situation. This mode can be used to make a phone call to another person. Text Mode: He can use WhatsApp, SMS, and other social media in this mode. He will be able to text and send data in this status. Walking Style (used when walking around [3].

The increase in the demand for orientation and navigation aids. The white cane and trained dogs are used as the most cost effective and basic navigational tool. Despite their widespread use, technologyies available in today's world is not so beneficial to the blind as compared to the people with sight. This gadget helps by providing a comprehensive review on researches on different routing tactics and are suggested to the visually impaired persons. Unlike most other evaluations, this one includes navigation systems that may be used in a number of environments (such as outdoors, inside, and so on) and that use a variety of technologies (vision, non-vision, mobile-based, *etc*.).

When technological advances were employed to create common items, people began to apply that advantage to assistive technology as well. These goods are intended to help people with impairments in their daily lives. Accessibility Aid were later coined to describe these types of assistive devices. Assistive technology, according to analysis, refers to innovation, A person with a disability can overcome physical, social, infrastructural, and ease of access obstacles to liberty and lead an active, productive life as an equal member of society with the use of apparatus, gadgets, instruments, facilities, systems, processes, and ecological adjustments. Research indicates that the use of assistive technology, particularly for navigation, is becoming more and more important in the lives of individuals with disabilities. Way finder, Envision, and other like services are a few examples [4].

Mobile devices that have adequate computational power and sensor capabilities are also offering countless potential in the development of G.P.S devices as a consequence of technical advancements in the mobile sector. The biggest and most popular mobile platforms, according to Csapó et. al., are quickly becoming the de-facto norms for the use of assistive technology [5].

There has been a great deal of research done on the creation of assistive navigational devices for just the visually impaired. It could be because the creation of route planning, wayfinding, information flow, communication, and other tools and approaches involves both technical and physiological components. The physiological causes of vision loss, variables affecting how individuals move, orient, and obtain information, in addition to the technical aspects involved in the creation of these technology and techniques, are some of these. The authors claim that it is difficult to convey the spirit of this environment with just one picture. There are various navigation systems available for the blind and visually impaired, but only a few of them can give dynamic interactions and flexibility for variations, and none of them fully operate. Numerous studies on various navigation gadgets and approaches used by vision impaired or blind people have been conducted. Tapu et al. conducted research on wearable devices that aid

CHAPTER 13

Stage of Retinopathy of Prematurity Using CNN and Object Segmentation Technique

Jothimani K.[1,*]

[1] *Computer Science and Engineering, Graphic Era Deemed to be University, Dehradun-248002, Uttarakhand, India*

Abstract: Premature adolescents with Retinopathy of Prematurity (ROP), a fibrovascular proliferative condition, have difficulties with the maturing peripheral retinal vasculature. Early identification of ROP is achievable in stages 1 and 2, distinguished by a demarcation line and ridge that divides the peripheral retina from the vascularized retina. Because newborn retinal images have poor contrast, it is difficult to distinguish demarcation lines or ridges. This study used segmentation and convolutional neural networks to detect ridges, which are crucial landmarks in the diagnosis of ROP. Our contribution is implementing Mask R-CNN for identifying boundary line/ridge recognition, which enables doctors to identify ROP stage 2 more accurately. To combat poor image quality, the suggested approach uses a pre-processing stage of image augmentation. In this study, the utility of the Convolutional Neural Network was examined to localize ridges in labeled neonatal photos. The KIDROP study and a dataset comprising 220 photos of 45 infants were used. Using the segmentation of the ridge region as the ground truth, 175 retinal images were used to train the system. The system's detection accuracy was 0.94, with 45 images under test, proving that data augmentation detection in conjunction with image normalizing pre-processing allows accurate identification of the ROP in its early stages.

Keywords: ROP, Convolutional Neural Network, R-Convolutional Neural Network, Enhancement.

1. INTRODUCTION

The most common reason for blindness in people of working age in developed countries is diabetic retinopathy. An estimated 93 million people would be impacted. According to a statement from World Health Organization and US Centers for Disease Prevention and Control, 347 million people worldwide have diabetes. Diabetes-related retinopathy (DR) is a condition that affects the eyes.

* **Corresponding author Jothimani K.:** Computer Science and Engineering, Graphic Era Deemed to be University, Dehradun-248002, Uttarakhand, India; Tel: 9483212671; E-mail: jothimani.k@geu.ac.in

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

The illness is at some stage in 40% to 45% of diabetic Americans. If DR is discovered early enough, the progression of vision impairment can be delayed or prevented. The condition, however, is often difficult to detect and treat because its symptoms are rarely noticed until it is too late to benefit from effective treatment. A trained practitioner examines a digital color fundus picture of the retina in depth to diagnose DR. Human assessors send their assessments late, usually several days later, so the continuation is missed, communication gets inaccurate, and treatment is delayed [1].

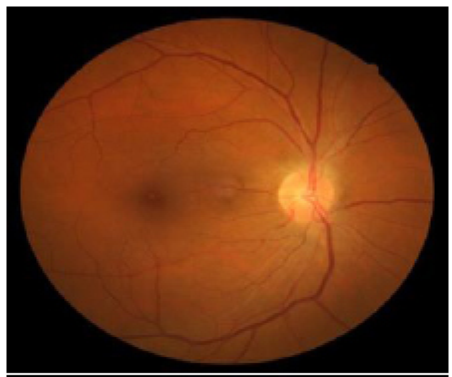


Fig. (1). Diabetic Retinopathy (DR).

While this strategy works, it has substantial resource requirements. Clinicians can identify DR by looking for lesions connected to vascular anomalies caused by the disease. Diabetes prevalence and DR detection shown in Fig. (**1**) often lack the necessary knowledge and tools in local populations where DR detection is most necessary. With the growing number of diabetics, the infrastructure needed to stop DR-related blindness will become even more inadequate. In the past few years, several initiatives have been developing an automated and comprehensive DR screening system using image categorization, pattern recognition, and machine learning. This challenge aims to test the limits of color fundus photography as a method of automated detection, ideally producing models with clinical relevance. In order to maximize the effects of winning models on enhancing DR detection, the winning models will be made public.

Ophthalmologists can diagnose ROP phase identification by automatically identifying demarcation lines and ridge patterns. The distinction between the anteriorly vascularized retina and the caudal vascularized retina is shown by the demarcation line. The demarcation line turns into a ridge as it gets wider and taller. Fig. (**2**) displays enlarged images as well as many representations of demarcation ridges and lines. Due to a lack of gemstone ground observations, limited fundus scanning, and an inadequate understanding of ROP symptomatology, establishing boundary lines with earlier findings will lead to difficulty in curing ROP.

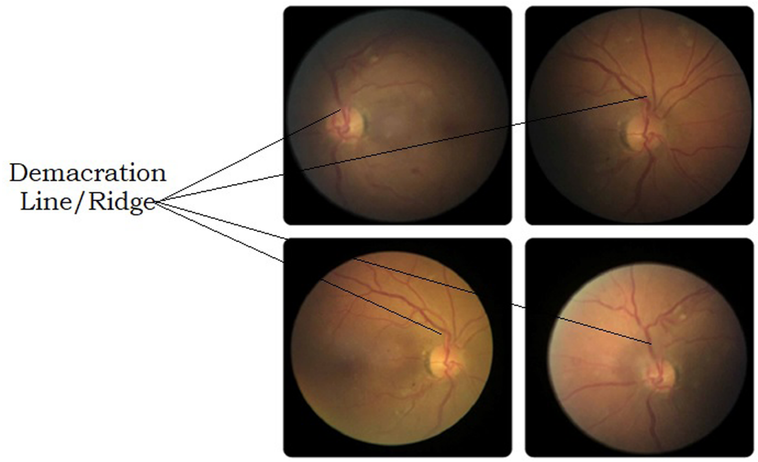


Fig. (2). Examples of a demarcation line/ridge.

Our suggestion to use Convolutional Neural Network for ridge identification in early ROP staging is the first of its kind [2] used the watershed approach for image processing to identify ridges in newborn pictures. But in addition to the ridge, additional locations that are not part of the ROP were also found. The native method [3] for the automated detection of ROP phases increases tubular properties which are helped to locate the ridge or demarcation line [4]. The same work is done by using multilayer vessel augmentation. Instead, the most effective method for locating the demarcation line/ridge is to employ the Mask R-CNN. This technique binds specifically the ridges or boundary line; however, it could be challenging to distinguish between phase 2 ROP because of the little differences between them.

For several reasons, this study is primarily concerned with identifying ROP in different stages. First, healthy retinas are more subtly separated with their presence, size, and shape of the separating line (or ridges; following phases prefer to refer to them as the dividing line for conciseness). Stages 3 and 4 may easily be differentiated from Stages 1 – 2 due to the severity of the physical sign as shown in Fig. (**3**). A diagnosis during Stages 1 - 2 ROP is crucial for enabling physicians to suggest the appropriate therapy while vision is still curable, making it even more vital to diagnose ROP during Stages 1-2 as those with Stages 3 - 4 ROP have already permanent retinal damage.

CHAPTER 14

An Overview of Recent Medical Applications of Soft Robotics

Manoj[1], P. C. Shrihari[1], Gouda Shankar S.[1], M. Pramod Rao[1] and **Rathishchandra R. Gatti[1,*]**

[1] *Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India*

Abstract: Soft robotics is one of the trending subdomains of robotics. It involves the application of compliant materials for building robotic mechanisms and controlling them using robot programming. This chapter discusses some of the recent applications of soft robotics in the medical field and their future scope. Minimal Invasive Surgeries (MIS) and Natural Orifice Transluminal Endoscopic Surgeries (NOTES) are the two commonly used surgeries, and the most familiar form of these two surgeries is endoscopy. In this chapter, we will discuss how soft robotics can be applied in both MIS and NOTES. This chapter will review the soft robotics applications in the medical field. This chapter will also discusses soft robotics's challenges and future directions in the healthcare industry.

Keywords: Soft robotics, Surgical, Healthcare, Compliant mechanisms, Robotics, Medical CPS.

1. INTRODUCTION

Soft robotics is a subsection of robotics that concentrates on technologies that are very similar to the physical characteristics of living organisms. Soft robotics is used in several applications, such as consumer, healthcare, and industrial. The scope of the present review is limited to only medical applications of soft robotics. Some state-of-art applications of soft robotics in healthcare include robotic devices for Minimal Invasive Surgery (MIS), E-skin for biomedical wearables and prosthetics, abnormal cell detection using bio-impedance, and bio-mimicry. In Minimal Invasive Surgery (MIS), we use surgical instruments that are flexible or inflexible, which are placed inside the body through natural orifices or

* **Corresponding author Rathishchandra R. Gatti:** Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India; E-mail: gattirathish@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

minor cuts made during the surgical operation. This MIS aims to perform surgical operations more safely and as quickly as possible and to lower the harm caused to the external tissue. MIS is preferred as a substitute for open surgery because it takes less recovery time, improves patient safety, and induces less pain than open surgery [1]. Soft robotic devices can perform minimally invasive surgeries causing minimal pain and injuries due to the flexibility of soft robotic materials.

Biohybrid soft robots are another soft robot that conforms to utilizing biological tissue inside their structure. Skin in any organism is the medium between it and the environment for communication. E-skin is one of the favourite subjects explored in soft robotics. It is one example of biomimicry application of soft robotics. One of the E-skin applications is biomedical wearables. Bioimpedance is the reaction of living organisms to an externally applied AC. It is based on the structure of the tissue of the specific living organism. It shows a high ability to find the damage to biological tissues, monitoring the development of the tissue and decay of dying cells. Further, bio-impedance can also be used to detect abnormalities in cells [2].

MIS and Natural Orifice Transluminal Endoscopic Surgery (NOTES) is the replacement for open surgery as it reduces pain and recovery time. The endoscope is the most well-known form of MIS and NOTES. An endoscope is a tool that was earlier used to visualize the patient's lumen. However, over the years, it has been developed to be used in surgical intervention. The study about MIS and NOTES was analyzed to show the clinical history and the restrictions to the present endoscopic instrument in the last decade [3]. Animals use the soft structure to move effectively in the complex natural environment, which inspired robotic engineers to adopt soft robotics technology into their designs. Learning how soft animals use their soft body to travel in complex and erratic environments can give invaluable ideas for future robotic applications in medicine, search and rescue, and disaster [4].

2. MINIMAL INVASIVE SURGERY (MIS)

MIS is the most popular and common surgery in the present world. In conducting MIS operations, there are many types of robots used. Those are as follows. Continuum Robots: continuum robots are devices that do not have a single rigid link or joint but can bend continuously. Octopus is the inspiration for these soft robots. Moreover, these robots seem like an appropriate selection for MIS applications because they need only one point to enter the body, and they can attain significant bending points.

Paralytic robots are self-propelled devices inspired by the earthworm and snakes because these achieve motion by anisotropic friction. These robots have the potential to access without stretching the colon and without causing pain or damage to the patient, as present techniques do.

Pneumatic actuation is the most commonly used actuation. Furthermore, a few sensors are used to give helpful information in the situation of MIS, such as a proprioceptive sensor, an electromagnetic sensor, an exteroceptive sensor, and a diagnostic sensor [1]. Inspired by biology, he envisions designing soft and controllable devices by taking octopus as a reference. Currently, the flexible surgical system aims to reach remote areas in the body. For such cases, soft robotics is used, which gives the tool to build a robot that can access remote areas inside the body and interact with the environment safely and actively. The surgical manipulator required for the surgery should be soft, flexible, and thin. Moreover, they should achieve elongation and soft multi-bending to obtain this fluidic or pneumatic actuation feature. There are drawbacks to MIS that even clinicians agree on it, that includes difficulties in instrument control, limitations in control, and rigidity in instrumentation that causes ergonomics [5].

3. BIOHYBRID SOFT ROBOTS, ESKIN, AND BIOIMPEDANCE

Biohybrid soft robots are a soft robot that utilizes biological tissue inside their structure. There are two main strategies to control biohybrid soft robots. The first one is directly triggering the biological cell used inside the robot to attain desired response or motion [6]. Furthermore, the second strategy is to generate the force through external stimulation, which affects the synthetic material associated with the biological one. In early-stage development, soft robotics was limited to rat muscle-based systems, but now researchers successfully developed robots with human skeleton tissue. Soft robotics is used in multiple rehabilitation and also in nursing care applications [2].

Biohybrid robots based on living material currently look for promising solutions to overcome the disadvantages of the presently available actuation system. In the future, biohybrid robots may combine with different cells and tissue types for sensing and processing information and with vascular networks to carry oxygen, nutrients, and biochemical factors inside the body. As an emerging technology of biohybrid robots, micro-robots will be introduced in the future, called biobots. Due to their small size, these robots will be used for disease monitoring and diagnosis as they can enter the circulation system quickly. Secondly, it will be the best choice for drug delivery, which helps treat tumours [7].

CHAPTER 15

Applications of AI-enabled Robotics in Healthcare

Blaren D'Silva[1] and **Rathishchandra R. Gatti**[1,*]

[1] *Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India*

Abstract: Robotics began roughly 30 years ago in medical applications, but it is still relatively young for biological applications. Because of the precision, accuracy and reproducibility of robotic technology, robotic interventions in medical fields, such as robotic surgery, can enable doctors to work inside the human body, which is either non-invasive or minimally invasive, with improved surgical results. The importance of medical robots in the medical sector is intended to deliver good outcomes to assist people in doing complex tasks that need a significant amount of time, accuracy, concentration, and other routines that cannot be accomplished solely through human capability. Due to advancements in AI and IoT and their convergence to AIoT, the potential of medical robots has tremendously increased in the healthcare industry. The chapter outlines the various applications of robotics in the healthcare sector, including surgical, rehabilitation, telemedicine, and diagnostic. The advantages of robotics in Healthcare are highlighted, along with the discussion on the current and future challenges in their deployment and adoption. The role of AIoT in enhancing these healthcare robots' cognitive and other capabilities is also discussed. Finally, the future of robotics in Healthcare is explored, including emerging trends and technologies, their impact on the healthcare industry, and the potential for innovation and growth.

Keywords: Sensors, Effectors, AIoT, Nanotechnology, Nanorobotics, Reproducibility, Nanites.

1. INTRODUCTION

Robotics in Healthcare refers to using robots and automation technology in the medical field for various purposes such as diagnosis, treatment, surgery, and rehabilitation of patients. This technology involves the design, construction, and use of robots for performing various tasks in a medical environment. Robotics in Healthcare aims to improve patient outcomes, reduce costs, and increase the efficiency and accuracy of medical procedures and treatments. These robots can be programmed to perform specific tasks, such as conducting surgery, performing

* **Corresponding author Rathishchandra R. Gatti:** Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India; E-mail: gattirathish@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

physical therapy, or monitoring patients remotely. The growth of AIoT has enabled the cognitive intelligence of these robots towards Artificial General Intelligence (AGI) from traditional specific machine learning tasks [1].

Medical robots offer much potential for enhancing physician precision and skills during surgical operations [2]. Even though multiple commercial firms provide medical robots, the overall number of robots is relatively modest, and the industry is expected to develop slowly. Unlike industry robotics, medical robotics has yet to achieve critical mass. On the other hand, medical robots' benefits are projected to become increasingly apparent with time, culminating in a gradual growth in their use in medicine [3]. AI-enabled robotic surgical treatments have provided superior clinical outcomes and lower total medical expenditures by reducing hospital stays, recovery durations, and the need for recurrent surgery [4]. The range of applications now includes the whole medical treatment process, from diagnosis through operation execution, preoperative planning, and postoperative rehabilitation.

Due to the diverse spectrum of products, technology and applications, computer-assisted surgery [5], image-guided surgery [6], medical robots, computer-integrated surgery [2], and virtual medical reality [7] have all been given importance. Each of the domains of this study that has shown promising applications in the medical sciences is referred to as medical robotics. These technologies are not designed to take the position of doctors; instead, they are meant to supplement their talents.

Medical and Healthcare robots are designed to work in a range of settings. Micro-robotics is related to developing surgical tools such as minimally invasive surgery [8], image-guided surgery, computer-integrated advanced orthopaedics [9], and stereotactic guidance [10]. In contrast, Macro-robotics is concerned with developing wheelchairs and rehabilitation manipulators [10] to help the disabled and elderly. Bio-robotics [11] is the fourth category, which involves developing models and simulations of biological processes to better understand the human body and system. As previously stated, the economic and societal benefits of widespread robotics usage in medicine (notably surgery) are substantial. If all of the preceding steps are done, robots' full potential can be realized in the medical field, just as in industrial applications, for the betterment of society worldwide.

2. NEED FOR ROBOTS IN THE HEALTHCARE SECTOR

The healthcare sector faces numerous challenges, including an ageing population, increasing demand for medical services, and rising costs. Robotics in Healthcare has emerged as a solution to these challenges, offering numerous benefits that can improve patient outcomes, increase efficiency, and reduce costs. One of the key reasons for the need for robotics in Healthcare is the ageing population [12]. The number of older adults is increasing rapidly, and many of them require medical care for various chronic conditions. Robots can be programmed to assist with tasks such as monitoring patients, providing physical therapy, and performing medical procedures, reducing the burden on healthcare providers and enabling them to provide better care to a larger number of patients [13]. Another reason for the need for robotics in Healthcare is the increasing demand for medical services. With the world's population growing, there is a growing demand for medical services. Robots can help healthcare providers meet this demand by automating tasks, freeing healthcare providers to focus on more complex procedures, and reducing patient wait times [14]. In addition, the increasing costs of Healthcare are also driving the need for robotics in Healthcare. Robots can automate time-consuming and repetitive tasks, reducing the need for human intervention and reducing costs. They can also perform medical procedures with greater accuracy, reducing the risk of errors and costs associated with malpractice lawsuits.

Finally, robotics in Healthcare can improve patient outcomes by enabling healthcare providers to perform medical procedures with greater accuracy and speed. Robots can be programmed to perform procedures with precision and accuracy, reducing the risk of human error and ensuring that patients receive the best possible care [14]. In conclusion, the need for robotics in Healthcare is driven by numerous factors, including an ageing population, increasing demand for medical services, rising costs, and the desire to improve patient outcomes. By automating tasks, reducing costs, and improving patient outcomes, robotics in Healthcare has the potential to revolutionize the way medical services are provided.

3. REHABILITATION ROBOTS

Rehabilitation Robotics aims to look into the use of robotics in motor rehabilitation procedures for individuals who have lost motor control and capacities due to diseases like stroke, as well as to create robotic and mechatronic technological assistance for disabled and older adults to live independently. This provides robots with a more significant role in rehabilitating neuro-motor functions and motor capacities by giving flexible and programmable tools and allowing for quantitative settings and assessing operations [15]. Automated tools have been successfully used to promote the psychological enrichment of the elderly and motor rehabilitation [16].

Personal care for the disabled is another area where you can see rehabilitation robots. With the increasing number of people with disabilities, including those with physical and social disabilities due to birth and old age, mobility aids, from

CHAPTER 16

An Overview of Current and Future Applications of Robotics In Surgical Operations

Veerishetty Arun Kumar[1], **Nishan Rai**[1], **A. R. Badrinath**[1], **Abhishek Kamath**[1] and **Rathishchandra R. Gatti**[1,*]

[1] *Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India*

Abstract: Technology has changed almost all aspects of our life. Similarly, in the medical field, the new technology is Robotic surgery. Robotic surgery involves employing robots in the process of surgery. The employed robot, known generally as the surgical robot, is self-regulating, partially or entirely computer-controlled, and can be programmed as required for the surgery. As different surgical robots are employed for different types of surgery, robotic surgery improves patient care and ensures better treatment than regular surgery. The purpose of this article is to provide an outline of the main ideas of robotic applications used in surgery. This article aims to provide an overview of robotics's current and future applications in surgical operations and the advantages and disadvantages of surgical robots.

Keywords: Surgical robots, Laparoscopy, Robotics, Surgery.

1. INTRODUCTION

Robotically Assisted Surgical Systems (RASS) have performed over 7 million surgeries. From the first basic ideas in the 1970s until 2010, the Medical Robotics Database (Merida) was maintained by the Mannheim and Heidelberg University clinics in Germany. It featured more than 450 medical robotics initiatives around the world. Due to a variety of factors, just a few of these research initiatives resulted in commercially accessible systems: The creation of such systems involved high-risk and high-costs due to technological complexity, patent issues, regulatory difficulties, and a lack of uniformity [1]. In 1970, the procedure was performed as an open operation, in which a large cut was made in the organ, and surgery was performed. In 1980, keyhole surgery, also known as laparoscopy, was

* **Corresponding author Rathishchandra R. Gatti:** Department of Mechanical Engineering, Sahyadri College of Engineering and Management Sahyadri Campus, Adyar Mangalore Taluk, India; E-mail: gattirathish@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

introduced. Instead of a large surgical incision, a tiny hole is made through the belly, and the procedure is performed [2].

The fundamental issue with the standard laparoscopic procedure is the instrument, which is a straight item with x, y, and z-axis motion. All operations cannot be performed with this movement [3]. Pronation and supination bending is used in robotic surgery, and laparoscopy fails to capture this moment. Whereas robotic surgery prefers open surgery, open surgery is impossible with laparoscopy due to mobility restrictions [4]. A robotic surgery instrument inserted into the abdomen requires all the movements called an endo-wrist. The robot can do all the movement that can be done by hand. The doctor controls the robot, and there is no contact between the doctor and the patient during the surgery [5]. When compared to traditional surgery, robotic surgery offers a 12x magnification. The doctor can even have HD 3D vision due to the camera in the device, allowing him to manage the robot and do the treatment safely and effortlessly. The mechanical arm will control the robot's overall mobility, whereas the doctor controls the arm and transmits the movement to the robot [6].

Shorter hospitalization, faster recovery, less discomfort compared to laparoscopic surgery, lower risk of infection, less blood loss, and improved surgical quality are all advantages of robotic surgery. Cost is one of the downsides of why robotic surgery is still not among the regular choices in the medical industry [7].

2. WORKING PRINCIPLE OF A SURGICAL ROBOT

The robot's operation is controlled by mechanical arms controlled by the surgeon's hands. Following that, it contains an insertion into the human body, which is smaller in-depth than the other processes that require instruments to be delivered through this insertion. After insertion by the surgeon, he comes back to the table (at a remote location away from the operation) and performs surgery by viewing it from a 3D view [4, 5].

One commonly used robotic surgical system is da Vinci, which consists of three essential components. The first is the surgeon console, the central sub-system for the machine to observe the doctor and is operated by the surgeon by sitting with the help of arms. The console may be positioned outside the room or in any place in the room. The surgeon sees the 3D perspective of the robot through the lens of the machine, and he controls the robot's movement using his hand, arms, and foot. Because the surgeon has little feedback, the person working near the screen must provide the necessary information to the surgeon [5].

The second component is the vision system, which allows him to see the 3D view on the screen using two cameras and two lights to enhance the vision. A 12 mm endoscope is also used to get 6x to 10x visual clarity to achieve higher operation quality [4]. Any further information from the screen is unnecessary because the sight is superb and straightforward. The screen displays a clear view of the surgical site and the surrounding circumstances. Any other issue may be seen easily compared to any other technique [1].

The third component is the robot's arms, which have three arms in the original series and four in the updated series. An instrument called an endo wrist is linked to the mechanical arm. The endo wrist is an essential component of the whole surgery. It is now like a human hand coming inside with a little hole and performing surgery because it can move in all seven directions like human hands. The computer reproduces the surgeon's hand movement, and the ultimate product is found in the endo wrist. This procedure is used to do surgery on humans using robotic surgery. The software plays a key role here by showing the required details to the doctor and maintaining the tools as suggested by the doctor [1, 5].

3. TYPES OF ROBOTS USED FOR SURGERY

3.1. Da Vinci

Da Vinci is the most often utilized robotic surgery. It is commonly used for cardiac, head, neck, and gynecologic procedures. Da Vinci received FDA certification in 2011 and has since increased in popularity in the robotic medical field, becoming one of the most popular surgical robots. The da Vinci has been evaluated and analyzed, and the results and studies indicate that it is safe and may be used without issue [4]. da Vinci's most recent model, the XI, was introduced in 2014 and was built for large operations with a movable platform. It has three degrees of freedom and can attain seven degrees of movement with an endo wrist. It has an 8 mm camera for visual reasons, through which the clarity may be observed in HD-3D clarity. The main disadvantage is that each surgical system costs $2 million, and the size is too large; the set demands space and must be inexpensive [1].

3.2. Senbance

The senbance TELELAP ALFA-X system used in Senbance robots, authorized by FBA in 2017, is used in the sentence console type robot surgery. It has an open remote-control system and is an updated version of da Vinci. The robot has four arms, each of which can insert a tool. It has three degrees of freedom, similar to

CHAPTER 17

Healthcare Applications Centered on AIoT

Sapna R.[1,*] and **Preethi**[2]

[1] *Nitte Meenakshi Institute of Technology, Bangalore, India*

[2] *Manipal Institute of Technology, Bengaluru Manipal Academy of Higher Education, Manipal, Karnataka 576104, India*

Abstract: The Internet of Things (IoT) is a quickly expanding environment which combines software, hardware, physical components, as well as computing tools for data collection, sharing, or rather interaction. The IoT enables a unified platform for humans to interact with a wide range of physical and virtual objects, like personalised healthcare domains. Due to the explosive growth and advancement of the internet, traditional patient care strategies have enhanced with the replacing e-medical records mechanisms. The use of IoT technology provides medical modern healthcare equipment device setting for both physicians and clients. IoT devices and Artificial Intelligence are beneficial in many implementations, starting with remote weather monitoring to mechanical mechanisation. Furthermore, medical care applications are showing a strong interest in IoT devices due to cost savings, easiness of using it, and an increase in service quality. The most recent services for IoT-based healthcare, which have been investigated and are still facing challenges in the clinical setting, are required for intellectual, creative solutions. An exploration of prospects for artificial intelligence and the internet of things in the medical sector is provided in this chapter.

Keywords: Internet of Things, Artificial Intelligence, Wearable devices, Medical health services.

INTRODUCTION

In latest days, artificial intelligence (AI) has gained significant traction, been widely embraced, and revolutionised a number of industries, such as health care system, commerce, banking, wealth management, market research, transport, property investment, logistical support, and food science. The Internet of Things (IoT) is a collection of interconnected gadgets that are coded to act either selectively or jointly using the information gleaned from every connected gadget. IoT gadgets usually have internet connectivity, processors and memory, sensors to

* **Corresponding author Sapna R.:** Nitte Meenakshi Institute of Technology, Bangalore, India; Tel: 8105254854; E-mail: sapna.aradhya@gmail.com

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

gather useful data, and are a component of a network with vast numbers of other comparable gadgets.

Edge computing, which can effectively control a modest quantity of information within a constrained bandwidth and provides us with improved local safeguards, quick response times, and reduced latency, or fog computing are the two options used to process the collected data locally. With a decentralised architecture, fog computing offers the very same benefits as edge computing for data security and delay because computing is done at a fog node that is a part of the local area network. The intellectual ability is still nearer to the data's origin. Even so, cloud computing is the better decision when intensive data processing and data processing are needed owing to the data's quantity and speed, though it is at the price of significant costs and delay and potential data security issues [1]. Because of its Enhanced performance, better data security, and higher responsiveness in comparison with fog and cloud computing architectures, edge computing is receiving more attention lately, particularly for IoT systems [2].

According to several studies, AIoT (Artificial Intelligence of Things) is a union of AI's computational power and IoT's combined interoperability that exceeds the boundaries on the intellectual ability of smart devices by enabling them to do extremely difficult tasks that are completely impossible with existing architecture. According to Ghosh et al., A lot of people are using AIoT in a variety of industries, including retail, healthcare, transportation, and home appliances [3, 4].

Healthcare facilities can quickly try to assign outpatients to treatment facilities with less congestion thanks to health prediction model. They expand the patient base that receives health care. The frequent problem of abrupt shifts in healthcare patient flow is addressed by a health prediction system. Throughout many hospitals, emergency situations such as the influx of ambulances at the times of natural mishaps and vehicle collisions, and standard outpatient necessitate, are what drive the demand for healthcare services. Healthcare facilities will often have problems in individual patient flow data in actual times like, to meet requirement, while facilities close by might only see a small number of patients. To encourage interaction, the Internet of Things (IoT) sets up a link among digital and physical objects. Through cutting-edge microprocessor chips, it lets the instantaneous collection of data [5].

It is important to remember that healthcare is the process of improving and maintaining health by identifying and preventing disorders. Diagnostic tools could be utilized to examine inconsistencies and ruptures that occur under the skin's surface. Similar to this, specific anomalous conditions like insomnia and heart disease can be tracked [6]. Modern healthcare facilities are under pressure due to the booming population and the erratic spreading of persistent diseases. The demand for medical services is very great. In general, the demand is for nurses, physicians, and hospital beds [7].

There may be ways to relieve the strain on medical practices using the Internet of Things (IoT). If few cases, healthcare centers use RFID systems to lower healthcare costs and improve clinical care. Notably, medical monitoring programmes make it simple for doctors to keep track of their patients' cardiac impulses, which helps them make an exact diagnosis [8, 9]. A variety of wearable appliances were developed in providing steady wireless data transmission. Regardless of the positive impact it has in healthcare, data security is a major drawback for both patients and healthcare personnels [10]. To protect data integrity, many researchers have evaluated the use of IoT and machine learning for monitoring individuals suffering from abnormalities in their health.

In the healthcare industry, the IoT has ushered in an impact where experts can proactive patient engagement. The IoT with machine learning assesses the demand for emergency care and develops a plan to deal with the issue all through seasonal times. Crowding in waiting areas is an issue that many outpatient departments deal with [11]. Hospital visitors have various illnesses, some of which require immediate medical attention. It gets most difficult when people those who require urgent attention should await in an extensive queue. In developing nations with hospitals with inadequate staffs, the issue is made worse. Because hospitals are often overcrowded, many patients often leave without receiving medical care.

By enabling physical equipment and objects to see, hear, and think, AI and IoT enable their connectivity as well as enable them to cooperate. For exchanging information and speaking, they make judgements. Utilizing a wide range of embedded devices, sensor systems, protocols, and their applications, AIoT technology allows previously nonintelligent objects to become intelligent. This allows previously nonintelligent devices to become connected to the Internet and develop into intelligent devices. The healthcare profession makes use of several AIoT-based medical services, including e-health and telemedicine systems, diagnostic test, preventative measures, rehabilitative services, and monitoring equipment.

Remote monitoring of health is technically possible, according to studies in key sectors, but there are some situations where the advantages could be larger. It may be possible to supervise non-critical patient data from residence, instead of being at a hospital, reducing the need for healthcare resources like bedrooms as well as physicians. This could increase senior citizens' access to medical care who can stay in their homes for prolonged duration. In fact, it could improve availability of

SUBJECT INDEX

Shreyas Suresh Rao, Steven Lawrence Fernandes, Chandra Singh, Rathishchandra R. Gatti, Harisha A., & Rohanchandra R. Gatty (Eds.)

I

L

M

N

O

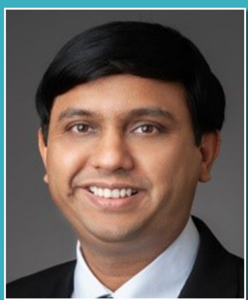
P

R

S

Shreyas Suresh Rao

Prof. Shreyas is an associate professor with work integrated Learning Programmes, BITS Pilani. He has more than 18 years of experience in IT, teaching and research domains. He obtained Ph.D. from Manipal Academy of Higher Education (MAHE), M.S in software systems from BITS, Pilani and B.E from VTU. His previous stints include working as associate professor in the CSE department at Sahyadri College of Engineering and Management, Mangalore; assistant professor in CSE department at Presidency University, Bangalore; and assistant professor in CSE department at Sir MVIT. His research interests include software engineering, DevOps, natural language processing and health informatics areas.



Steven Lawrence Fernandes

Prof. Steven Fernandes began his postdoctoral research at the University of Alabama at Birmingham, where he worked on NIH-funded projects. He also conducted postdoctoral research at the University of Central Florida. This research included working on DARPA, NSF, and RBC funded projects. His publications include research articles in highly selective artificial intelligence venues. He received Ph.D., M.Tech, and B.E. in electronics and communication engineering from Karunya Institute of Technology and Sciences, Manipal Institute of Technology, and Visvesvaraya Technological University respectively. His current area of research is focused on using artificial intelligence techniques to extract useful patterns from big data. This includes robust computer vision and natural language processing applications using deep learning and computer-aided diagnosis using medical image processing

Chandra Singh

Prof. Chandra Singh is an assistant professor in the Department of Electronics and Communication Engineering at the Sahyadri College of Engineering & Management. He has obtained B.E. and M. Tech. from Srinivas School of Engineering, Mukka and NMAM Institute of Technology, Nitte. He is pursuing Ph.D. from VTU Belagavi, India. He has more than 10 patents, more than 25 publications. He has also received many awards and accolades during his short career. He has published more than 8 books by Scopus.

Rathishchandra R. Gatti

Prof. Rathishchandra R Gatti is currently professor and head of the Department of Mechanical and Robotics Engineering at SCEM. Previously, he worked in Curtin University as academic and patent analyst, General Electric as new product development engineer, SVI as manufacturing supervisor, Meritor Automotive as automotive designer, and trainee engineer at Rapsri Engineering. He did Ph.D. in mechanical engineering from Curtin University, MBA Operations from IGNOU and BE in mechanical engineering from NITK, Surathkal. He has more than 18 patents, more than 40 publications and edited /coauthored more than 8 Scopus indexed books. His research interests are energy harvesting, self-powered autonomous systems, robotics and cyber-physical systems.

Harisha A.

Prof. Harisha is an assistant professor in the Department of Computer Science & Engineering, Sahyadri College of Engineering & Management Mangaluru with ten years of experience in teaching, learning and research. He completed his master's degree from Indian Institute of Information Technology Allahabad with specialization in wireless communication and computing. He has published ten research papers which are indexed in DBLP, Scopus and SCI. He also attended various international conferences and presented research findings. Prof. Harisha is an active member of professional bodies ISTE, ACM and CSI. He has also received funding from government agencies for project proposals submitted.

Rohanchandra R. Gatty

Prof. Rohanchandra R. Gatty is currently working as onco-surgeon and head of surgical oncology at Father Mullers Hospital, India. He has more than 26 years of experience in surgical oncology. He is also a partner in Mangalore Institute of Oncology group of hospitals. He pursued his M.ch in surgical oncology from Gujarat Cancer Research Institute, M.S in general surgery from Mysore Medical College, Mysore and MBBS from Vijayanagar Institute of medical Sciences, Bellary. He has more than 10 publications in Scopus and PubMed publications.