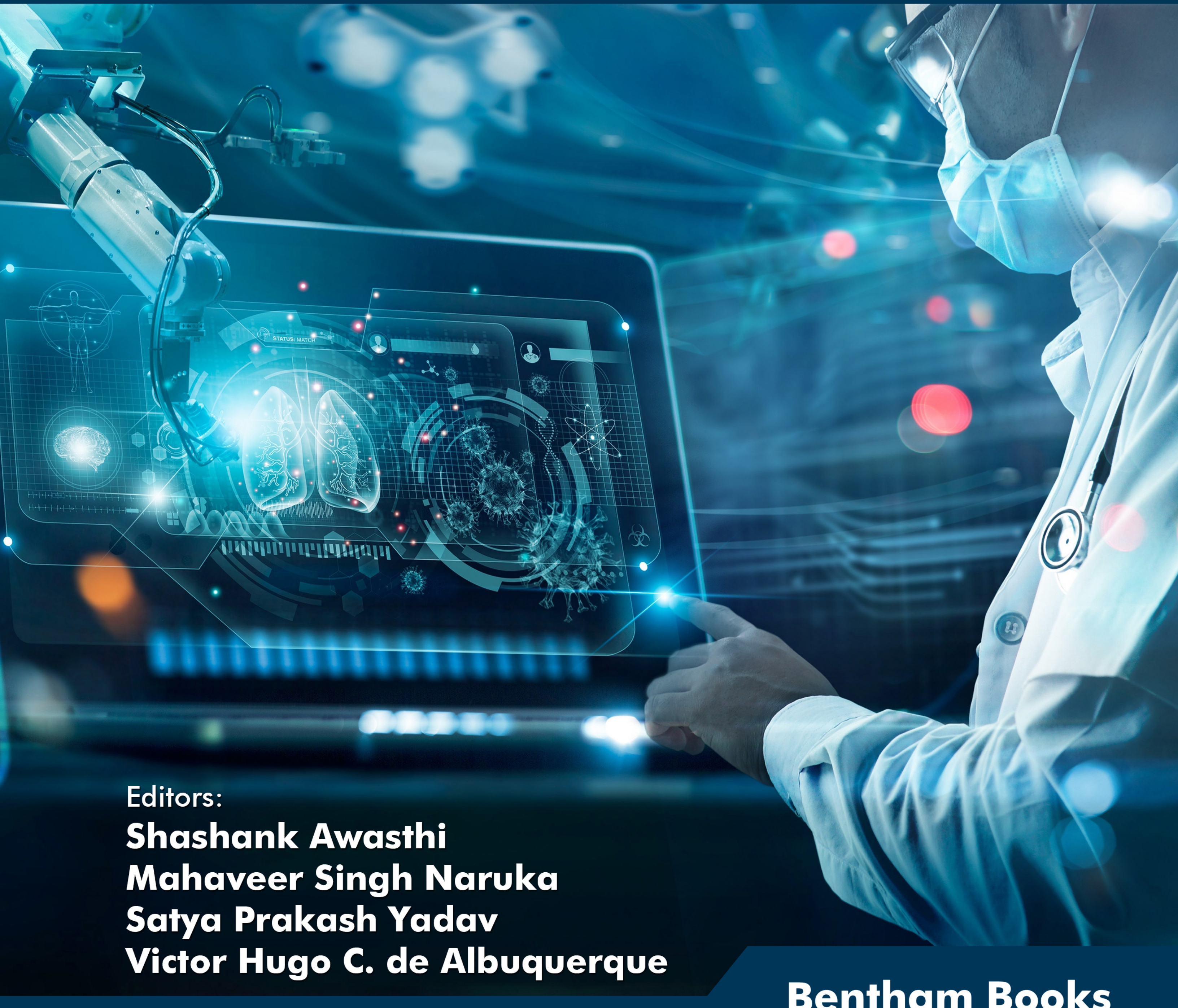
AI AND IOT-BASED INTELLIGENT HEALTH CARE & SANITATION



Editors:
Shashank Awasthi
Mahaveer Singh Naruka
Satya Prakash Yadav
Victor Hugo C. de Albuquerque

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AI and IoT-based Intelligent Health Care & Sanitation

Edited by

Shashank Awasthi
Department of Computer Science and Engineering
G.L. Bajaj Institute of Technology and Management
(GLBITM), Affiliated to AKTU
India

Mahaveer Singh Naruka
G.L. Bajaj Institute of Technology and Management
(GLBITM) Affiliated to AKTU
India

Satya Prakash Yadav
Department of Computer Science and Engineering G.L. Bajaj
Institute of Technology and Management (GLBITM)
Affiliated to AKTU, Greater Noida- 201306, U.P. India
Graduate Program in Telecommunications Engineering
(PPGET), Federal Institute of Education, Science, and
Technology of Ceará (IFCE)
Brazil

&

Victor Hugo C. de Albuquerque
Department of Teleinformatics Engineering (DETI)
Federal University of Ceará
Brazil

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Editors: Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav &
Victor Hugo C. de Albuquerque

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PREFACE

The book aims to provide a deeper understanding of the relevant aspects of AI and IoT impacting each other's efficacy for better output. Readers may discover a reliable and accessible one-stop resource; An introduction to Artificial Intelligence presents the first full examination of applications of AI, as well as IoT presents the smart objects, sensors or actuators using a secure protocol to the Artificial Intelligence approaches. They are designed in a way to provide an understanding of the foundations of artificial intelligence. It examines Education powered by AI, Entertainment and Artificial Intelligence, Home and Service Robots, Healthcare re-imagined, Predictive Policing, Space Exploration with AI, and weaponry in the world of AI. Through the volume, the authors provide detailed, well-illustrated treatments of each topic with abundant examples and exercises.

KEY FEATURES

- This book contains different topics about the most important areas and challenges in the Internet of Things. In this book, you will be able to read about the different subparts that compose the Internet of Things and the different ways to create a better IoT network or platform.
- This book will contain the possible architecture and middleware that you can use to create a platform and how to manage the data that you obtain from different objects (Smart Objects, sensors, or actuators) using a secure protocol or messages when you send the data through insecure protocols.
- These improvements can be applied in different ways. We can use different technologies and create different applications, or we can use the research of other fields like Big Data to process the massive data of the devices, Artificial Intelligence to create smarter objects or algorithms, Model-Driven Engineering to facilitate the use of any people, Cloud Computing to send the computation and the applications to the cloud, and Cloud Robotics to manage and interconnect the Robots between themselves and with other objects.

- This book will bring forth the details in a precise and concise form about all the right and relevant technologies and tools to simplify and streamline the concepts, processes, model development, and budget development for readers of respective backgrounds.

Shashank Awasthi
Department of Computer Science and Engineering
G.L. Bajaj Institute of Technology and Management (GLBITM), Affiliated to AKTU
Greater Noida- 201306, U.P.
India

Mahaveer Singh Naruka
G.L. Bajaj Institute of Technology and Management (GLBITM) Affiliated to AKTU
Greater Noida- 201306, U.P.
India

Satya Prakash Yadav
Department of Computer Science and Engineering
G.L. Bajaj Institute of Technology and Management (GLBITM)
Affiliated to AKTU, Greater Noida- 201306, U.P.
India

Graduate Program in Telecommunications Engineering
(PPGET), Federal Institute of Education, Science, and Technology of Ceará (IFCE)
Fortaleza-CE
Brazil

&

Victor Hugo C. de Albuquerque
Department of Teleinformatics Engineering (DETI)
Federal University of Ceará
Brazil

List of Contributors

Aman Abidi	Swinburne University of Technology, Victoria, Australia
Abdullah Al-Shenqiti	College of Medical Rehabilitation Sciences, Taibah University, Madinah, Saudi Arabia
Ajit Kumar	School of Computer Science and Engineering, Soongsil University, Seoul, South Korea
Anuradha Patil	Department of ECE, Faculty of Engineering and Technology Exclusive for Women Sharn Basva University, Kalburagi, India
Ahmed Mateen Buttar	Department of Computer Science, University of Agriculture Faisalabad, Faisalabad, Punjab, Pakistan
Ajit Kumar	School of Computer Science and Engineering, Soongsil University, Seoul, South Korea
Arvind Kumar Shukla	Department of Computer Application, IFTM University, Moradabad, Uttar Pradesh, India
Ajad	Department of Electronics and Communication Engineering, S J C Institute of Technology, Chickballapur, Karnataka, India
Aditya Mandloi	Electronics Engineering Department, Medi-Caps University Indore, Madhya Pradesh, India
Abdul Rahman H. Ali	Mahatma Gandhi University/Taibah University, Meghalaya, India
B. Radha	ICT & Cognitive Systems, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India
Bharat Maurya	Department of Political Science, Chaudhary Bansi Lal University, Bhiwani Haryana, India
B. Venkata Srinivasulu	Department of CSE, JJTU, Rajasthan, India
Chandrakala G. Raju	BMS College of Engineering, Bangalore, Karnataka, India
C.R. Aditya	Department of Computer Science & Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India
Christopher Francis Britto	Information Technology & Computer Sciences, Mahatma Gandhi University, Meghalaya, India
Chandra Sekhar Kolli	Aditya College of Engineering & Technology, Surampalem, East Godavari, India
Dattathreya	Alva's Institute of Engineering and Technolog, Mijar, Moodbidri, Karnataka, India
Dimitrios Alexios Karras	National and Kapodistrian University of Athens (NKUA), Hellas, Greece
Dillip Narayan Sahu	Department of MCA, School of Computer Science, Gangadhar Meher University, Sambalpur, Odisha, India
G. Appasami	Department of Computer Science, Central University of Tamil Nādu, Tiruvarur, Tamil Nādu, India

G. Sudhakar	Computer Science Engineering, School of Information Technology, Jawaharlal Nehru Technological University, Hyderabad, Telangana, India
Girish Saunshi	Department of Computer Science and Engineering, KLE Institute of Technology, KLEIT, Karnataka, India
Hemlata Joshi	Department of Statistics, CHRIST (Deemed to be University), Bangalore, Karnataka, India
H. Roopa	Information Science and Engineering, Bangalore Institute of Technology, Bangalore, Karnataka, India-560079
Jagadeesh Kumar Ega	Chaitanya (Deemed to be University), Hanamkonda, Telangana State, India
K. Sheela Sobana Rani	Department of Electrical and Electronics Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamil Nadu, India
Korla Swaroopa	Department of CSE, Aditya Engineering College, Surampalem- East Godavari, Andhra Pradesh, India
K.T. layarajaa	Department of Electronics and Communication Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India
Kaushalendra Kumar	Department of Bio-Science, Galgotias University, Greater Noida, Uttar Pradesh, India
K. R. Krishnareddy	SJM Institute of Technology, Chitradurga, Karnataka, India
Koteswara Rao Vaddempudi	ECE Department, Prakasam Engineering College, Kandukur, Prakasam, Andhra Pradesh, India
Karthika Ganesan	Sri Vidya College of Engineering and Technology, Sivakasi Main Road, Virudhunagar, Tamilnadu, India
Kamal Alaskar	Bharati Vidyapeeth (Deemed to Be University) Institute of Management Kolhapur, Maharashtra, India
K. Nirmala Devi	Department of Computer Science and Engineering, Kongu Engineering College Perundurai, Erode, Tamilnadu, India
K. R. Prasanna Kumar	Siddaganga Institute of Technology, Tumkur, Karnataka, India
K.R. Shobha	Department of Electronics and Telecommunication Engineering, Ramaiah Institute of Technology, MSR Nagar, MSRIT Post, Bangalore, Karnataka, India
Muthukumar Subramanian	SRM Institute of Science & Technology, Tiruchirappalli Campus, (Deemed to be University), Trichy, Tamilnadu, India
Makarand Upadhyaya	Department of Management & Marketing, College of Business, University of Bahrain, Administration, Bahrain
M. Malathi	Department of ECE, Vivekananda College of Engineering for Women (Autonomous), Elayampalayam, Namakka, Tamilnadu, India
M. Sugadev	Department of Electronics and Communication Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India

Makhan Kumbhka	Computer Science & Elex, Christian Eminent College, Indore, Madhyapradesh, India
Mrunalini U. Buradkar	Department of Electronics and Telecommunication Engineering, St.Vincent Pallotti College of Engineering & Technology, Nagpur, Maharashtra, India
Madhu Khurana	University of Gloucestershire, UK
M. Sudhakar	Department of Mechanical Engineering, Sri Sairam Engineering College, Chennai, Tamil Nadu, India
Muthukumar Subramanian	SRM Institute of Science & Technology, Tiruchirappalli Campus, (Deemed to be University), Trichy, Tamilnadu, India
Merin Meleet	Department of Information Science and Engineering, RV College of Engineering, Bengaluru, Karnataka, India
M. Lakshminarayana	Department of ECE, SJB Institute of Technology, Bengaluru, Karnataka, India-560060
N. Arulkumar	Department of Statistics and Data Science, CHRIST (Deemed to be University) Bangalore, Karnataka, India
Nagaraj Bhat	RV College of Engineering, Bengaluru, Karnataka, India-560059
Nayani Sateesh	Department of Information Technology, CVR College of Engineering, Vastunagar, Mangalpalli (V), Ibrahimpatnam (M), Rangareddy, Telangana, India-501510
Nagendra Kumar	Department of Electronics and Communication Engineering, S J C Institute of Technology, Chickballapur, Karnataka, India
N. Krishnamoorthy	Department of Software Systems and Engineering, Vellore Institute of Technology, Vellore Campus, Thiruvalam Road, Vellore, School of Information Technology and Engineering, Tamilnadu, India
Naveen Nagendrappa Malvade	Department of Information Science and Engineering, SKSVM Agadi College of Engineering and Technology, Lakshmeshwa, Karnataka, India
N. Chaitanya Kumar	Department of CSE, Sri Venkateswara Engineering College, Karakambadi Road, Tirupati, Andhra Pradesh, India
Nagaraj G Cholli	Department of Information Science and Engineering, RV College of Engineering, Bengaluru, Karnataka, India
N. Ramesh Babu	Department of Electronics and Communication Engineering, BMS Institute of Technology and Management, Bengaluru, Karnataka, India-560064
Praveen Gupta	Department of Computer Science and Engineering, GITAM School of Technology, GITAM (Deemed to be University), Visakhapatnam, Andhra Pradesh, India
Perumalraja Rengaraju	Department of Information Technology, Velammal College of Engineering and Technology, Madura, Tamil Nādu, India
R. Ambika	Departmnt of Electronics and Communication Engineering, BMS Institute of Technology and Management, Bengaluru, Karnataka, India-560064

Ranjan Walia	Department of Electrical Engineering, Model Institute of Engineering and Technology, Jammu & Kashmir, India
S. Hemavathi	CSIR - Central Electrochemical Research Institute (CECRI), CSIR-Madras Complex, Chennai, Tamil Nadu, India-600113
S. V. Vijaya Karthik	Department of Computer Science and Engineering, KLE Institute of Technology, KLEIT, Dharwad, Karnataka, India
Shubhi Jain	Swami Keshvanand Institute of Technology Management & Gramothan, Ramnagaria, Jagatpura, Jaipur, Rajasthan, India
Shantala Devi Patil	Department of Electronics and Communication Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India
S. Kamalesh	Department of Information Technology, Velammal College of Engineering and Technology, Madura, Tamil Nādu, India
Sujata V. Mallapur	Sharnbasva University, Kalaburagi, Karnataka, India-585103
Sonu Kumar	Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India
S. Thejaswini	BMS Institute of Technology and Management, Bengaluru, Karnataka, India-560064
Sachin Kumar	College of IT Engineering, Kyungpook National University, Daegu, South Korea
Shweta M Madiwal	Department of CSE, Faculty of Engineering and Technology, Exclusively for Women's) Sharnbasva University Karnataka, Kalaburagi, India
S. Nagaprasad	Department of Computer Science, Tara Government College (A), Sangareddy, Telangana, India
Santosh Pawar	Electronics Engineering Department, Dr. APJ Kalam University, Indore, Madhya Pradesh, India
Santosh Karajgi	BLDEA's SSM College of Pharmacy and Research Centre Vijayapur, Karnataka, India
T. V. Aravinda	SJM Institute of Technology, Chitradurga, Karnataka, India
Tariq Hussain Sheikh	Government Degree College Poonch J&K UT, Poonch, J&K UT, India-185101
T.N.R. Kumar	Ramaiah Institute of Technology, Bangalore, Karnataka, India-560054
T. Vamshi Mohana	Department of Computer Science, RBVRR Women's College, Hyderabad, Telangana, India
Vedanarayanan Venugopal	Electronics and Communication Engineering (ECE), Sathyabama Institute of Science and Technology (Deemed to be University), Chennai, Tamil Nadu, India-604119
V. Shanmugasundaram	Department of Electrical and Electronics Engineering, Sona College of Technology, Salem, Tamil Nadu, India-636005

V. Vani	Information Science and Engineering, Bangalore Institute of Technology, Bangalore, Karnataka, India
Vinit Gupta	Electronics Engineering Department, Medi-Caps University Indore, Madhya Pradesh, India
Vaishali Gajendra Shende	East point College of Engineering and Technology Bangalore, East Point Campus, Virgo Nagar Post, Avalahalli, Bengaluru, Karnataka 560049, India
Zafaryab Rasool	Deakin University, Geelong, Victoria, Australia

CHAPTER 1

IoT Based Website for Identification of Acute Lymphoblastic Leukemia using DL

R. Ambika[1,*], **S. Thejaswini**[2], **N. Ramesh Babu**[3], **Tariq Hussain Sheikh**[4], **Nagaraj Bhat**[5] and **Zafaryab Rasool**[6]

[1] *Department of Electronics and Communication Engineering, BMS Institute of Technology and Management, Bengaluru, Karnataka, India-560064*

[2] *BMS Institute of Technology and Management, Bengaluru, Karnataka, India-560064*

[3] *Department of Computer Science & Engineering, Amruta Institute of Engineering & Management Sciences, Bidadi, Karnataka, India-562109*

[4] *Government Degree College Poonch J&K UT, Poonch, J&K UT, India-185101*

[5] *RV College of Engineering, Bengaluru, Karnataka, India-560059*

[6] *Deakin University, Geelong, Victoria, Australia*

Abstract: A form of cancer known as leukemia, attacks the body's blood cells and bone marrow. This happens when cancer cells multiply rapidly in the bone marrow. The uploaded image is analyzed by the website, and if leukemia is present, the user is notified—a collection of pictures depicting leukemia as well as healthy bones and blood. Once collected from Kaggle, the data is preprocessed using methods like image scaling and enhancement. To create a Deep Learning (DL) model, we use the VGG-16 model. The processed data is used to "train" the model until optimal results are achieved. A Hypertext Markup Language (HTML) based website is built to showcase the model. Using a DL model, this website returns a response indicating whether or not the user's uploaded photograph shows signs of leukemia. The primary aim of this site is to lessen the likelihood that cancer cells may multiply while the patient waits for test results or is otherwise unaware of their condition. Waiting for results after a leukemia test can cause further stress and even other health problems, even if the person is found to be leukemia-free. This problem can be fixed if this website is used as a screening tool for leukemia.

Keywords: Deep Learning, Image Augmentation, Image Processing, Leukemia, VGG-16, Web Development.

* **Corresponding author R. Ambika:** BMS Institute of Technology and Management, Bengaluru, Karnataka, India; E-mail: ambikar@bmsit.in

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Extremely high numbers of white blood cells and platelets in the blood are thought to be the root cause of leukemia and other forms of bone marrow malignancy. Leukemia's early symptoms are similar to those of other diseases, such as fever, weight loss, chills, *etc.* Furthermore, the patient may experience no outward signs of leukemia's presence or progress as it is slowly killing them. Needle biopsies and other forms of differential diagnosis are used to check for leukemia. This test may take a while to get reliable findings, and the patient's condition or stress level may worsen as a result. The consequences for the patient's life are negative either way. The prevalence of this problem can be mitigated with the use of self-administered, accurate screening tests. The problem can be solved by a website that, given a picture of the patient's blood, can determine whether or not they have leukemia and provide that information to the user. After a user uploads an image, it is processed with a variety of image preprocessing processes, including cropping, resizing, and enhancing. Once the image has been preprocessed, a DL model is built using a module called VGG-16 and applied to the data. When using transfer learning with this DL module, the user needs just to adjust the first and last layers to achieve the desired results rather than the full module itself. To show the final result to the user, a website built in HTML is created alongside the model. Modifications to the website's output can be made in response to the results returned by the DL model.

2. LITERATURE SURVEY

The unexpectedly high number of new cancer cases harms the mental health of the elderly. The World Health Organization classifies leukemia as an uncommon disease. Even though over one million Indians were diagnosed with leukemia, the absence of a precise forecast of the disease's presence is the primary reason for the severity of the disease. The following scientists have conducted extensive studies on the prevalence and effects of leukemia, as well as studies on DL algorithms that may be useful in detecting leukemia.

Research into leukemia and its causes has been conducted by scientists at St. Jude Children's Research Hospital and other medical institutions. The comprehensive analysis [1] highlights the impact of diagnostics, prognostics, and therapies on advances in our understanding of the molecular processes involved in Acute Lymphoblastic Leukemia. Researchers from Philadelphia Children's Hospital's Oncology Division and Childhood Cancer Research Center report that 90% of patients with the most common childhood cancer are now cured. The most molecularly resistant subsets of acute lymphoblastic leukemia are the current focus of drug development efforts. Researchers from the Departments of

Hematology and Oncology, Pharmaceutical Sciences, and Pathological Studies, St. Jude Children's Research Center, and the Colleagues of Medicine and Pharmacy, Tennessee Health Center, St. Jude Children's Research Centre, agree that treating leukemia can be complicated depending on its type [2]. However, the success of your treatment can be enhanced by the use of several tools and methods. Chemical therapy was also proposed by them as an effective treatment for leukemia [3].

Leukemia is a malignancy of the blood and bone marrow. In a nutshell, cancer is the excessive growth of cells. Leukemia differs from other cancers in that it does not typically form a mass (tumor) visible in imaging tests like x-rays, increasing the likelihood of a catastrophic outcome. You can find a lot of leukemia cases today. Some are more prevalent among children, while others are more often observed among adults. Leukemia is the first step in the production of blood cells in the bone marrow. The stem cells go through a series of stages before reaching their final, mature state. Acute lymphocytic leukemia is the most common type of leukemia in people less than 39 years old, including children, adolescents, and young adults. Some 57% of new cases occur in persons under the age of 19. Hispanics and Caucasians are disproportionately affected. New cases of leukemia are diagnosed in about 1,7 per 100,000 American adults each year. The Department of Hematology at the NYU Perlmutter Cancer Center and the NYU School of Medicine conducted a comprehensive evaluation of the many subtypes of leukemia and their potential triggers. They claim that the treatment of acute lymphoblastic leukemia with dose-intensification chemotherapy and Allo-SCT represents a breakthrough in pediatric oncological sciences. Given the high-risk nature of the disease and the significant toxicity of chemotherapeutic treatments in adults, the outcomes are far less promising. Current drugs that are well-tolerated for the treatment of other cancers are now being investigated in Acute Lymphoblastic Leukemia [4].

The IoT, or the Internet of Things, is an effective resource that has many potential applications, one of which is in the medical profession. Alongside Big Data and AI, the IoT is expected to become a game-changer in many fields. According to a recent editorial article on IoT written by scholars at Indiana University in the United States of America, in general, IoT is defined as the interconnection of common objects, most of which also feature pervasive computing capabilities. Thanks to the exponential growth of the underlying technology, IoT offers tremendous potential for a plethora of new applications that will enhance the standard of living for all people. Researchers and professionals from all around the world have been focusing on IoT over the past few years. In the research [6], a brand-new image of the most recent state-of-the-art research on the topic is shown. When given the appropriate data, parameters, and conditions, DL can be

CHAPTER 2

AI and IoT-based Intelligent Management of Heart Rate Monitoring Systems

Vedanarayanan Venugopal[1,*], **Sujata V. Mallapur**[2], **T.N.R. Kumar**[3], **V. Shanmugasundaram**[4], **M. Lakshminarayana**[5] and **Ajit Kumar**[6]

[1] *Electronics and Communication Engineering (ECE), Sathyabama Institute of Science and Technology (Deemed to be University), Chennai, Tamil Nadu, India-604119*

[2] *Sharnbasva University, Kalaburagi, Karnataka, India-585103*

[3] *Ramaiah Institute of Technology, Bangalore, Karnataka, India-560054*

[4] *Department of Electrical and Electronics Engineering, Sona College of Technology, Salem, Tamil Nadu, India-636005*

[5] *Department of Medical Electronics Engineering, M S Ramaiah Institute Of Technology, MSRIT Post, M S Ramaiah Nagar, MSR Nagar, Bengaluru, Karnataka, India - 560054*

[6] *School of Computer Science and Engineering, Soongsil University, Seoul, South Korea*

Abstract: The Heart Rate Monitoring system is developed using Artificial Intelligence (ANN) and Internet of Things technology to detect the heartbeat and SpO2 of the patient to monitor the risk of heart attack and also make the person do regular check-ups. Health monitoring is very important to us to make sure our health is in which condition. The proposed framework examines the sources of information gathered from sensors fit with the patients to discover the crisis circumstance. The IoT technology is employed; it helps anyone monitor the patient's health from anywhere. A deep learning algorithm such as ANN is utilized to identify whether the person's health is normal or abnormal. In case an abnormality in health is noticed, an alert will be popped out. The proposed framework with artificial intelligence and IoT can reduce the death occurring due to heart rate, and other related issues can also be avoided.

Keywords: Accuracy, Artificial Neural Network Algorithm, Heart Rate, SpO2, Thing Speak.

* **Corresponding author Vedanarayanan Venugopal**: Electronics and Communication Engineering (ECE), Sathyabama Institute of Science and Technology (Deemed to be University), Chennai, Tamil Nadu, India-604119; E-mail: veda77etce@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Heart disease is presently the leading cause of death in China, claiming the lives of more than 1,500,000 people each year, according to official statistics. The likelihood of becoming bedridden and requiring medical treatment from family and friends is higher among patients with heart issues, according to the American Heart Association. Even though they may not feel well until late in the disease, it is too late for them to undo the damage that has already occurred. Furthermore, the vast majority of people die before obtaining any form of medical attention or treatment. The transformation of passive healthcare into a general strategy is therefore essential for enhancing heart disease healthcare performance and decreasing mortality rates. The physical conditions of their patients must be monitored by their physicians, and choices regarding when to deliver healthcare services must be made based on this monitoring. An effective real-time monitoring system is essential in delivering universal healthcare services.

As a result, the world's population is growing at an alarming rate. When it comes to accommodating an ever-increasing number of people, larger cities are under tremendous strain. However, even though medical resources and facilities in urban areas are continually being expanded, the essential level of care has not yet been achieved. As a consequence of the high demand for urban healthcare management, technical developments have occurred that have resulted in effective remedies to the expanding difficulties facing the city's population. Due to the increase in the number of people who want medical attention, remote healthcare is becoming increasingly frequent. Wearable sensors have gained in popularity in recent years, and gadgets like these are now more readily available on the market at a cheaper cost for self-care and activity tracking than they were previously. These cutting-edge devices have been investigated for medical applications such as data logging and management, as well as real-time health monitoring and monitoring of patients. Healthcare services will be able to reach new heights as a result of the development of the Internet of Things [1].

The use of low-cost, trustworthy, and handy devices by patients, as well as smooth networking between patients, medical equipment, and doctors is ensured by this method of delivery. The sensors are in charge of recording a continuous stream of signals [2]. It is the researchers who receive the signals captured by the sensors, which have been coupled with physiological data and supplied over a wireless network. It is necessary to link this new information with existing health data to make sense of it [3]. Using current data records and decision support systems, it is feasible for the doctor to create a more accurate forecast and recommend early treatment. Modern technology can predict health concerns even if a doctor is not readily available due to the analysis performed on the data. Other than being able to make predictions, robots may be able to design pharmaceuticals by thoroughly researching medical databases. Due to the improvements in progressive technology, it will be possible to dramatically lower healthcare expenses while simultaneously enhancing the accuracy of illness projections in the future. In this article, we discuss a service model in terms of technology and economics for the benefit of patients, as well as the challenges that remain in integrating the Internet of Things into the real-world medical environment.

2. LITERATURE SURVEY

The health of an individual is vital to their overall well-being. In the context of health, the absence of illness as well as a better physical and mental state, are seen as blessings. Society as a whole is placing an increasing emphasis on health and healthcare, and new technologies are being implemented to support this. A result of the economic effect of COVID-19 in recent years has been the implementation of smart healthcare systems around the world. A smart healthcare system keeps an eye on patients from a distance to avoid disease transmission and provides high-quality treatment at an affordable price for patients and their families. In this context, healthcare solutions incorporating IoT and machine learning are considered the most optimal [4]. These solutions have become more successful as a result of the Internet of Things (IoT), artificial intelligence (AI) and machine learning technologies, among others. A breakthrough in microelectronics has permitted the development of compact and low-cost medical sensing devices, which have had a significant impact on the delivery of medical care [5]. As a result, in healthcare systems, these therapies are separated into two categories: symptomatic treatments and preventive treatments. Disease prevention and early identification, as well as discovering the most effective treatment choices for a wide range of chronic disorders, are now highly valued by the general public. Consequently, national healthcare monitoring systems are becoming an inescapable development in the contemporary era. In recent years, there has been a significant increase in interest in Internet of Things (IoT) devices and machine learning algorithms for remotely monitoring patients to provide more accurate diagnoses in telemedicine. Real-time healthcare systems that regulate people's vital signs are in high demand, and researchers are working hard to build systems that are energy-efficient, cost-effective and scalable [6]. While conventional wireless communication technology may be employed in healthcare, it does so at the expense of higher expenses and radiation exposure, among other things. Health monitoring systems that do not rely on radiation provide more flexible communication routes and may be used to monitor a wide range of circumstances and conditions. Using a wireless connection to the local router, for example, can be used to communicate and send data within the home environment. When people need to utilize portable healthcare equipment while they are out in the

CHAPTER 3

Deep Learning Applications for IoT in Healthcare Using Effects of Mobile Computing

Koteswara Rao Vaddempudi[1,*], K.R. Shobha[2], Ahmed Mateen Buttar[3], Sonu Kumar[4], C.R. Aditya[5] and **Ajit Kumar[6]**

[1] *ECE Department, Prakasam Engineering College, Kandukur, Prakasam, Andhra Pradesh, India*

[2] *Department of Electronics and Telecommunication Engineering, Ramaiah Institute of Technology, MSR Nagar, MSRIT Post, Bangalore, Karnataka, India-560054*

[3] *Department of Computer Science, University of Agriculture Faisalabad, Faisalabad, Punjab, Pakistan-38000*

[4] *Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India-522502*

[5] *Department of Computer Science & Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India-570002*

[6] *School of Computer Science and Engineering, Soongsil University, Seoul, South Korea*

Abstract: Diabetes is a chronic ailment characterized by abnormal blood glucose levels. Diabetes is caused by insufficient insulin synthesis or by cells' insensitivity to insulin activity. Glucose is essential to health since it is the primary source of energy for the cells that make up a person's muscles and tissues. On the condition that if a person has diabetes, his or her body either does not create enough insulin or cannot utilize the insulin that is produced. When there isn't enough insulin or cells stop responding to insulin, many dextroses accumulate in the person's vascular framework. As time passes, this could lead to diseases such as kidney disease, vision loss, and coronary disease. Although there is no cure for diabetes, losing weight, eating nutritious foods, being active, and closely monitoring the diabetes level can all assist. In this research, we used Artificial Neural Network to create a Deep Learning (DL) model for predicting Diabetes. Then it was validated using an accuracy of 92%. In addition, with the help of the MIT website, a mobile application was constructed. This project will now assist in predicting the effects of diabetes and deliver personalized warnings. Early detection of pre-diabetes can be extremely beneficial to patients since studies have shown that symptoms of early diabetic difficulties frequently exist at the time of diagnosis.

Keywords: Accuracy, ANN Algorithm, Deep Learning, Diabetes, Portable Mobile Application.

[*] **Corresponding author Koteswara Rao Vaddempudi**: ECE Department, Prakasam Engineering College, Kandukur, Prakasam, Andhra Pradesh, India; E-mail: vaddempudi@yahoo.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Diabetes is a group of hormonal disorders characterized by persistent high blood sugar levels caused by an inadequacy in insulin release, insulin activity, or both. The importance of insulin as an anabolic molecule causes hormonal dysfunction in carbohydrates, lipids, and proteins (hormones). The severity of the presentation is determined by the length and type of diabetes [1]. DL is a mathematical progression built on a neural network with multiple layers. During the 1940s, McCulloch and Pitts proposed the concept of artificial brain organization. The core idea of neural organizing for data processing was influenced by biological neural frameworks [2]. In 2014, 8.5% of adults over the age of 18 had type 2 diabetes. Diabetes was the cause of 1.5 million deaths in 2019. Diabetes-related premature death increased by 5% between 2000 and 2016. Currently, key medical care administrations in numerous countries are unable to analyze and manage diabetes. Increasing access to essential medications is an essential aspect of preventing and managing diabetes and other noncommunicable diseases. DL can be used to forecast the status of diabetes as technology advances in the medical care field. DL's Artificial Neural Network technique is critical in constructing a precise forecast and providing the correct assessment [3].

Smartphone technology supports patients in the developed administration of several chronic infections, such as psychological wellness concerns, diabetes, obesity, cancer, and chronic obstructive pulmonary disease [4]. As a result of the results obtained from the MIT site, a mobile application has been created. The dataset comes from Kaggle and has a variety of attributes as its features. Initially, the dataset is pre-processed (that is, cleaned and prepared for the DL model to perceive). The ANN algorithm is then used to create a model utilizing this new information. The accuracy of this algorithm is determined and analyzed to obtain the best-prepared model for the forecast. Following a real assessment, an advanced mobile phone application has been developed with a pre-planned model for new clients to receive personalized warnings on self-evaluation of Diabetes and provides lifestyle modifications to eliminate Diabetes.

2. LITERATURE SURVEY

This section intends to survey the studies conducted on DL applications for IoT in the clinical sector. A study [5] investigated the use of medical images through image fusion technology. The researchers [6] present a rigorous outline of DL study to monitor the patient's well-being using gadgets. The problem with this review is that the size of the dataset limits the depth of the DL model. The primary goal of this paper is to evaluate and summarize the emerging DL research work [7] on patient well-being monitoring. This paper also looks at various recent

DL fads in patient monitoring. The study [8] looked at various DL processes in the portable and individual pursuit that are based on sensors and serviceable in a way that extricates the features and offers reliable data. Straightforwardly or by implication, the well-known models claim to address genuine issues by combining mind-boggling Internet of Things (IoT) factors. The primary goal of this review article is to quickly summarize the current state of the Internet of Things frameworks in many sectors. The study [9] focused on the hypothesis of the Internet of Medical Things (IoMT). In emergency clinics, exchanging items stimulates control of the patient's state of being by gathering and mixing information on all essential indications. IoMT is divided into four stages: collection, storing, processing, and presenting. The systematic review is used to evaluate DL for cloud applications in medical sector frameworks in this research. By surveying the relevant works, significant DL applications for the cloud in the medical sector and clinical care are introduced.

The article [10] discusses information combinations for IoT, focusing on computational and numerical procedures such as strategies in probability, and AI, and IoT complexions such as spread, irregularity, heterogeneity, and conditions where objects are traced. Sharing and cooperating on information and various assets would be critical to empowering practical universal conditions such as cities and societies. The journal [11] investigated several provisions of IoT-based improvements in the medical services sector and proposed multiple clinical organization structures and stages that make the IoT establishment accessible. This viewpoint paper aims to provide an overview of current IoT innovation in medical care, outline how IoT gadgets are further improving the well-being administration conveyance, and outline how IoT innovation will influence and disrupt global medical care in the coming decades. The journal article [12] offered a precise writing audit depicting comprehensive writing, including the supported living solutions. The research is divided into four major sections: self-checking, wearable framework, clinical administration framework, surrounding upheld daily bread in the elderly population, and profound learning-dependent framework to analyze heart infection. This precise writing study gives precise writing on surrounding assisted living arrangements and aids in understanding how encompassing assisted living aides propels patients with cardiovascular ailments to self-administration to decrease related grimness and mortalities.

Naive Bayesian and SVM classifier approaches were utilized for diabetic categorization [13]. The PIMA Diabetes dataset was used in this study. To improve accuracy, the researchers used a feature extraction-based technique as well as k-fold cross-validation. In the experiments, the SVM outperformed the naïve Bayes model. Unfortunately, along with achieved accuracy, a cutting-edge evaluation is missing. Conduct a comparison of diabetic classification strategies

CHAPTER 4

Innovative IoT-Based Wearable Sensors for the Prediction & Analysis of Diseases in the Healthcare Sector

Koteswara Rao Vaddempudi[1], Abdul Rahman H Ali[2], Abdullah Al-Shenqiti[3], Christopher Francis Britto[4], N. Krishnamoorthy[5] and **Aman Abidi[6,*]**

[1] *ECE Department, Prakasam Engineering College, Kandukur, Prakasam, Andhra Pradesh, India*

[2] *Mahatma Gandhi University/Taibah University, Meghalaya, India-793101*

[3] *College of Medical Rehabilitation Sciences, Taibah University, Madinah, Saudi Arabia-41411*

[4] *Mahatma Gandhi University, Meghalaya, India-793101*

[5] *School of Information Technology and Engineering, Department of Software Systems and Engineering, Vellore Institute of Technology, Vellore Campus, Thiruvalam Road, Vellore, Tamilnadu, India - 632014*

[6] *Swinburne University of Technology, Melbourne, Victoria, Australia*

Abstract: Health monitoring may be required regularly in everyday life, which might help predict the significant health consequences. Accurate surveillance is required for effective health parameters like temperature, stress, heart rate and blood pressure (BP) in the medical and healthcare domains. The Ideal health-related characteristics for efficient persistent health monitoring are established in this study. The primary goal of the device is to monitor the health parameters of a person in everyday life, facilitating psycho-physiological supervision to examine the relationship between underlying emotional states, including changing stress levels, and the progression and prognosis of cardiovascular disease. Non-invasive sensors are employed here to observe the mentioned health-related variables. The observed data will be stored in the cloud for further processing. IoT technology has been used to process and store the measured parameters in the cloud. At the same time, the device will give a notification in the form of an alarm to the concerned person. The data can be frequently monitored by the guardian and the concerned doctor. This may help to keep an eye on the people even if they are far away from the person and the stored data can be viewed at any time from anywhere. Thus, the wearable device will record the health parameters of a person, which may assist them to know their mental and physical health, as well as give

* **Corresponding author Aman Abidi:** Swinburne University of Technology, Melbourne, Victoria, Australia; E-mail: aabidi@swin.edu.au

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alerts in case of abnormalities. Implementation of this system will be helpful for the people to get an awareness about their health condition and also make them stay healthy.

Keywords: Blood Pressure, Cloud, Heart Rate, Display, Temperature.

1. INTRODUCTION

In today's world, an IoT of improvement in the research area of the healthcare domain, and the new products under development mainly focused on Wireless transmission for the reason of comfortability and accessibility. Even these days, people are at risk of dying because of not getting medical support on time, and sometimes patients are undergoing unexpectedly become victims of a specific cause of heart issues and attacks, which may be caused by a lack of required medical care provided to patients at the appropriate time. The proposed idea is for precisely monitoring and alerting physicians and family members of elderly people. This research aims to merge IoT technology with health surveillance to render the issue even more customized and responsive by permitting devices to communicate with each other. This study will look into a variety of wearable health monitoring devices that consumers may use to track their health parameters. The wireless sensor has been used to gather data to construct a health inspection system. To accomplish real-time monitoring, the data is combined with the IoT for processing, connecting, and computation. ThinkSpeak cloud has been used to store the data collected from the device. The intimation will be given to the user if there is any abnormality observed by the device.

The data is getting stockpiled in the cloud, which could be accessed by their doctor and the well-wisher of the user. Here, a wearable device is designed to provide efficient surveillance of the major healthcare variables such as temperature, BP, heart rate, and stress monitoring. In this pandemic situation, the temperature is an important parameter that needs to be monitored regularly; BP is a common health parameter that frequently varies according to the mental state of the person, heart rate is also an important health parameter that needs attention, and it plays a major role to monitor the stress level of a person. Nowadays, stress is a big problem in modern life. Everyone is focused on their job, and virtually everyone, including students and employees, is working frantically to achieve deadlines and objectives.

People are typically aware that they are under a lot of job pressure and mental stress, yet they ignore their health. They also fail to take their medicine at the appropriate times, which might result in catastrophic consequences and even death. If left unchecked, some sensor values, such as heart rate and BP, might be alarming. When the appropriate medication is prescribed at the right moment, this could hopefully avoid medical complications in the future and lower the risk of mortality. As a result, developing stress detection and health monitoring technologies that can assist individuals in understanding their mental and physical states is critical. The health parameters are monitored using sensors, and stores the collected information over the cloud using a WiFi-enabled controller; this wearable health monitoring system helps to monitor the person from anywhere by their guardians, and also patient health reports will be continuously shared with the doctor so they can easily identify if there is any abnormality. Implementation of this device will help people to lead a safe and healthy environment to live.

2. LITERATURE SURVEY

According to Tamilselvi *et al.* [1], an IoT-based health monitoring system can measure vital signals like heart rate, oxygen saturation, core temperature, and eye movement. The heartbeat, SpO2, temperature, and eye blink sensors were used to record the data, which was then processed by an Arduino-UNO. There are no patient-specific performance measurements for the proposed device, even though it was used. Acharya *et al.* [2] predicted a healthcare inspection kit based on the Internet of Things (IoT). Other useful healthcare factors were examined by the installed method, including heartbeat, ECG, respiratory rate, and body temperature. Here, a pulse sensor, a digital temperature sensor, a BP sensor, an electrocardiogram sensor, and a Raspberry Pi are the primary hardware components. IoT sensors' data will now be processed on a Raspberry Pi before being transmitted back to the cloud for storage. The device's fundamental flaw is that it does not allow for the development of interconnections between modeling methodologies. Trivedi *et al.* [3] proposed a mobile phone-based healthcare parameter inspection system that uses microcontrollers to monitor the health of patients. The ATMega 328p microprocessor received the data from the analog sensors and processed it. Analog values are converted into digital data using the built-in analog-to-digital converter (ADC). The built-in gadget received the physical characteristics *via* Bluetooth. The Bluetooth gadget relied on a single component that didn't cover a large area of the spectrum.

There is a new IoT safety monitoring device that can be moved around [4]. The platform's configuration is divided into three layers: control, device, and transport. Pulse oximeter and DS18B20 sensors were used to monitor the body's temperature and pulse rate, respectively. The Wi-Fi module of the transport layer was used to transfer data from the Arduino to the cloud. Finally, data were obtained from the server using the framework layer. However, several sensors

CHAPTER 5

Construction and Evaluation of Deep Neural Network-based Predictive Controller for Drug Preparation

K. Sheela Sobana Rani[1], **Dattathreya** [2], **Shubhi Jain**[3], **Nayani Sateesh**[4], **M. Lakshminarayana**[5] and **Dimitrios Alexios Karras**[6,*]

[1] *Department of Electrical and Electronics Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamil Nadu, India-641010*

[2] *Alva's Institute of Engineering and Technology, Mijar, Moodbidri, Karnataka, India-574225*

[3] *Swami Keshvanand Institute of Technology Management & Gramothan, Ramnagaria, Jagatpura, Jaipur, Rajasthan, India-302017*

[4] *Department of Information Technology, CVR College of Engineering, Vastunagar, Mangalpalli (V), Ibrahimpatnam (M), Rangareddy, Telangana, India-501510*

[5] *Department of Medical Electronics Engineering, M S Ramaiah Institute Of Technology, MSRIT Post, M S Ramaiah Nagar, MSR Nagar, Bengaluru, Karnataka, India - 560054*

[6] *National and Kapodistrian University of Athens (NKUA), Hellas, Greece*

Abstract: The evaporator used in the pharmaceutical industry is for drug preparation. The purpose of the evaporator in drug manufacturing is to extract the water content in the material through the heating process. In this research, the SISO evaporator is taken, which contains temperature as input and dry matter content as output. The mathematical modelling of the drug preparation evaporator is done with the help of the system identification method. Controlling and maintaining the temperature inside an evaporator is a tedious process. In this regard, the Neural Network predictive controller (NNPC) is designed and implemented for drug preparation. It helps to predict the future performance of the evaporator and tune the control signal based on that. The setpoint tracking challenge is given to the designed controller. For analysing the performance of the controller, the error metrics, such as integral square error (ISE), integral absolute error (IAE), integral time square error (ITSE), and integral time, absolute error (ITAE), are employed. The time-domain specification, such as rise time, settling time, and overshoot, is also used to better understand controller performance. From the above two analyses, the conclusion is made that the predictive controller is performing well in comparison with the conventional PID controller in the drug preparation pharmaceutical industry.

[*] **Corresponding author Dimitrios Alexios Karras:** National and Kapodistrian University of Athens (NKUA), Hellas, Greece; E-mail: dimitrios.karras@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

Keywords: Error Metrics, PID Controller, Predictive Controller, Time-domain Specifications.

1. INTRODUCTION

In this civilization, drugs and pharmaceutical engineering play a major role. In the initial twentieth century, the basics of contemporary Indian pharmaceuticals and pharmaceutical business were placed. India is now producing a bigger volume of diverse medicinal ingredients The pharmaceuticals and drugs manufacturing industry has emerged as one of the country's most important sectors. Approximately 82 percent of the majority of bulk pharmaceuticals are produced domestically, with the remainder imported [1, 2]. The collective process of distillation, evaporation, condenser, dryer crystallizer and other unit activities used in drug manufacture produces a large amount of effluent and causes environmental deterioration. Manufacturing is distinguished by a wide range of goods, developments, size of plants, and also the amount and value of wastewater produced. In truth, the pharmaceutical sector encompasses a wide variety of trades, each with its processes and procedures. As a result of this variability, describing a typical pharmaceutical effluent is nearly difficult. An evaporator is an element movement that separates the fluid from solids through heat interchange by earnings of evaporation or bubbling. The inspiration behind disappearing is to emphasize a response of a non-volatile solute (*i.e.,* solids) and a dissoluble (*i.e.,* fluid), which is commonly water. Evaporating a part of the dissoluble amasses the solute into a more adhesive fluid item. Evaporation is dependably operated in food preparation [3, 4], synthetic, and drug ventures. Concentrating aqueous solutions by evaporation is a common practice. It is necessary to bring the liquor to a boil in an evaporator and then remove the vapor. If the solution contains liquified components, the resulting strong liquor may become saturated, which will lead to the formation of rock crystals. The following are the numerous sorts of liquids that can be evaporated.

1. People who can resist high temperatures, such as those in the 330 K range, are free of decay.

2. Those that create solids once concentrated, where instance, crystal size and shape may be essential, and that do not.

3. These boil at about the same heat as waters at the given pressure, and those with a much more boiling point.

The flush is evaporated by raising the temperature of the mixture. The temperature is largely offered to provide the latent heat of vaporization, and it can accomplish significant efficiency in heat utilization by utilizing technologies for collecting heat from the vapor. While low-pressure drain steam from turbines is the most common heating medium, specific temperature transfer fluids are also utilized. The particle implementation of data on temperature transfer to boiling liquid, as well as a realization of what occurs to the fluid during concentration, are required for the construction of an evaporation unit. In addition to the three primary characteristics listed above, liquors with an inverse solubility curve and a high likelihood of depositing scale on the heating surface should be given different considerations.

The solvent is vaporized to produce a thick, strong liquor solution during evaporation. Evaporation varies from drying in that the deposit is a liquid—occasionally a very sticky one—relatively than a solid; it changes from purification in that the vapor is a mixture; it differs from crystallization in that the importance is on extracting a solution relatively than establishing and structuring the crystal. A slurry of crystals can form during the evaporation process in the saturated mother liquor. Vapor is condensed and discarded in evaporation, with the abundant liquor being the prized by-product. Mineral-bearing water, for example, is routinely evaporated to create a liquid that does not have solid particles for boiler feed, particular process needs, or humanoid feeding. Even though it is commonly referred to as liquid distillation, the actual procedure is called desertion. Fig. (**1**) depicts how large-scale evaporation technologies are being used to recover potable water from seawater. The desired product is condensed water in this example. Only a small percentage of the total water in the feed is collected, with the rest being discharged into the sea [5].

Evaporation contrasts with the Dryness of the product, and drying results in the vanishing of concentrated fluid non-strong. Dissipation may be utilized as an underlying advance in delivering a dehydrated item on the off chance that the fluid concentrate, goes through a drying interaction, for example, shower aeration. The mix of dissipation and shower drying is regularly used to do crushed items, like crushed milk. This mix of cycles is financially appealing because high-effectiveness dissipation is essentially less expensive than drying and different strategies for eliminating water [6]. The evaporators are contained in 2 areas: a warming segment and a smoke/watery divider segment. Those segments can be positioned inside a private vessel, or the heating area may be outside the container that families the smoke/watery division segment [7].

CHAPTER 6

Machine Learning based Predictive Analysis and Algorithm for Analysis Severity of Breast Cancer

B. Radha[1,*], Chandra Sekhar Kolli[2], K R Prasanna Kumar[3], Perumalraja Rengaraju[4], S. Kamalesh[4] and **Ahmed Mateen Buttar[5]**

[1] *ICT & Cognitive Systems, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India-641008*

[2] *Aditya College of Engineering and Technology, Surampalem, Andhra Pradesh, India-533291*

[3] *Department of Computer Science & Engineering, Siddaganga Institute of Technology, Tumkur, Karnataka, India-572103*

[4] *Department of Information Technology, Velammal College of Engineering and Technology, Madurai, Tamil Nādu, India-625009*

[5] *Department of Computer Science, University of Agriculture Faisalabad, Faisalabad, Punjab, Pakistan-38000*

Abstract: Breast cancer is the 2nd frequent occurrence of cancer among women, after skin cancer, according to the American Cancer Society. By using mammography, it is possible to detect breast cancer before it has spread to other parts of the body. It primarily affects females, though males can be affected as well. Early identification of breast cancer improves survival chances significantly, however, the detection procedure remains difficult in clinical studies. To solve this problem, a Machine Learning (ML) algorithm is used to detect breast cancer in mammogram images. In this study, 100 images from the mini-MIAS mammogram database were used, 50 of which were malignant and 50 of which were benign breast cancer mammograms. Before training the model, the sample image datasets are pre-processed using numerous techniques. The required features are then extracted from the sample images using Feature Extraction (FE) techniques, such as Daubechies (DB4) and HAAR. Finally, the extracted features are fed into ML classifiers such as Linear Discriminant Analysis (LDA), Support Vector Machine (SVM), and Random Forest (RF) to create a model. Several performance metrics are used to evaluate FE and classification. According to the results of the analysis, the HAAR FE with the RF model is the ideal combination, with an accuracy level of 91%.

Keywords: Accuracy, Breast Cancer, Confusion Matrix, Diagnosis, Feature, Metrics.

* **Corresponding author B. Radha:** ICT & Cognitive Systems, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India-641008; E-mail: radhakbr10@gmail.com

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1. INTRODUCTION

Breast cancer is one of the three most frequent types of cancer in the world, and it affects women of all ages. Breast cancer is thought to be curable if detected early [1]. Breast cancer exhibits a broad spectrum of clinical characteristics, with certain tumors steadily growing and having a better prognosis, while some are combative. It is usually characterized by abnormal growth in the breast, which then aggregates and forms lumps or masses. These cells can spread from the breast to the lymphatic system or even other parts of the body. According to scientists, 5-10 percent of the total cases of breast cancer are prompted by a mutated gene or by family heredity [2]. The impacts of global invasive breast cancer are projected to reach an estimation of 3 million cases per year by 2050. These statistics emphasize the shocking pervasiveness of breast cancer and the critical need for treatment and prevention measures.

Breast carcinoma is currently classified based on morphological characteristics, with cancerous cells classified into types such as infiltrating ductal carcinoma and a large number of distinct types such as mucinous, tubular, medullary, adenoid cystic carcinoma, and infiltrating lobular carcinoma, among others [3]. According to epidemiological studies, addressing socioeconomic factors is critical in ensuring that almost all females have sufficient access to primary treatment, from monitoring to an effective remedy, and only drastic execution can reduce the global risk of developing breast carcinoma. A computer-assisted diagnostic approach is in greater demand as a result of this pressing issue.

The accuracy of an optimized SVM classifier utilized by Ilias Maglogiannis *et al*. for automated detection of the Wisconsin Diagnostic Breast Cancer datasets is around 97% [4]. Hussain *et al*. published the findings of a comparison analysis on SVM with various kernels for breast carcinoma detection, concluding that with all features included, the accuracy is 94.6% [5]. Sri Hari Nallamala *et al*. proposed the detection of breast cancer using three different classification methods such as SVM, Logistic Regression Algorithm, and K-Nearest Neighbor (KNN) Algorithm and concluded with a precision of 98.50% [6]. Furthermore, M. Muthu Rama Krishnan *et al*. claim that by combining the kernel function with the training-test partition, an SVM-based classifier may achieve an accuracy of 99.385%and 93.726% for two separate datasets [7]. Lal Hussain *et al*. used different resilient classifiers, like Bayesian strategy, Decision Tree, and SVM kernels, to identify carcinoma mammograms from the subjects [8]. Furthermore, Chelvian Aroef *et al*. conducted a comparison study for classifying breast cancer using ML models like RF and SVM. According to the experimental result, RF obtained the best accuracy of 90.90% using 80% training data, while SVM obtained 95.45% using 80% [9].

Saima Rathore *et al*. proposed a combination feature set comprising conventional statistical features that relied on characteristics and variants of statistical moments and Haralick feature and used an SVM classifier to classify the biopsy images, which resulted in an accuracy of 98.85% [10]. According to Bazazeh *et al*. analysis, SVMs perform best in terms of accuracy, specificity, and precision, but RF offers the best chance of properly diagnosing cancers [11]. Further Ricvan Dana Nindrea *et al*. used four main ML algorithms for their study and concluded by saying that the SVM has a good accuracy of 97.13% with high precision and low error when compared to other ML algorithms [12]. Khourdifi *et al*. did a study on breast cancer detection using 5 different ML algorithms and compared the result and concluded that SVM had proven to give the best performance at several levels compared to other ML algorithms [13].

The journal is systemized as follows: Section 2 discusses the materials used and the procedure used to detect Breast cancer. DB4 and HAAR FE techniques are covered in section 3. SVM, RF, and LDA are among the classification algorithms covered in section 4. Section 5 examines the performance of several FE and classification algorithms in combination. Finally, Section 6 suggests that for Breast cancer diagnosis, it is best to aggregate FE with different classifier methods.

2. MATERIALS AND METHODS

The breast mammograms for this study were taken from the mini-MIAS mammography database, which has a total of 100 mammogram images. 50 of the 100 photos are malignant, while the other 50 are benign. ML Algorithms are employed to train and test these mammography images; an 8:2 split is used for the image data, where 80% of it goes to training, and the remaining 20% goes to testing. For training and testing processes, the complete image collection is divided into 8:2 ratios (*i.e.,* 80:20 in this case). The images collected initially are raw RGB images. To analyze and enhance these images further, some preprocessing methods to increase the pixel brightness, filtering, segmenting, re-saturation methods, *etc*., are used. Fig. (**1**) below illustrates the wavelet-based FE and classification of breast mammography image data for breast cancer in a flow chart.

CHAPTER 7

Glaucoma Detection Using Retinal Fundus Image by Employing Deep Learning Algorithm

K.T. Ilayarajaa[1], **M. Sugadev**[1], **Shantala Devi Patil**[1], **V. Vani**[2], **H. Roopa**[2] and **Sachin Kumar**[2,*]

[1] *Department of Electronics and Communication Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India-600119*

[2] *Information Science and Engineering, Bangalore Institute of Technology, Bangalore, Karnataka, India-560079*

Abstract: Glaucoma is an eye disease that can result in permanent blindness if not detected and treated in the early stages of the disease. The worst part of Glaucoma is that it does not come up with a lot of visible symptoms, instead, it can go from the preliminary stage to a serious issue quickly. A Deep Learning (DL) model is capable of detecting the presence of Glaucoma by analyzing the image of the retina which is uploaded by the user. In this research, two DL algorithms were used to detect the presence of Glaucoma in the uploaded image. The DL algorithms include the convolutional neural network or the CNN and the transfer learning algorithm. The transfer learning algorithm is implemented by the VGG-19 model. Once two DL models were developed using the above-mentioned algorithms, the models were trained and tested using the images of the retina. The trained models are tested to find the better model. The efficiency of the model is measured based on some metrics. These metrics include the True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN). Using these metrics, the true positive rate, the true negative rate, the false-positive rate, and the false-negative rate are calculated. From the above values, the DL algorithm, which is more efficient than the other one in identifying Glaucoma, can be found.

Keywords: CNN, DL Algorithm, Glaucoma, Performance Metrics, VGG-19.

1. INTRODUCTION

Glaucoma is an eye condition that is caused due damage to the optic nerve in the eye. This results in the development of a blind spot due to the elevated blood pressure in the eyes and even results in permanent blindness. There are different

* **Corresponding author Sachin Kumar:** Information Science and Engineering, Bangalore Institute of Technology, Bangalore, Karnataka, India-560079; E-mail: sachinkumar@knu.acs.kr

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

types of glaucoma, such as open-angle glaucoma, angle-closure glaucoma, normal-tension glaucoma, pigmentary glaucoma, *etc*. There are not a lot of preventive measures present for glaucoma as it can be considered a hereditary disease. In India, about 12 million people whose age is above 40 were diagnosed to be affected by glaucoma [1].

Sometimes it becomes tougher for glaucoma-affected people to live a normal life like others. One of the most important and dreadful facts about glaucoma is that it cannot be diagnosed in its initial stages due to the lack of any visible symptoms [2]. Hence, it becomes necessary for people who are born in a family with the traits of glaucoma to undergo some simple processes for the detection of the presence of glaucoma to prevent themselves from being affected by glaucoma in the premature stage itself.

This research works in the development of two DL methods using two algorithms named the transfer learning algorithm and the CNN algorithm [3]. Both the models are then trained and validated to achieve higher accuracy and lower loss level. Once the models are trained, they are tested to find the most effective algorithm that can be used for glaucoma detection. By evaluating the test results, the best DL algorithm for the detection of glaucoma can be determined.

2. LITERATURE SURVEY

Glaucoma is one of the most threatening eye diseases in the world; many researchers have used various techniques to reduce the worst consequences caused by glaucoma. These techniques include both earlier detection and advanced treatment methods. The researchers of the Federal University of Brazil researched glaucoma detection using machine learning algorithms. The call detail record metric is the most significant information in the detection of glaucoma, according to the methodologies they utilized, which included certain machine learning approaches. Furthermore, all of the studies found that adopting an automated system for ocular structural evaluations has the benefit of reducing variance in medical competence assessments. They concluded that DL is one of the most efficient algorithms in terms of computer vision and processing of retinal fundus images. They also said that one downside of DL is that it requires an adequate outcome to create a large database and fast response time [4]. Tomaz Ribeiro Viana Bisneto *et al*. of Brazil discovered the usage of a Generative adversarial network in the detection of glaucoma. The findings they obtained indicated the promise of texture extraction approaches since the suggested taxonomic diversity indices proved to be effective in OD region characterization. They got positive findings, with substantial values in all outcome indicators and a 100% success rate using several classifiers. Their discovery might help professionals with auxiliary analyses during glaucoma identification, ensuring a better quality of life for patients and a better prognosis for glaucoma therapy [5]. Soheila Gheisari *et al*. from the University of Technology, Australia, came up with the idea of combining the CNN algorithm and the RCNN in the detection of glaucoma with higher efficiency. They claimed that by using a retinal picture sequence to train and validate a combined CNN and RNN, they were able to extract both spatial and temporal data, resulting in a much better glaucoma diagnosis. In differentiating glaucoma from healthy eyes, the VGG19 + LSTM combination outperformed all other networks, with all the parameters like sensitivity, specificity, and F-measure above ninety-five percent. In the end, they found that Deep CNNs were an effective AI-based technique for finding clinically relevant characteristics in retinal fundus pictures [6]. CNN is not a new technology that is used for object detection. Yanan Sun *et al*. of the Sichuan University, China designed an automatic CNN model which can be used for image classification. An new encoding strategy was developed by them to encode the in-depth layers of the CNNing algorithms, incorporating skip connections to encourage deeper CNN algorithms to be produced during evolution, and the construction of the new encoding technique of CNN algorithms, all while working with limited computational resources. On two difficult benchmark datasets, the suggested approach was compared against numerous current CNN models, including 8 manually produced CNNs, 6 mechanized + manually adjusted CNN algorithms, and four mechanical algorithms that found CNN structures [7]. Like the CNN algorithm, the transfer learning algorithm can also be used for object detection. Taranjit Kaur *et al*. from the Indian Institute of Technology, India, used CNN in the classification of the images of the brain. They evaluated a lot of models to find the one with the results. They concluded that among all the models they tested, the Alexnet model performed the best, with classification results of 100 percent, 94 percent, and 95.92 percent for all three different datasets. The results they achieved are relatively higher than that of the many existing image classification algorithms. They also stated that in the current DL-based studies, the transferred Alexnet model achieves greater performance metrics [8].

3. MATERIALS AND METHODS

A dataset consisting of 705 retinal fundus images is collected from the ACRIMA database. Out of the 705 images, 396 images contain a retina with glaucoma infection and 309 normal images of the retina. The images are then divided into three parts for three different purposes. 493 images from the total dataset are used to train both DL models. Another 141 samples of the retina are used to validate the models. The final 71 models are used to test the efficiency of the models. Two DL models were developed using transfer learning and the CNN algorithm. The transfer learning algorithm is implemented using the VGG-19 architecture. Once

CHAPTER 8

Texture Analysis-based Features Extraction & Classification of Lung Cancer Using Machine Learning

Korla Swaroopa[1,*], N. Chaitanya Kumar[2], Christopher Francis Britto[3], M. Malathi[4], Karthika Ganesan[5] and **Sachin Kumar[6]**

[1] *Department of CSE, Aditya Engineering College, Surampalem- East Godavari, Andhra Pradesh, India-533437*

[2] *Department of CSE, Sri Venkateswara Engineering College, Karakambadi Road, Tirupati, Andhra Pradesh, India*

[3] *Information Technology & Computer Services, Mahatma Gandhi University, Meghalaya, 793101, India*

[4] *Department of ECE, Vivekananda College of Engineering for Women (Autonomous), Elayampalayam, Namakkal, Tamilnadu, India-637205*

[5] *Sri Vidya College of Engineering and Technology, Sivakasi Main Road, Virudhunagar, Tamilnadu, India-626005*

[6] *College of IT Engineering, Kyungpook National University, Daegu, South Korea*

Abstract: Lung cancer is a form of carcinoma that develops as a result of aberrant cell growth or mutation in the lungs. Most of the time, this occurs due to daily exposure to hazardous chemicals. However, this is not the only cause of lung cancer; additional factors include smoking, indirect smoke exposure, family medical history, and so on. Cancer cells, unlike normal cells, proliferate inexorably and cluster together to create masses or tumors. The symptoms of this disease do not appear until cancer cells have moved to other parts of the body and are interfering with the healthy functioning of other organs. As a solution to this problem, Machine Learning (ML) algorithms are used to diagnose lung cancer. The image datasets for this study were obtained from Kaggle. The images are preprocessed using various approaches before being used to train the image model. Texture-based Feature Extraction (FE) algorithms such as Generalized Low-Rank Models (GLRM) and Gray-level co-occurrence matrix (GLCM) are then used to extract the essential characteristics from the image dataset. To develop a model, the collected features are given into ML classifiers like the Support Vector Machine (SVM) and the k-nearest neighbor's algorithm (k-NN).

[*] **Corresponding author Korla Swaroopa:** Department of CSE, Aditya Engineering College, Surampalem- East Godavari, Andhra Pradesh, India-533437; E-mail: swaru2004@gmail.com

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To evaluate FE and classification, several performance metrics are used, such as accuracy, error rate, sensitivity specificity, and so on.

Keywords: Classification, CT scan, Lung Adenocarcinoma, Performance Metrics, Texture.

1. INTRODUCTION

The primary cause of all forms of cancer in humans is a bodily mutation in cellular DNA. Adenocarcinoma is cancer that develops in the glandular tissues surrounding the organs and produces biological fluids like phlegm, digestive fluids, *etc.* It can be found in many different organs, including the colon, breasts, lungs, prostate, and esophagus. Adenocarcinoma of the lung is one of the most prevalent kinds of lung cancer when compared to squamous and small carcinoma. It is responsible for about 40% of all non-small carcinoma cases and 30% of all cancer cases overall. This form of carcinoma is located in the peripheral region of the lung and, in certain cases, in the areas of inflammation or scars. It is one of the most prevalent cancers detected in people who have never smoked [1]. Smoking nicotine is by far the most serious reason for lung cancer in individuals, but other factors such as family genetic heritage and environmental exposures to smoke and other carcinogenic substances also play a role. The most prevalent cause of lung tumor formation is a genetic abnormality in the p53 gene, which functions as a tumor suppressor and is accountable for cell division and cell death in roughly 52% of people [2]. Lung cancer is a kind of carcinoma that affects a vast number of people around the world, with a 5-year survival chance of less than 12% to 15%. A low-dose CT scan is often advised for high-risk patients, such as former and present heavy smokers. If the CT scan reveals mediastinal nodes, the patient will be advised to undergo various tests to stage cancer, and treatment options will be discussed based on the stage of the malignancy. This shows that in recent years, a computer-aided diagnostic tool for screening lung cancer at a preliminary phase with great precision has become quite desirable.

Though early detection of lung cancer is critical, some studies have used ML algorithms to analyze data and diagnose lung cancer. Singh, G.A.P., *et al*. in their study of the direction and classification of lung cancer using various ML techniques, propose the seven classifiers trained using the GLCM FE method that contains all 14 features and conclude that MLP neural network has the maximum classification accuracy [3]. Bayanati *et al*. created a methodology for separating cancer from benign mediastinal lymph. Their research combined texture-based FE methods (GLCM and GLRL) and structure attributes with regression models and SVM Classifiers [4]. Alves, A.F.F., *et al*. developed an approach that included 15 characteristics with three ML techniques and five distinct operators, yielding an accuracy of less than 5% [5]. Makaju *et al*. proposed an approach where they employed a watershed segmentation technique for identification and a classical SVM classifier to classify the carcinoma in a Lung cancer CT scan image. The proposed approach gave an accuracy of 92%.[6]. Tyagi and colleagues advocated for a complete examination of a wide range of image segmentation approaches to detect and diagnose lung cancer. These methodologies make use of edge detection, thresholding methods, and PDE-dependent algorithms, among other techniques. One of these methods is Marker Controlled Watershed Segmentation. Various classification methodologies for the detection of lung carcinoma lesions using image classification can be combined with numerous segmentation techniques [7].

Faisal *et al*. attempted to determine the excluding value of several classifiers to enhance the accuracy of lung cancer prediction. To achieve maximum accuracy, they used Multi-Layer Perceptron, SVM, Nave Bayes, and other classifiers to analyze the datasets retrieved from the UCI repository [8]. Nasser and Abu-Naser (2019) used ANN to improve a lung cancer diagnosis computer-aided model. Anxiety, yellow fingers, and other symptoms are used to identify lung cancer. It is proposed that an ANN model be developed, trained, and evaluated utilizing data from a "survey lung cancer" dataset, as well as additional patient-specific information [9].

The following is how the article is built: Section 2 discusses the materials and processes for detecting lung cancer. Section 3 discusses the texture-based FE approaches employed in this work, such as GLCM and GLRM. SVM and k-NN are two of the classification algorithms discussed in Section 4. In Section 5, the performance of a variety of FE and classification approaches is compared. Finally, for lung cancer detection, Section 6 suggests integrating FE with several classifier methods.

2. METHODOLOGY

This study makes use of a Lung CT image dataset from the Kaggle database, which totals 430 images. To improve the image quality, the raw photos are normalized utilizing a multitude of preprocessing procedures. The FE process follows, with the texture-based FE method being used in this research. Finally, to get the best level of accuracy, the images are classified using ideal classifiers. The complete images are divided into two parts in this work, and the above-mentioned ML techniques are used to train and test these CT images. In this study, 80% of the images (*i.e.,* 344 images) are utilized as training sets, whereas 20% of the images (*i.e.,* 86 images) are used as testing sets. Figs. (**1** and **2**) show sample lung

CHAPTER 9

Implementation of the Deep Learning-based Website For Pneumonia Detection & Classification

V. Vedanarayanan[1], **Nagaraj G. Cholli**[2], **Merin Meleet**[2], **Bharat Maurya**[3], **G. Appasami**[4] and **Madhu Khurana**[5,*]

[1] *Electronics and Communication Engineering (ECE), Sathyabama Institute of Science and Technology (Deemed to be University), Chennai, Tamil Nadu, India-604119*

[2] *Department of Information Science and Engineering, RV College of Engineering, Bengaluru, Karnataka, India-560059*

[3] *Department of Political Science, Chaudhary Bansi Lal University, Bhiwani Haryana, India, 127021*

[4] *Department of Computer Science, Central University of Tamil Nādu, Tiruvarur, Tamil Nādu, India-610005*

[5] *University of Gloucestershire, UK*

Abstract: It is often difficult to diagnose several lung illnesses, such as atelectasis and cardiomegaly, as well as Pneumonia, in hospitals due to a scarcity of radiologists who are educated in diagnostic imaging. If pneumonia is diagnosed early enough, the survival rate of pulmonary patients suffering from the disease can be improved. Most of the time, chest X-ray (CXR) pictures are used to detect and diagnose pneumonia. When it comes to detecting pneumonia on CXR images, even an experienced radiologist may have difficulty. It is vital to have an automated diagnostic system to improve the accuracy of diagnostic results. It is estimated that automated pneumonia detection in energy-efficient medical systems has a substantial impact on the quality and cost of healthcare, as well as on response time. To detect pneumonia, we employed deep transfer learning techniques such as ResNet-18 and VGG-16. Each of the model's four standard metrics, namely accuracy, precision, recall, and f1-score, are used to evaluate. The best model is established by the use of metrics. To make pneumonia detection simple, the website is designed by employing the best model.

Keywords: Deep Learning, Performance Metrics, Pneumonia, ResNet-18, *Streptococcus Pneumoniae*.

[*] **Corresponding author Madhu Khurana:** University of Gloucestershire, UK; E-mail: mkhurana1@glos.ac.uk

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Pneumonia is a prevalent lung disease that is the main cause of death in children and the elderly. Though various factors such as age, underlying illness, and environment have a role in the development of pneumonia in babies and small children, *Streptococcus pneumoniae* is the most prevalent bacterial cause of pneumonia. Pneumonia affects children of all ages, however, it is more common in children under the age of 5 and adults above the age of 75. *Chlamydia pneumoniae* and *Mycoplasma pneumoniae* have recently been identified as the microorganisms that cause pneumonia in children over the age of five [1]. According to WHO estimates, 450 million cases of pneumonia are registered each year, resulting in roughly 4 million fatalities, accounting for 7 percent of the global mortality rate of 57 million people [2]. Cough, respiratory pain, fever, and abnormalities in X-rays are considered as the analysis of Pneumonia. However, no clinical approach can properly define the pathogenesis of pneumonia. Doctors can identify pneumonia in hospitalized patients using a medical examination, medical records, diagnostic tests such as phlegm or blood work, pulmonary X-rays, and other imaging techniques. The most frequent tool for detecting lung infections such as pneumonia is chest X-rays, which are getting less expensive because of technological developments in biomedical instruments [3]. The competence to distinguish between bacterial and viral pneumonia might have significant consequences for treatment. Despite progress, diagnostic testing in many afflicted patients still fails to identify the underlying pathogens. Computer-assisted diagnostics can overcome the problem of professional availability. Artificial intelligence research is progressing at a rapid pace, which can be extremely beneficial.

Stephen *et al*. [4] proposed using a Deep Learning (DL) model to diagnose pneumonia. They created a DL model from scratch using a set of chest X-ray scans. Meanwhile, researchers were interested in such pre-trained systems' ability to execute X-ray image processing tasks, and they sought to grasp more about the potential of various DL models. For example, Loey *et al*. [5] employed AlexNet, GoogleNet, and ResNet-18 to describe and categorize X-ray images for corona diagnosis *via* a transferable learning technique. Rajpurkar *et al*. [6] constructed a DL model for diagnosing pneumonia in chest x-ray images using the dataset ChestX-ray14. Using CheXNet, a hundred-twenty-one layer CNN, they categorized chest X-rays with a good rate that exceeded expert clinicians. Their system also discovered 14 more ailments in addition to pneumonia. Szegedy *et al*. [7] built 3 new unique deep CNN models that are combinations of Inception and ResNet systems. Their technique generated good outcomes. On the ImageNet classification challenge testing dataset, they had a top 5 error rate of 3.08 percent.

The structure of the article is as follows: The materials and techniques for detecting Pneumonia are discussed in Section 2. The preprocessing techniques used in this study, such as image scaling and image augmentation, are discussed in Section 3. Two of the DL algorithms covered in Section 4 are VGG-16 and ResNet-50. Web development is described in Section 5. Finally, in Section 6, the results are examined, and in Section 7, the general conclusion of the study is presented.

2. MATERIALS AND METHODS

With the use of an image dataset taken from the Kaggle website, this study has been able to create and assess an image-based DL model capable of accurately diagnosing patients with Pneumonia through the use of a user-friendly human-interfaced website. The process of using DL models to diagnose pneumonia is shown schematically in Fig. (**1**).

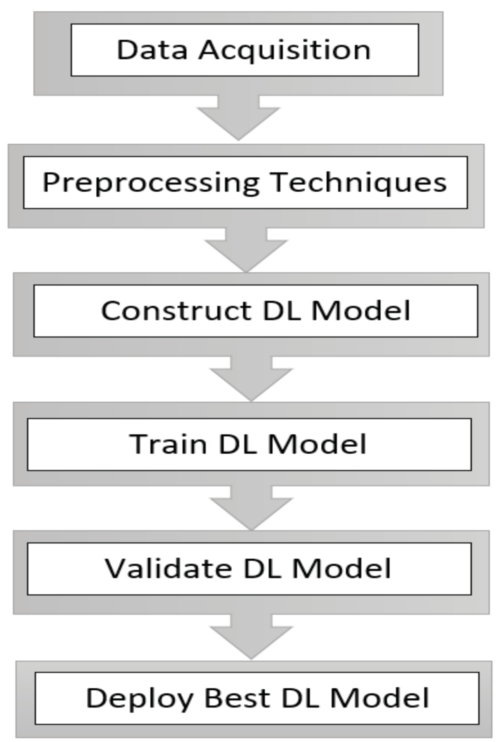

Fig. (1). Block diagram of Pneumonia detection model using DL Algorithms.

CHAPTER 10

Design and Development of Deep Learning Model For Predicting Skin Cancer and Deployed Using a Mobile App

Shweta M Madiwal[1,*], M. Sudhakar[2], Muthukumar Subramanian[3], B. Venkata Srinivasulu[4], S. Nagaprasad[5] and **Madhu Khurana[6]**

[1] *Department of CSE, Faculty of Engineering and Technology (Exclusively for Women's) Sharnbasva University, Kalaburagi. Karnataka, India-585101*

[2] *Department of Mechanical Engineering, Sri Sairam Engineering College, Chennai, Tamil Nadu, India-600044*

[3] *SRM Institute of Science & Technology, Tiruchirappalli Campus, (Deemed to be University), Trichy, Tamilnadu, India - 621105*

[4] *Department of CSE, JJTU, Rajasthan, India-333010*

[5] *Department of Computer Science, Tara Government College (A), Sangareddy, Telangana, India-500021*

[6] *University of Gloucestershire, UK*

Abstract: Melanoma, the deadliest form of skin cancer, is becoming more common every year, according to the American Cancer Society. As a result of the artifacts, low contrast, and similarity to other lesions, such as moles and scars on the skin, diagnosing skin cancer from the lesions might be difficult. Skin cancer can be diagnosed using a variety of techniques, including dermatology, dermoscopic examination, biopsy and histological testing. Even though the vast majority of skin cancers are non-cancerous and do not constitute a threat to survival, certain more malignant tumors can be fatal if not detected and treated on time. In reality, it is not feasible for every patient to have a dermatologist do a complete examination of his or her skin at every visit to the doctor's office or clinic. To solve this challenge, numerous investigations are being conducted to provide computer-aided diagnoses. In this work, skin cancer can be predicted from an image of the skin using deep learning techniques such as convolutional neural networks. The accuracy and loss functions of the model are used to evaluate its overall performance. The mobile app is created to detect skin cancer using the developed model. As soon as the images have been submitted, the app can communicate with the user about their progress.

[*] **Corresponding author Shweta M Madiwal:** Department of CSE, Faculty of Engineering and Technology (Exclusively for Women's) Sharnbasva University, Kalaburagi. Karnataka, India-585101;
E-mail: shwetamadiwal3@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

Keywords: Convolutional Neural Network, Deep Learning Algorithm, Melanoma, Web Development.

1. INTRODUCTION

Melanoma is a kind of cancer growing increasingly widespread worldwide, particularly in Western countries. Melanoma is still thought to be mostly influenced by sunlight exposure. Other factors, such as certain genetic changes, have a role in melanoma development in addition to UV exposure. Melanoma is considered one of the deadliest and most aggressive forms of skin cancer, especially cutaneous malignant melanoma. Surgical removal, radiotherapy, photodynamic therapy, immunotherapy, chemotherapy and laser surgery are some of the modern treatment options. Based on the patient's condition, tumor stage, and locale, the treatment approach may comprise standalone drugs or combination therapy [1]. Melanoma of the skin kills 55’500 people a year. The disease's incidence and fatality rates vary greatly over the world, based on the availability of rapid diagnosis and basic healthcare. Melanoma research has progressed significantly during the last ten years. Immunotherapy with anti-CTLA4 monoclonal antibodies and targeted treatment with BRAF inhibitors have emerged as two independent ways to try and extend life in patients with advanced melanoma cancer. However, due to pre-existing or developed tolerance, virtually all of them relapse. As a result, malignant melanoma has a dismal long-term prognosis [2].

Despite improvements, many affected patients' screening test still misses pinpointing the underlying disorders. Professional dependability can be addressed using computer-assisted diagnosis. Artificial intelligence technology is moving at an incredible speed, which has the potential to be tremendously useful.

The problem of melanoma detection through dermoscopy images has been studied for decades. Reviews have been published that analyze a selection of papers published in the last decade [3]. Deep learning techniques for melanoma identification have been used in several studies recently. To identify a melanoma, Codella *et al*. presented an integrated technique that used convolutional neural networks (CNNs), sparse coding, and SVM [4]. To collect multi-scale characteristics for melanoma identification, Kawahara *et al*. used a deep convolutional network [5]. Ayan (2018) investigated the efficiency of a CNN model for the detection of skin problems by comparing it to a dataset that had not been upgraded and a dataset that had been improved. According to the authors of this work, preprocessing approaches may be effective in building powerful classifiers when there is insufficient data. Performance between networks that used updated datasets compared to networks that used unenhanced datasets was significantly different [6]. Esteva *et al*. reported the outcomes of using Convolutional neural networks, training a large sample size (129450 clinical images) from 18 distinct healthcare professionals, open-access internet archives (including ISIC) and Stanford Medical Center. The testing findings for three class recognition problems showed average reliability of 72.1 percent, which was superior to 21 board-certified dermatologists' findings [7]. Many computer-aided diagnostic applications, such as classification [8], detection [9], and segmentation, have recently seen successes through convolutional neural networks (CNNs) with high-level feature learning capability.

The raw picture is fed into the deep neural networks, eliminating the time-consuming pre-processing, categorization, and development of customized features. Convolutional Neural Networks (CNN) have been acknowledged in the scientific area for a few years now, but the ImageNet classification challenge brought them to the spotlight.

The following is the article's structure: Section 2 discusses the materials and techniques for diagnosing Melanoma. Section 3 discusses the preprocessing steps employed in this work, such as image scaling and image augmentation. An algorithm for deep learning in Section 4, for example, CNN, is discussed. Section 5 discusses web development. Finally, in Part 6, the results are discussed, and in Section 7, the study's overall conclusion is stated.

2. METHODOLOGY

The study makes use of image data from the Kaggle mobile app. Initially, 2900 sample images are gathered to train and test the image using deep learning methods to create a user-friendly human-interfaced mobile app that accurately detects Melanoma in individuals. Fig. (**1a** and **1b**) depict benign and melanoma skin images. The obtained skin image data set is separated into three groups with a 7:2:1 ratio: training, testing and validation (*i.e.,* 70%, 20%, and 10% of the total data set). It is estimated that the training dataset contains 2030 images, the validation dataset has 580 images, and the testing dataset contains 290 images. To assure the image dataset's quality, pre-processing methods such as image scaling and image augmentation are used to examine the images for quality assurance. After the images have been preprocessed, deep learning models are used to determine if the image is melanoma-affected or not. Fig. (**2**) depicts a block diagram of the phases involved in using deep learning to diagnose melanoma.

CHAPTER 11

Feature Extraction and Diagnosis of Dementia using Magnetic Resonance Imaging

Praveen Gupta[1,*], Nagendra Kumar[2], Ajad[2], N. Arulkumar[3] and **Muthukumar Subramanian[4]**

[1] *Department of Computer Science and Engineering, GITAM School of Technology, GITAM (Deemed to be University), Visakhapatnam (Andhra Pradesh)- India-530045*

[2] *Department of Electronics and Communication Engineering, S J C Institute of Technology, Chickballapur, Karnataka-562101, India*

[3] *Department of Statistics and Data Science, CHRIST (Deemed to be University) Bangalore, Karnataka, India - 560029*

[4] *SRM Institute of Science & Technology, Tiruchirappalli Campus, (Deemed to be University), Trichy, Tamilnadu, India - 621105*

Abstract: Dementia is a state of mind in which the sufferer tends to forget important data like memories, language, *etc.*. This is caused due to the brain cells that are damaged. The damaged brain cells and the intensity of the damage can be detected by using Magnetic Resonance Imaging. In this process, two extraction techniques, Gray Level Co-Occurrence Matrix (GLCM) and the Gray Level Run-Length matrix (GLRM), are used for the clear extraction of data from the image of the brain. Then the data obtained from the extraction techniques are further analyzed using four machine learning classifiers named Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Random Forest (RF), and the combination of two classifiers (SVM+KNN). The results are further analyzed using a confusion matrix to find accuracy, precision, TPR/FPR – True and False Positive Rate, and TNR/FNR – True and False Negative Rate. The maximum accuracy of 93.53% is obtained using the GLRM Feature Extraction (FE) technique with the combination of the SVM and KNN algorithm.

Keywords: Confusion Matrix, Dementia, Extraction Techniques, Magnetic Resonance Imaging.

* **Corresponding author Praveen Gupta:** Department of Computer Science and Engineering, GITAM School of Technology, GITAM (Deemed to be University), Visakhapatnam (Andhra Pradesh)- India-530045;
E-mail: praveen2gupta@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Dementia is a brain disorder that is caused due damage to brain cells. When the brain cells are damaged, it becomes uneasy for them to communicate with each other, resulting in mental disorders such as memory loss and forgetting the way to communicate with other people. Sometimes, it also leads to a lack of problem-solving and quick-thinking abilities. In India, almost 5% of people above the age of 60 suffer from dementia or even the severe stage of dementia, *i.e.,* Alzheimer's [1]. Dementia is a chronic disorder that can only be treated, and there is no cure. It also may last for a lifetime, even if it is treated properly. Studies state that there are chances for the risk of dementia to double in the upcoming twenty years. By 2040, about 80 million people will be affected by dementia. Especially in western countries, dementia is the worst-case, *i.e.,* Alzheimer's disease will be one of the most common diseases, with about 60% of the cases [2]. The main cause of dementia is damage to the brain cells. The brain cells are damaged due to the lack of supply of oxygen for a long period. Though people don't realize the impact of this brain cell damage, when this condition is prolonged for a long time, it leads to dementia and Alzheimer's. The initial stages of dementia include a lack of interest in performing everyday tasks, frequent memory issues, confused behavior, *etc.*. Normally, dementia is not a hereditary disease as it does not affect the genetic parts of the human brain. But some rare mutations of dementia can be inherited by the offspring of the patient. Even in that case, dementia will not be as worse as it was with the successor. Dementia is a disorder that often affects people aged more than 65. Due to the increase in population in the past few decades, scientists have already predicted that the population will rapidly increase in the next few decades. The increase in population also leads to an increase in people whose age is above 65. By the end of 1950, 8% of the whole population of the United States consisted of people aged above 65; by 1995, this 8% increased to 12.8%. With this data, it can be predicted that the percentage of people whose age is greater than 65 will be 20% of the total population. In that 20% of the people, there are chances for 35% of the total elderly people to get affected by dementia and Alzheimer's. About 0.6 percent of the total population has been affected by dementia in the last decade, and this percentage is again increased to 0.9 percent [3].

Dementia is also linked with some other chronic disorders like Traumatic, and Parkinson's. Dementia is an irreversible condition that should be diagnosed in the initial stages. The following tests are done in the initial stages of dementia to diagnose the intensity of the disorder. First, cognitive and neurological tests are taken to evaluate the thinking and problem-solving abilities of the person. If the person is diagnosed with the illness of fundamental activities from the cognitive and neurological test, then several brain scans are done to check whether there is any damage in the brain cells. These brain scans involve the CT scan, which is an updated version of an X-Ray; the MRI scan, which uses magnetic resonant images, and the PET scan, which uses a radioactive tracer to detect damage in the brain cells. If any brain cells are found damaged in the above-mentioned scans, then some genetic blood tests are taken to ensure the presence of dementia. The process of magnetic resonance imaging can be done by various combinations of extraction techniques and machine learning classifier algorithms. The extraction techniques include the GLCM and the GLRM. Both methods will be further analyzed throughout the article and the method whose performance index is high will be found. The data obtained from the extraction technique is then classified using some machine learning classifying algorithms. Those algorithms are the SVM algorithm, KNN algorithm, RF algorithm, and the combination of SVM and KNN. These four algorithms are also implemented, and the best classifier algorithm is found. The usage of machine learning algorithms and extraction techniques is not new in the medical field. The volumetric usage of magnetic resonance imaging in the study of patients with dementia, vascular dementia, and in the worst case, Alzheimer's. According to them, the MRI scan can be used to detect the presence of a pathological body called the Lewy body. The Lewy bodies are present in the striatum part of the brain. The final finding of the research states that the usage of additional algorithms like neuroimaging techniques can be used in the detection of dementia, Alzheimer's, and vascular dementia [4]. The extraction of data is done using texture-based extraction techniques. The support vector machine integrated with some other pasting votes techniques can be used to detect the presence of dementia in its early stages. At first, the MR images of the patient's brain are taken from the database, and the wavelet features are extracted from the image using SVM. The diagnosis of dementia using this method includes three steps. They are feature selection, extraction, and classification. The Morphometry technique that uses Voxel's method is used in this research for FE. Finally, the classification is done using the SVM technique [5]. Another research states the usage of another classification method, *i.e.,* the K-Nearest Neighbor method, for classification purposes. In that research, they state that the KNN algorithm is one of the easiest and simplest algorithms. The distance formula by Minkowski is used for classification in this research. Along with the KNN algorithm, the Support Vector Machine Algorithm and the Linear Discriminant Analysis method are used in the classification process.

The following journal is explained in the following way: The second part of the journal explains the materials and methods used to detect dementia using MRI, along with the block diagram and its explanation. The third part explains the extraction techniques that are used in the process. The fourth portion consists of the machine learning classification techniques, formulae, and expressions used to classify. The fifth part analyses the outputs obtained from different combinations

CHAPTER 12

Deep Learning-Based Regulation of Healthcare Efficiency and Medical Services

T. Vamshi Mohana[1,*], **Mrunalini U. Buradkar**[2], **Kamal Alaskar**[3], **Tariq Hussain Sheikh**[4] and **Makhan Kumbhkar**[5]

[1] *Department of Computer Science, RBVRR Women's College, Hyderabad, Telangana- 500027, India*

[2] *Department of Electronics and Telecommunication Engineering, St. Vincent Pallotti College of Engineering & Technology, Nagpur, Maharashtra - 441108 India*

[3] *Bharati Vidyapeeth (Deemed to Be University), Institute of Management, Kolhapur, Maharashtra, India*

[4] *Department of Computer Science, Government Degree College, Poonch, J&K UT-185101, India*

[5] *Christian Eminent College, Indore, Madhyapradesh-452001, India*

Abstract: There has been an increase in new diseases in recent years, which has had both economic and societal consequences. Patients in the modern environment require not only constant monitoring but also all-encompassing smart healthcare solutions. These systems keep track of the patient's health, store data, and send alerts when critical conditions arise. Healthcare may be considerably improved with the use of Artificial Intelligence and Machine Learning (ML) systems. These systems can help with earlier diagnosis of diseases, as well as more specific treatment plans. As big data, the Internet of Things with many more smart technologies grows more widespread; deep learning is becoming more popular. Due to the apparent rising complexity and volume of data in healthcare, artificial intelligence (AI) will be used more frequently. This work aims to develop a deep learning-based smart healthcare monitoring system. This system keeps track of patients' health, analyses numerous parameters, categorizes data, and organizes requirements. The algorithm using the python program is developed and discussed to track the health of several patients with various illnesses. This method also aids in the categorization of data, organization of pharmacological requirements. This approach yields satisfactory performance, and the results are also provided.

Keywords: Deep Learning, Healthcare, IoT, Regulation.

* **Corresponding author T. Vamshi Mohana:** Department of Computer Science, RBVRR Women's College, Hyderabad, Telangana- 500027, India; E-mail: vamshi.mohana.reddy@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

The Healthcare industry has grown tremendously in the last decades, not only in Research and Development but also in data mining and organization. Mobile technologies and smart devices made significant improvements in monitoring and assistance [1]. Due to the supplementary health issues, monitoring the health and organizing the previous data are more critical. Though wearable devices have been given continuous monitoring and organization, those data are not reliable in extreme cases since we require a sophisticated health monitoring and communication system that can also be used to organize the data of a patient and suggest the drug and surgical requirements [2].

The Internet of Things (IoT) improves the performance of medical equipment by reducing human error. In this technique, medical devices transmit patient data to a gateway that can be stored and analyzed. Monitoring all patients from different locations is one of the main impediments to implementing the Internet of Things for healthcare applications [3]. In recent years, Wireless Medical Sensor Network (WMSN) has been gaining attention in remote monitoring system. Implanted bio-sensors are used in this method to detect sensitive information about a patient that may then be transferred to remote hospitals for additional analysis. Medical professionals can access patient data via WMSN from anywhere in the world with the help of the Internet [4].

Data acquired from individuals and patients require authorization from the system because of the increased sensitivity due to the participation of people. Consumers are deterred from taking full advantage of the technology because of their privacy concerns. To protect the accuracy, security, and privacy of healthcare data, we must develop a security framework for real-time patient monitoring. Healthcare practitioners and rescuers have been using a variety of security frameworks and devices for some time now. However, these systems get increasingly absurd with time. The flow of data and its related elements are mentioned in the Fig. (**1**).

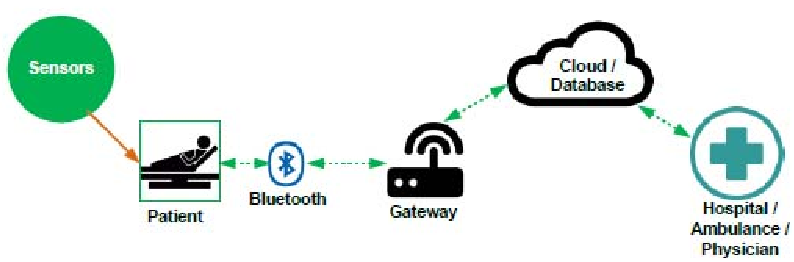

Fig. (1). Flow of data from the patient to healthcare system.

Recent decades have seen a shift in the world population's size and composition. For example, such demographic shifts have a profound impact on health and healthcare. Even in wealthy countries, people are living longer and healthier lives. This should be celebrated and seen as an opportunity for people to enjoy longer and healthier lives. As a result, healthcare and living circumstances will need to be significantly improved. Healthcare costs are increasing at an alarming rate. Paradoxically, all nations around the globe are seeing rapid economic growth. Our daily lives are impacted by deep learning to various extents. These are among the most popular applications, and they are constantly evolving [5].

This paper aims to present an online smart patient monitoring system that monitors vital parameters like Heart Rate, $SpO_{2,}$ and Body Temperature. These details are shared with ThingSpeak and a server to store and analyze the data. The algorithm using the python program is developed and discussed to track the health of several patients with various illnesses. This method also aids in the categorization of data, and organization of pharmacological requirements. The output can be viewed using a mobile application also using the ThingSpeak app viewer. This approach yields satisfactory performance, and the results are also provided.

2. IOT IN MEDICAL CARE SERVICES

With the arrival of the “Internet of Things,” it is now feasible to distinguish “patient data” and “physical sensor data” in the analysis and diagnosis of a physician. The greatest benefit of the Internet of Things in healthcare is a reduction in maintenance costs, followed by an increased probability of receiving healthcare. The inclusion of a personal and digital healthcare network was a valuable learning experience, and cloud health services were projected to emerge as a result of mobile information and general technology killer applications. The Internet of Things (IoT) is already in use as a primary platform for evaluating neuronal attention. But even though adequate monitoring mechanisms are unavailable, significantly higher risks can be taken. The Internet of Things (IoT) and other innovations are used here. Such caution is in the best interests of the patient. Sensed data are employed to assess patient information. The caregiver is capable of providing sufficient medical advice. IoT devices, which are frequently used by people with disabilities, necessitate additional supervision. The deployment of sensors has been used to collect monitoring tactics to maintain a continuous material movement by the patients referred to the facility for caregivers. As either a result, the treatment quality improves. This leads to higher hospital bills. Fig. (**2**) shows the impact of the Internet of Things (IoT) on healthcare.

CHAPTER 13

An Efficient Design and Comparison of Machine Learning Model for Diagnosis of Cardiovascular Disease

Dillip Narayan Sahu[1,*], **G. Sudhakar**[2], **Chandrakala G. Raju**[3], **Hemlata Joshi**[4] and **Makhan Kumbhkar**[5]

[1] *Department of MCA, School of Computer Science, Gangadhar Meher University, Sambalpur, Odisha-768001, India*

[2] *School of Information Technology, Jawaharlal Nehru Technological University, Hyderabad, Telangana- 500085, India,*

[3] *BMS College of Engineering, Bangalore, Karnataka-560019, India*

[4] *Department of Statistics, CHRIST (Deemed to be University), Bangalore, Karnataka-560029, India*

[5] *Christian Eminent College, Indore, Madhyapradesh-452001, India*

Abstract: Cardiovascular disease has a significant global impact. Cardiovascular disease is the primary cause of disability and mortality in most developed countries. Cardiovascular disease is a condition that disturbs the structures and functionality of the heart and can also be called heart disease. Cardiovascular diseases require more precise, accurate, and reliable detection and forecasting because even a small inaccuracy might lead to fatigue or mortality. There are very few death occurrences related to cardio sickness, and the amount is expanding rapidly. Predicting this disease at its early stage can be done by employing Machine Learning (ML) algorithms, which may help reduce the number of deaths. Data pre-processing can be employed here to eliminate randomness in data, replace missing data, fill in default values if appropriate, and categorize features for forecasting and making decisions at various levels. This research investigates various parameters that are related to the cause of heart disease. Several models discussed here will come under the supervised learning type of algorithms like Support Vector Machine (SVM), K-nearest neighbor (KNN), and Naïve Bayes (NB) algorithm. The existing dataset of heart disease patients from the Kaggle has been used for the analysis. The dataset includes 300 instances and 13 parameters and 1 label are used for prediction and testing the performance of various algorithms. Predicting the likelihood that a given patient will be affected by the cardiac disease is

* **Corresponding author Dillip Narayan Sahu:** Department of MCA, School of Computer Science, Gangadhar Meher University (GMU), Sambalpur, Odisha-768001, India;
E-mail: Dillip1seminar@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

the goal of this research. The most important purpose of the study is to make better efficiency and precision for the detection of cardiovascular disease in which the target output ultimately matters whether or not a person has heart disease.

Keywords: Bayes, Evaluation Metrics, Prediction, Pre-process, Supervised.

1. INTRODUCTION

The major cause of mortality in the modern world is heart disease, also known as cardiovascular disease. A WHO study estimates that over 17.9 million people die each year as a result of cardiovascular disease. Middle to low economies has a substantial number of fatalities. Variables such as individual and career actions, as well as an inherited propensity, can all contribute to heart disease. The reasons for cardiovascular disease may include nicotine, excess drinking, anxiety, lack of physical activity, and also physiologic illness. The capacity to swiftly and effectively detect heart disease is crucial to taking preventative measures to avoid death.

The process of data preprocessing is to extract essential information from massive datasets in a variety of disciplines, including medicine, business, and education. These algorithms can analyze huge amounts of data from several sectors, which may include the medical field. It is a computer-assisted alternative method over a traditional way of predicting models to reduce the errors in projected and actual results. The dataset is supposed to be analyzed using various ML algorithms. These data are analyzed by healthcare professionals for them to make efficient diagnostic decisions. Analyzing the health care domain dataset using classification algorithms gives clinical assistance. It includes a classification algorithm to test whether they can predict patients' cardiac problems. Data mining is the process of getting valid data or information from large datasets. Many ML methods, including regression, grouping, classification methods, and a few more segmentation techniques, can be used to do classification. A comparison analysis is used to analyse the classification approaches. This study will make use of data available on Kaggle. A classifier model was constructed using classification techniques to aid in the prediction of diseases. This research compares current technologies, as well as various methods that might be used to forecast heart illness.

1.1. Literature Survey

Coronary disease was one of the major reasons for death in a few countries, such as India and the United States. Computations incorporating ML techniques such as logistic regression, irregular woodlands, angle boosting, and SVM. For example, NB experiences a variety of heart-related difficulties. These computations can be used to improve the storing of data for valid and important reasons. Most analysis carries a variety of classifiers, for example, SVM, KNN, Neural Network and twofold discretization with Decision Tree [1]. It is assumed in the paper [2] that even using NB and Decision tree with data to start picking up counts produces superior results and greater precision when compared to conventional techniques. Since the nature of the heart is complicated, it must be handled with care. Heart disease severity is classified using a variety of approaches, including NB, Generic Algorithms, Decision Trees, and KNN. Mohan *et al*. [3] outline the procedure to combine two distinct ways to create a hybrid strategy with an accuracy of 88.4 percent, which is higher than the accuracy of any previous approach. Several researchers have researched ML algorithms that may be used for the prediction of cardiovascular illnesses. Kaur *et al*. [4] investigated this and defined the process by which interesting patterns and knowledge are extracted from a large dataset. They compare the accuracy of multiple ML and data preprocessing algorithms to determine the best and conclude the benefit of the SVM classifier. ML algorithms were utilized here to identify different types of diseases or illnesses, and many researchers like Kohali *et al*. [5], have started working on this for the prediction of heart disease using various ML models and concluded that the logistic regression algorithm has 87.1 percent of accuracy, SVM seems to have an accuracy of 87.1 percent, and the AdaBoost classifier has an 87.1 percent of accuracy.

2. ML

Artificial intelligence is a sub-discipline of ML and is a technology widely used today. The main goal is to create systems that really can learn from their experiences and make predictions. It may use the training dataset to create a model that trains ML algorithms. To forecast cardiac disease, the approach integrates the new input data. The models may be generated by detecting hidden patterns in the input dataset using ML algorithms. For new datasets, it makes accurate predictions. To design an effective model, the dataset needs to be cleaned, and any missing values have to be filled with either zeros or nearby values. The model is instead evaluated for accuracy using the new set of input data to predict the illness of the heart.

The model has been trained using a labeled dataset. It has input data as well as output data. A training data set can be used in supervised learning to train models to produce the preferred output. This may be prepared with the dataset containing both correct and incorrect data, which may allow the model to improve its

CHAPTER 14

Deep Learning Based Object Detection Using Mask R-CNN

Vinit Gupta[1,*], **Aditya Mandloi**[1], **Santosh Pawar**[2], **T.V Aravinda**[3] and **K.R Krishnareddy**[3]

[1] *Electronics Engineering Department, Medi-Caps University, Indore, Madhya Pradesh, India-452001*

[2] *Electronics Engineering Department, Dr. APJ Kalam University, Indore, Madhya Pradesh, India-452001*

[3] *SJM Institute of Technology, Chitradurga, Karnataka, India-577502*

Abstract: Nowadays, an image must be verified or analyzed keenly for further processing methods. Few numbers of images can be analyzed manually for a particular object or a human being. But when millions and millions of images are present in a dataset, and every single one of them must be verified and classified based on the objects present in the image, it is necessary to find an algorithm or a technique to assist this process. Of many types and applications of object detection, this research aims at pedestrian detection. Pedestrian detection is a special way that only aims to detect the human beings in the uploaded image. The Mask R-CNN algorithm is used in pedestrian detection. The Mask R-CNN model is a Deep Learning (DL) model that can detect a certain object from an image and can also be used for image augmentation. The Mask R-CNN stands for Mask Regional Convolutional Neural Network (CNN). This is one of the classification techniques which can be designed using the Convolutional Network theories. The Mask R-CNN algorithm is the updated version of the Faster R-CNN. The main difference between the faster R-CNN and the Mask R-CNN is that the mask R-CNN can bind the borders of the object detected while the faster R-CNN uses a box to identify the object. One of the major advantages of mask R-CNN is that it can provide high-quality image augmentation and is also one of the fastest image segmentation algorithms. This model can be easily implemented when compared to other object detection techniques. Python contains various inbuilt dependencies which can be installed with the help of repositories. These dependencies are used to design the model. The model is then trained and tested with various inputs for better accuracy. Image segmentation is used in various fields like medical imaging, video surveillance, traffic control, *etc*., so the mask R-CNN technique would be an extremely efficient DL algorithm.

Keywords: Data, DL, Mask R-CNN, MaxDets, Object Detection, Pedestrian.

[*] **Corresponding author Vinit Gupta:** Electronics Engineering Department, Medi-Caps University, Indore, Madhya Pradesh, India-452001; E-mail: vinit@medicaps.ac.in

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Images and videos are some forms of data that can be used for various purposes in our day-to-day life. Image processing and object detection are used in various fields like medical analysis, face detection, security systems, automated vehicles, and agriculture. Object detection is a computer vision task used to classify and detect the presence of individual objects or even human beings from an image. Object detection can be further classified into various tasks like face detection, animal detection, vehicle identification, security systems, picture retrieval, *etc*. Object detection can be employed using either machine learning algorithms or DL algorithms. Yet, DL algorithms used for object detection are far more effective than machine learning algorithms. By the year 2014 and after, object detection was effectively done using DL algorithms. Many DL algorithms can be used in object detection. Some of the most commonly used DL algorithms for object detection include ***You Only Look Once algorithm*** or the **YOLO** algorithm, the single-shot detector algorithm, SqueezeDet, and the mask R-CNN. The YOLO algorithm is one of the fastest DL algorithms that can bind a box regression just by scanning the image once. The single-shot detector is the most commonly used DL algorithm for object detection. The SqueezeDet algorithm is specifically designed for human driving and is also capable of bounding a box regression in one scan, just like the YOLO algorithm. The Mask R-CNN is an upgraded version of the Fast R-CNN. This algorithm is capable of detecting the object along with its border, and unlike the other object detection algorithms, the mask R-CNN does not use box regression bounding. Thus, the mask R-CNN algorithm can be claimed as the simplest and the most efficient DL algorithm. The process of object detection using the mask R-CNN is explained.

Computer vision for real-time applications, such as driving assistance and video surveillance, is expanding, and pedestrian identification is one of the most promising areas of research. For the past ten years, the topic of pedestrian detection has piqued the interest of many academics in the research community. Pedestrian detection aims to identify the obvious objects in the information gathered from the labeled pedestrian and non-pedestrian examples in the information collection process. Due to its practical application in a variety of computer vision applications, such as video surveillance and robotics interaction, tremendous progress has been made in the last decade. It has become possible to deal with pedestrian detection by installing a variety of sensor systems on the autos and even integrating the data given by some of the sensors. Some of the sensors used to accomplish this goal include cameras and stereoscopic machine vision systems, laser sensors, time-of-flight cameras, and three-dimensional laser sensors (three-dimensional laser sensors). Despite all of the significant advancements in the identification of pedestrians, this task continues to provide significant challenges. For example, one of them is the achievement of dependable performance under highly fluctuating lighting conditions, such as those found in real-world driving situations.

2. LITERATURE SURVEY

Many types of research and projects have been developed based on the mask R-CNN algorithm and its usage in object detection. For instance, by the end of the year 2019, Phil Ammirato *et al.* developed Mask-RCNN Baseline for Probabilistic Object Detection. They used a two-stage pipeline to develop a DL model using the mask R-CNN algorithm. They also used instance segmentation and the MSCOCO class to train the data. They concluded that there is a lot of possibility for development in future work with a final score of 21.432, albeit the lack of training data is a limiting problem. Most of the improvements in this paper are based on basic heuristics that use the PDQ calculation's structure [1]. Researchers from the National Authority for Remote Sensing and Space Science, Cairo, Egypt, and the 2 Faculty of Computers and Information, Cairo University, Giza, Egypt, including Amira S. Mahmoud *et al.,* researched the usage of Adaptive Mask RCNN in object detection. They used the usage of the FPN and RPN to construct the DL model. They also used a loss function to increase the efficiency of the algorithm. The model is then optimized using stochastic gradient descent. According to them, the suggested method beats current baseline object detection methods, and they found that the performance of the algorithm is increased by six percent. By employing the switch between optimizers SWATS in the training phase, the proposed adaptive Mask RCNN is found to be the most efficient among other DL. They measured the efficiency using some metrics named PRC and IOU when compared to other methods that used the default optimizer [2].

According to Jeremiah W. Johnson, Mask-RCNN is an efficient approach for object detection, localization, and object instance segmentation in image features that was recently proposed. A cyclic learning rate regime is shown to allow effective Mask-RCNN model training without the need to refine the information gained, eliminating a laborious and time-consuming step in the training process. He concluded that the Mask-RCNN had been demonstrated to be capable of performing exceptionally effective and efficient automatic segmentation of a wide range of microscopy pictures of cell nuclei for a range of cells obtained under various conditions [3]. Again, by 2019, Evi Kopelowitz *et al.* used the three-dimension mask R-CNN to detect lung nodules. They tweaked MaskRCNN's 2D implementation to work with 3D pictures and account for small item detection.

CHAPTER 15

Design and Comparison Of Deep Learning Architecture For Image-based Detection of Plant Diseases

Makarand Upadhyaya[1,*], Naveen Nagendrappa Malvade[2], Arvind Kumar Shukla[3], Ranjan Walia[4] and **K. Nirmala Devi[5]**

[1] *University of Bahrain, Department of Management & Marketing, College of Business Administration, Bahrain*

[2] *Department of Information Science and Engineering, SKSVM Agadi College of Engineering and Technology, Lakshmeshwar, Karnataka, India 582116*

[3] *Department of Computer Application, IFTM University, Moradabad, Uttar Pradesh, India*

[4] *Department of Electrical Engineering, Model Institute of Engineering and Technology, Jammu, Jammu & Kashmir-181122, India*

[5] *Department of Computer Science and Engineering, Kongu Engineering College, Perundurai, Erode, Tamilnadu– 638060, India*

Abstract: Agriculture provides a living for half of India's people. The infection in crops poses a danger to food security, but quick detection is hard due to a lack of facilities. Nowadays, Deep learning will automatically diagnose plant diseases from raw image data. It assists the farmer in determining plant health, increasing productivity, deciding whether pesticides are necessary, and so on. The potato leaf is used in this study for analysis. Among the most devastating crop diseases is potato leaf blight, which reduces the quantity and quality of potato yields, significantly influencing both farmers and the agricultural industry as a whole. Potato leaves taken in the research contain three categories, such as healthy, early blight, and late blight. Convolution Neural Network (CNN), and Convolution Neural Network- Long Short Term Memory(CNN-LSTM) are two neural network models employed to classify plant diseases. Various performance evaluation approaches are utilized to determine the best model.

Keywords: Accuracy, Blight, CNN, Loss, LSTM.

* **Corresponding author Makarand Upadhyaya:** University of Bahrain, Department of Management & Marketing, College of Business Administration, Bahrain; E-mail: makarandjaipur@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Agriculture made a tremendous contribution to the development of today's modern primary food crops. Food insecurity [1, 2], which would be a significant problem arising from plant infections, is among the most pressing global issues confronting human civilization. Plant diseases, based on one research, contribute to approximately 16% of worldwide agricultural production loss [3]. Pesticide losses for wheat are expected to be over 50% and more than 25% for soya worldwide. Fast and effective identification of crop diseases is essential for both healthy and profitable cultivation as well as for avoiding financial loss of investments. Certain crops don't show any symptoms at all, which necessitates the employment of sophisticated diagnostic techniques. Though some plants have invisible signals, most diseases may be diagnosed by an expert plant pathologist through a visual inspection of an affected crop [4]. A crop pathologist's capability to track plants and recognize common symptoms of the disease are essential to their profession. Furthermore, due to a large number of plant species, alterations in the development of crop diseases, a consequence of global warming, and the quicker outbreak of infection to new locations, even expert pathologists are unable to detect some illnesses [5]. Agronomists benefit greatly from the existence of professional and sophisticated technologies which can properly identify crop diseases autonomously. However, providing such technology with a simplistic smartphone app even help non-expert farmers. This app gives significant profit to farmers who lack agronomists and technical support systems [6]. Plants that have been afflicted with a disease generally have visible scars or marks on the plant parts, such as leaves, branches, fruits, or flowers. In general, it is possible to use the out-of-the-ordinary appearances of many diseases as diagnostic tools. The leaves of crops are often vital sources for identifying plant illnesses, and the majority of infection signals can start solely on leaves [7]. While demand for processed potato products has increased, fresh potato consumption has dropped. As more people rely on potatoes as a staple diet, even minor differences in the nutritional profile of potatoes will have far-reaching effects on public health. As it is high in carbs, the potato delivers energy while being low in fat. Although potatoes are low in protein, they have a significant biological value (90-100). Potatoes are an excellent source of numerous critical nutrients, including vitamin C, potassium, and a variety of B vitamins. The skins contain a lot of fiber. Several compounds in potatoes contribute to their antioxidant effect, and there has recently been an increase in demand for cultivars with colored skins. It is critical to understand the health advantages of potatoes to improve the overall quality of our food supply.

1.1. Literature Survey

The study [8] used the K-means clustering technique to extract lesions areas and merged the global color histogram (GCH), completed local binary pattern (CLBP), color coherence vector (CCV), and local binary pattern (LBP) to obtain the color and texture of an apple, it helps to detect the three types of infection in apple. The improved machine learning algorithm of the support vector machine (SVM) is used for classification, giving an accuracy level of 93%. Utilizing principal component analysis (PCA) and stepwise discriminant, scientists investigated multiple tomato diseases. The 18 main features, including shape, color, texture, and some information, are extracted from collected images [9]. To recover the important features, the above-mentioned model is employed. The two techniques' accuracy was 94.71 percent and 98.32 percent, correspondingly. The journal [10] discussed a variety of diagnostic approaches for identifying plant diseases, with an emphasis on imaging technology. KNN, K-means, and SVM are the main approaches given for crop diseases and categorization. In the next study, the researchers proposed hot-spot recognition using image processing techniques and for earlier detection of 3 categorizations of wheat diseases. They implemented their proposed technique on cell phones and tested it in a real-world setting [11].

A novel model for the autonomous identification of crop diseases called the Group Method of Data Handling logistics, is presented [12]. For identifying plant diseases, several techniques merge feature extraction with Neural Network Ensemble. It provides a greater generalization of learning ability by training a particular number of neural networks [13]. This approach was used only for detecting tea leaf diseases, with a testing accuracy of 91% [14]. Utilized Probabilistic Neural Network for disease detection [15]; it contains four layers, including an input, pattern, summation and output layer. Additionally, this neural net seems to have a quicker training time than Back Propagation Neural Network (BPNN). A three-layered BPNN was used for classification tasks, with the first layer containing 22 neurons trying to describe the characteristics of the image which is extracted in the feature extraction stage, the hidden layer containing comprising four neurons, and finally, the last layer containing just a single neuron during the learning process and the outcome to be 0 or 1 depending on whether the given input image was good or unhealthy [16].

Another strategy depends on imaging data and employing ANN in combination with the K-means clustering algorithm for automating recognition and categorization of infection present in plants [17]. ANN was made up of ten secret layers. The range of outcomes was six, corresponding to five types of disease leaf and a normal leaf. The performance measure of categorization obtained using this method was 94.67 percent of the total. The PlantVillage group has been gathering

CHAPTER 16

Discernment of Paddy Crop Disease by Employing CNN and Transfer Learning Methods of Deep Learning

Arvind Kumar Shukla[1,*], Naveen Nagendrappa Malvade[2], Girish Saunshi[3], P. Rajasekar[4] and **S.V. Vijaya Karthik[4]**

[1] *Department of Computer Applications, IFTM University Moradabad, IFTM University, Moradabad, U.P, India-244001*

[2] *Department of Information Science and Engineering, SKSVM Agadi College of Engineering and Technology, Lakshmeshwar, Karnataka, India 582116*

[3] *Department of Computer Science and Engineering, KLE Institute of Technology, KLEIT, Gokul, Karnataka, India-580031*

[4] *Department of ECE, Kings College of Engineering, Punalkulam, Gandarvakottai Taluk, Pudukkottai, Tamil Nadu, India-613005*

Abstract: Agriculture is the backbone of human civilization since it is a requirement of every living entity. Paddy agriculture is extremely important to humans, particularly in Asia. Farmers are currently facing a deficit in agricultural yield owing to a variety of factors, one of which is illness. The composition of paddy crop diseases is complicated, and their presentation in various species is highly similar, making classification challenging. These agricultural infections must be discovered and diagnosed as soon as feasible to avoid disease transmission. The disease significantly impacts crop productivity, and early detection of paddy infections is critical to avoiding these consequences. These issues arise as a result of a lack of awareness regarding health. Identifying the disease needs the best expertise or previous knowledge to regulate it. This is both difficult and costly. To address the aforementioned problem, a Deep Learning (DL) model was created utilizing a Convolutional Neural Network (CNN) and the transfer learning approach. The model is trained using an image of a paddy crop as input. By comparing metrics like accuracy and loss, the optimum technique is identified.

Keywords: Agriculture, Image Augmentation, Paddy, Preprocessing, Transfer Learning.

[*] **Corresponding author Arvind Kumar Shukla:** Department of Computer Applications, IFTM University Moradabad, IFTM University, Moradabad, U.P, India-244001; E-mail: arvindshukla.india@gmail.com

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Agriculture is an occupation that is more than just an occupation. This is because, unlike other occupations, agriculture provides food to people working in various other sectors. Agriculture not only provides food; it provides occupation to workers who are not directly linked to agriculture. The need for agriculture and agriculture-related professions will keep increasing with the increase in population. In India, agriculture is said to be the main occupation for the majority of the population. The establishment of sedentary human civilization in agriculture was a crucial breakthrough, allowing humans to live in cities thanks to surpluses of food generated by tamed species. But in recent times, agriculture has been considered an occupation with a bane as it requires a lot of manpower, water, *etc*. Though farmers try their best to survive the need for water and human power, they are then faced with another problem. The problem is plant diseases. Many types of plant diseases can affect the growth of the plant and also the yield produced. These plant diseases are common in food material crops like paddy, wheat, millets, *etc*. Many pesticides and chemicals that can prevent plant diseases are available on the market. But the problem arises when the farmer is unaware of the problem. This ignorance can lead to heavy loss for the farmer and eventually to stop farming. It is necessary to adopt some preventative actions to limit the possibility of farmers switching to other occupations. This research aims the development of a DL model which can be used to predict the type of plant disease a particular plant is affected by. To test and train the model, the paddy crop is used. The paddy crop is often affected by diseases like bacterial leaf blight, brown spots, and leaf smut. To detect the above-mentioned diseases, a DL model is constructed. This model is constructed twice using two different algorithms to find the most efficient algorithm for this process.

The DL algorithms include CNNs and transfer learning. The transfer learning is implemented in the DL algorithm using the VGG-10 module. The images of paddy collected from the Kaggle are then used to train both models. Once the models are trained enough, they are tested for higher accuracy and lower loss. In the end, the accuracy and the loss levels of both the models are compared, and it is found that the transfer learning algorithm is the best algorithm for disease detection in plants, with an accuracy percentage of 98.75.

2. LITERATURE SURVEY

The literature survey taken for researching paddy disease classification using the paddy leaf images is detailed in this section.

1. Agriculturalists are confronted with the difficulties of diagnosing rice crop diseases and are unable to identify an effective pesticide or insecticide to manage

the disease outbreak. The aforementioned problem can be resolved by developing a machine learning model based on the CNN (CNN) algorithm that detects images of Rice Blast, Bacterial Blight, and Healthy paddy leaf images, providing a solution in the form of insecticides or pesticides to control the Rice Blast and Bacterial Blight outbreaks. It has been observed that the system is more resilient, user-friendly, and produces a faster and more cost-effective result than the present technique [1].

2. A combination of evolutionary algorithms, such as GA, and machine learning approaches, such as AdaBoost and Bagging Classifier, has been tried to detect paddy leaf diseases. The images of paddy leaves were processed to remove undesirable distortions and improve the image qualities. It includes image scaling, brightness adjustment, filtering, lighting corrections, noise reduction, geometric transformations, and greyscale transformations, among other things, as part of the whole process. A feature extraction approach is then applied to the processed photos after they have been pre-processed to extract the needed feature dataset from the images. The accuracy of the classification system is improved by applying cascaded classifiers with adjustments to the problem statement [2].

3. Several image-processing approaches were tested for their effectiveness in diagnosing rice plant sickness. According to the current study, the scientists looked into image processing, disease diagnosis and feature extraction approaches, among other things. In addition to exploring the potential challenges and opportunities in the field of paddy leaf disease detection, this research investigated the issue of automated rice plant disease detection [3].

4. Employs images taken directly from the farm field to obtain photographs of healthy paddy plants as well as images of paddy plants plagued with pests and illnesses for use in our photography. RGB pictures are converted to HSV before being utilized in pre-processing, where the hue component masking technique is employed to remove the background from the image. A clustering method is used to separate the damaged sections from the healthy parts during the segmentation process. The proposed DNN JOA approach is used to classify diseases, with the JOA selecting the best weights for each classification. A feedback loop is established in our system, which determines its stability. The results of analyzing and comparing experimental findings using ANN, DAE, and DNN offer several relevant and helpful metrics [4].

5. Neutrosophic logic, which is derived from the fuzzy set, was proposed as a strategy for segmenting data for ROI evaluation. Three types of membership functions were used to segment the data for this study, and they were as follows: To determine whether or not a plant leaf was diseased, segmented regions were

CHAPTER 17

Deploying Deep Learning Model on the Google Cloud Platform For Disease Prediction

C.R. Aditya[1,*], Chandra Sekhar Kolli[2], Korla Swaroopa[3], S. Hemavathi[4] and **Santosh Karajgi[5]**

[1] *Department of Computer Science & Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India-570002*

[2] *Aditya College of Engineering & Technology, Surampalem, East Godavari, India-570002*

[3] *CSE, Aditya Engineering College, Kakinada, Andhra Pradesh, India-533437*

[4] *CSIR - Central Electrochemical Research Institute (CECRI), CSIR-Madras Complex, Chennai, Tamil Nadu, India-600113*

[5] *BLDEA's SSM College of Pharmacy and Research Centre Vijayapur 586103, Karnataka, India*

Abstract: A brain tumor is defined by the proliferation of aberrant brain cells, some of which may progress to malignancy. A brain tumor is usually diagnosed via a magnetic resonance imaging (MRI) examination. These images demonstrate the recently observed aberrant brain tissue proliferation. Several academics have examined the use of machine learning and Deep Learning (DL) algorithms to diagnose brain tumors accurately A radiologist may also profit from these forecasts, which allow them to make more timely decisions. The VGG-16 pre-trained model is employed to detect the brain tumor in this study. Using the outcomes of training and validation, the model is completed by employing two critical metrics: accuracy and loss. Normal people confront numerous challenges in scheduling a doctor's appointment (financial support, work pressure, lack of time). There are various possibilities for bringing doctors to patients' homes, including teleconferencing and other technologies. This research creates a website that allows people to upload a medical image and have the website predict the ailment. The Google Cloud Platform (GCP) will be utilized to install the DL model due to its flexibility and compatibility. The customized brain tumor detection website is then constructed utilizing HTML code.

Keywords: Accuracy, Tumor detection, VGG-16, Loss, Kaggle, Google Cloud Search.

* **Corresponding author C.R. Aditya**: Department of Computer Science & Engineering, Vidyavardhaka College of Engineering, Mysuru, Karnataka, India-570002; E-mail: adityacr@vvce.ac.in

Shashank Awasthi, Mahaveer Singh Naruka, Satya Prakash Yadav, & Victor Hugo C. de Albuquerque (Eds.)

1. INTRODUCTION

Many healthcare problems can be remedied quickly as a result of the rapid evolution of healthcare technology in the field of information and communication engineering. According to a study conducted by the National Cancer Institute Statistics and the World Health Organization, brain tumors kill 12,764 people in the United States each year. As it manages all other organs and aids in decision-making, the brain is the most important organ in the human body. It is the central nervous system's primary control center and is in charge of the body's everyday voluntary and involuntary functions. Our brains are undergoing uncontrollable tissue growth, which is replicating uncontrollably in the tumor. Brain cancer develops when abnormal cells proliferate within or near the brain's surface. A risk to the healthy brain occurs as a result of either piercing or squeezing and moving normal brain tissue as a result of the procedure. A developing brain tumor can potentially cause considerable injury to the brain due to the limited amount of space inside the skull. It is critical to understand brain tumors and their stages to properly prevent and treat the problem. Several imaging modalities, such as MRI and computed tomography (CT), can be used to assess brain tumors [1]. Brain tumors are one of the most severe disorders that can occur in both children and adults. Brain tumors are thought to account for 85 to 90 percent of all primary Central Nervous System malignancies.

Appropriate therapy and planning, as well as accurate diagnoses and treatment recommendations, can all lead to better patient outcomes [2]. In 1969, Raymond V. Damadian invented the magnetic picture, which was the first of its kind. In 1977, the first MRI of the human body, as well as the most accurate technology, was developed. The inside anatomy of the brain, as well as the many other types of tissues in the human body, may be examined in fine detail using MRI. MRI images outperform X-ray and computer tomography images in terms of quality [3]. A brain tumor can be detected *via* MRI. Automatic data categorization using Artificial Intelligence (AI) is more accurate than manual data categorization. As a result, a system that employs DL Algorithms to detect and classify diseases would be extremely useful to clinicians all around the world.

2. LITERATURE SURVEY

1. The One-Pass Multi-Task Network (OM-Net) was created to address the issue of unequal data in medical brain volume. OM-Net learns discriminative features by using both task-specific and shared parameters for training. To improve performance in OM optimization, methods such as learning-based training and online training data transfer are used. Furthermore, the prediction results are exchanged between jobs *via* a CGA module [4].

2. Including the four MRI modalities in the architecture of brain tumor segmentation. As each modality has its own set of differentiating properties, the network will be able to discern between classes more efficiently. Working on a section of the brain image near the tumor tissue, it was proved that a CNN model can perform at least as well as human observers. Furthermore, a CNN model in cascade mode is used to extract both local and global features in two distinct ways, each with a different patch size [5].

3. The study looked into using a single model to categorize brain MRI data on many classification issues, rather than using a new model for each classification assignment, as prior research had done. This can be accomplished with the assistance of a Convolutional Neural Network (CNN), a type of artificial intelligence. A CNN-based model can also be used to pinpoint the site of a brain tumor [6].

4. CNN's and transfer learning are used in conjunction to examine MRI pictures of the human brain. Both methods have shown effective outcomes when compared to CNN; however, transfer learning requires a bigger investment of computational effort and memory [7].

5. The researchers intend to build a computer-assisted brain tumor diagnosis system utilizing the CNN network in this study. The deep network model represents a network of links mathematically. CNN was trained using MRI datasets of brain tumors, and its performance was tested on 72 percent of previously unseen data. In the training phase, only 28% of the data was utilized. The algorithm accurately predicted the existence of a brain tumor using two datasets and achieved the greatest accuracy [8].

6. A thorough hierarchical classification of brain tumors is established. Techniques for segmenting a brain tumor include thresholding, unsupervised and supervised machine learning, and DL. For diagnosing brain cancers, a comparison of machine learning techniques with DL-based algorithms is made [9].

7. To identify and characterize brain tumors in seven different locations, a DL architecture was used. Scientists employed DL to classify gliomas, meningiomas, and pituitary cancers, among other things. The comparison of cropped and uncropped regions in a categorized brain image resulted in improved segmentation accuracy [10].

3. METHODOLOGIES

Fig. (**1**) depicts the step-by-step procedure for installing the brain tumor detection model in GCP. The data is initially obtained from a well-known website called

CHAPTER 18

Classification and Diagnosis of Alzheimer's Disease using Magnetic Resonance Imaging

K.R. Shobha[1,*], **Vaishali Gajendra Shende**[2], **Anuradha Patil**[2], **Jagadeesh Kumar Ega**[3] and **Kaushalendra Kumar**[4]

[1] *Department of Electronics and Telecommunication Engineering, Ramaiah Institute of Technology, MSR Nagar, MSRIT Post, Bangalore, Karnataka, India-560054*

[2] *East point College of Engineering and Technology Bangalore, East Point Campus, Virgo Nagar Post, Avalahalli, Bengaluru, Karnataka 560049, India*

[3] *Chaitanya (Deemed to be University), Hanamkonda, Telangana State, India*

[4] *Department of Bio-Science, Galgotias University, Greater Noida. Uttar Pradesh, India-201310*

Abstract: Different types of brain illnesses can affect many parts of the brain at the same time. Alzheimer's disease is a chronic illness characterized by brain cell deterioration, which results in memory loss. Amnesia and ambiguity are two of the most prevalent Alzheimer's disease symptoms, and both are caused by issues with cognitive reasoning. This paper proposes several feature extractions as well as Machine Learning (ML) algorithms for disease detection. The goal of this study is to detect Alzheimer's disease using magnetic resonance imaging (MRI) of the brain. The Alzheimer's disease dataset was obtained from the Kaggle website. Following that, the unprocessed MRI picture is subjected to several pre-processing procedures. Feature extraction is one of the most crucial stages in extracting important attributes from processed images. In this study, wavelet and texture-based methods are used to extract characteristics. Gray Level Co-occurrence Matrix (GLCM) is utilized for the texture approach, and HAAR is used for the wavelet method. The extracted data from both procedures are then fed into ML algorithms. The Support Vector Machine (SVM) and Linear Discriminant Analysis (LDA) are used in this investigation. The values of the confusion matrix are utilized to identify the best technique.

Keywords: Alzheimer, Confusion Matrix Values, Feature Extraction, HAAR, Magnetic Resonance Imaging.

[*] **Corresponding author K.R. Shobha**: Department of Electronics and Telecommunication Engineering, Ramaiah Institute of Technology, MSR Nagar, MSRIT Post, Bangalore, Karnataka, India-560054;
E-mail: shobha_shankar@msrit.edu

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1. INTRODUCTION

Alzheimer's disease is a neurological illness that causes dementia in the elderly. It gradually decreases the person's cognitive function, resulting in declining memory and psychotic symptoms, and eventually death. Alzheimer's disease affects roughly 24 million people worldwide, and the number is anticipated to climb every 20 years until at least 2040. Alzheimer's disease affects women by a factor of 1.2 to 1.5% higher than men [1]. This disease affects roughly 10% - 15% of people over the age of 65, and 47% of people over the age of 80. People with this disease, according to Alois Alzheimer, have a damaged brain with neurofibrillary tangles and neuritis senile plaques [2]. Alzheimer's disease is the sixth greatest cause of death and is a devastating neurological disorder. Though signs of this disease can be found in the brain as early as middle life, symptoms do not develop until after the age of 65. Although the primary cause of this ailment is assumed to be old age, it is not the only one. In addition to age, risk factors include one or more apolipoprotein gene E4 alleles, a family history of Alzheimer's, low educational and vocational attainment, and moderate to severe concussions. The most important aspect of detecting Alzheimer's disease in humans is still assessing cognitive deficits, behavioral problems, functional impairment, and a variety of psychosocial therapies [3]. According to current research, reasonably benign Alzheimer's disease is rarely detected, and moderately severe Alzheimer's disease is under-recognized by diagnostic practice, even when the most thorough examination is undertaken. Numerous studies have suggested that neuroimaging, namely high-resolution MRI, could be utilized to identify or diagnose Alzheimer's disease. Structural MRI imaging provides additional information on diseased tissue degeneration or other abnormal biomarkers that can be detected early in the disease with great sensitivity. This implies that a computer-aided diagnostic tool for detecting Alzheimer's disease before lasting neuronal damage occurs is extremely desirable [4].

Although early detection of Alzheimer's disease is critical, some researchers have used ML approaches to assess data and diagnose the disease. According to the researcher [5] ML is the process that occurs between 'supervised' and 'unsupervised' learning. A supervised learning strategy was used, with a collection of MRI images and the accompanying prognosis training set fed into an ML model, in this case, an SVM. The SVM “learned” to identify between those with and without Alzheimer's disease [6]. According to the article [7], longitudinal processing of sequential MRIs is required to create and study the course of the disorder over time for a more definitive diagnosis. To differentiate between the three groups, the actual procedure uses anatomical abnormalities of the brain, longitudinal variations in MRI, and a built-in classifier.

The author proposed a multilayer classification strategy using ML algorithms such as NB, SVM Algorithm, and K-NN to differentiate between various themes [8]. The MM-SDPN method, which is based on MRI and PET imaging data, was offered as a new algorithm for diagnosing Alzheimer's disease in the study [9].

The journal is structured as follows: Section 2 discusses the materials and processes for identifying Alzheimer's disease. Section 3 discusses the preprocessing procedures employed in this investigation. Section 4 will go through how to extract features with GLCM and HAAR. Section 5 discusses classification algorithms such as SVM and LDA. Section 6 investigates the combined performance of numerous feature extraction and classification approaches. Finally, section 7 suggests integrating feature extraction with several classifier methods to diagnose Alzheimer's disease.

2. METHODS AND MATERIALS

The study uses brain MRI images from the Kaggle database, which contains over 6000 images. Fig. (**1**) given below, is a sample MRI image of the brain.

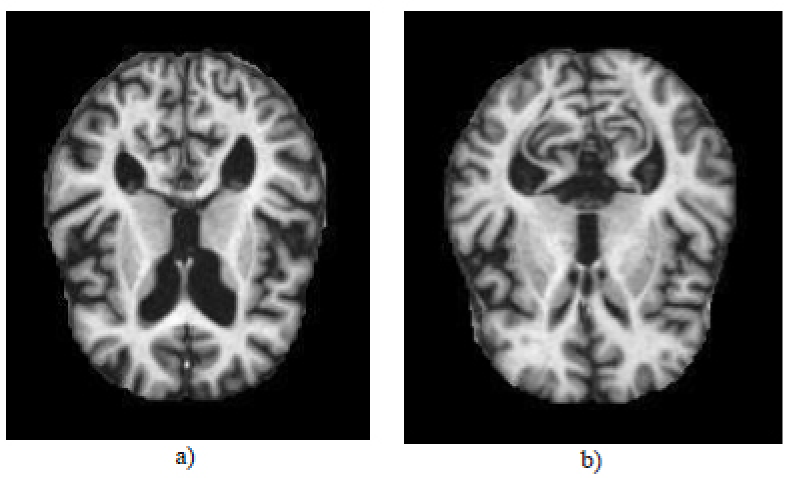

Fig. (1). a) Normal MRI b) Alzheimer MRI.

To train and test these MRI images, ML algorithms are used, with 80% of the image data used for training and 20% of the image data used for testing. In this scenario, the whole image data collection is divided into 8:2 ratios for training and testing operations (*i.e.*, 4800:1200). In this study, preprocessing techniques such as picture scaling and smoothing using the Gaussian method are employed to further examine and improve these images. Fig. (**2**) depicts a flow diagram of the

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