GREEN INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE AND INTERNET OF THINGS

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FOREWORD

I first met one of the editors of this book at an event on signal processing and machine learning on sensor networks in Cambridge. The topic caught my attention immediately since it really matched my vision for my current and future research. I am a Senior Researcher in distributed intelligent systems at the Institute for Manufacturing at the University of Cambridge (UK). I am a fellow of the Royal Statistical Society, where I also serve as a committee member of the special interest group in statistical engineering. In 2021, I was the recipient of the Frank Hansford-Miller fellowship in applied statistics, awarded by the West area branch of the Statistical Society of Australia. It was not a coincidence that the main part of the invited lecture at receiving this fellow was about time series mining and dynamic networks as research trends in engineering statistics. Both topics are closely related to decentralised learning on complex systems. Hence, writing a foreword for this book is a great pleasure to me, as it revolves around disruptive technologies and methods associated with the application of AI and IoT to human lives, societies, and industries. The role of AI in IoT is playing an essential role in the emergence of the resilient and ubiquitous internet connection today via 5G and beyond, along with the development of the so-called cyber-physical systems present almost everywhere. This, in principle, is an exceptional combination of AI and IoT, sometimes also named AIoT, is poised to be a norm in the technology for the coming years.

A book in AIoT is well-timed and of the highest interest to researchers, engineers and decision-makers. This is because AIoT provides a complete range of scalable solutions for system operations and automation. Such scalability is based on an AI algorithm development through a decentralised approach that enables edge-computing, a key step ahead towards the digitalisation of industry and society. For instance, in areas as important as the health sector, AIoT brings the possibility of tracking the health of individual patients as well as monitoring larger cohorts if working with algorithms at a coarser scale. This is of the highest importance in controlling both individual and population disease evolution. We all have in mind the recent COVID-19 pandemic and can immediately ascertain the myriad of solutions related to AIoT. This book shows the basis for this solution and many more since it also covers topics as disparate as intelligent asset management or smart manufacturing.

The depth and mathematical beauty of a theoretical algorithm development behind AIoT can only be overcome its appeal to many researchers and engineers by the plethora of solutions and the usefulness of their associated applications. We are in front of a really disruptive way of addressing further operations and management of truly intelligent, cognitive, and adaptive systems. The opportunity of getting involved in this formidable journey to change the world starts today. Let’s make it happen!

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PREFACE

This is the first edition of our book "Application of AI and IOT in human lives, societies and industries". The main aim of this book is to present the intricate concept to professionals, academicians, students, and researchers in detail. This book presents a detailed and thorough discussion of the domain of IOT and applications of AI and its allied applications in many connected diversified fields. The green environment around us is being affected daily by different technological activities. Protecting and preserving the green environment has become the prime challenge in the modern age of technological revolution. The modest use of this technology with a harmless approach to solve real-life problems has become of prime interest. The detailed views of how modern-day technologies are being spawned by the AI and IOT and have been successfully applied in the industries, human lives and societies to preserve the green resources is the focal point of this book. The theories and principles of soft computing and deep learning have been incorporated as the key tools for industrial automation. The concept of IOT and machine learning has been the main aspect of many industrial problems. These have been elaborated into books with relevant works in the concerned research fields. The topics like architecture, infrastructural aspects, safety systems, prediction models, and sustainable and smart manufacturing systems based on the principles of IOT, have been addressed. Each chapter consisting of the research papers has been well organised keeping in view the target audiences. The order of chapters is arranged in such a way so that the readers can be exposed to the subject of research and can easily correlate with the technological growth pattern used in the application.

The application-oriented approach is the unique feature of this book. Apart from the theoretical discussion, the problems and the allied case studies concerned with the topics discussed in this book are worthy of the interest of readers. The problems and their possible solutions through different models furnished in this book are crucial to researchers and academicians. This book comprises the state of the art information on various other subjects directly or indirectly connected to the main topic of the book.

An elaborate discussion on the topics relevant to the broad scopes of IoT and AI in human lives and in the advancement of industrial technologies has been presented under the proposed title. Some of the significant topics are the Applications of AI and IOT in the **reduction of e-waste, agricultural sustainability, species protection, checking air pollution and water pollution, generating renewable energies, building smart cities and health care systems, and the revolution of industries.** Under each concerned title, the elaborative explorations of AI and IoT along with their architectural nitty-gritty have been given. The new multidisciplinary approaches like soft computing, deep learning in AI, and application of different devices related to the IOT-based applications are some names to mention.

A massive advancement of technology and its productive outcomes have been realized in the field of agriculture in terms of the large yield of the crops and the abetment of plant diseases. Extensive research in the field of IOT has made the early detection of crop diseases possible. The advent of drones and the research works in the hybrid fields of IOT and image processing have also resulted in the large-scale reduction of time and money consumption and economic benefits across the whole country and globe.

Automation and optimization have become the buzzword in the industrial revolution. The application of such trends has become accelerated with a much deeper approach adopted by researchers in the fields of AI, ML, and IOT. The multifaceted application of IOT and AI along with ML has been of utmost need for researchers, students and professionals. Past research works and their continuation as a key to the modern research domain have been explored in this book thoroughly. The novel research contribution of eminent authors and researchers has been integrated in a judicial way to make the readers aware of the ongoing research and the probable future directions in this field.

Some new challenging areas and their corresponding research scopes have also been discussed. The traditional industry and the trends of its further evolution with the ever-progressing technologies along with new inventions and discoveries in the fields of Artificial Intelligence, IOT and other technologies have been discussed on comparative grounds. The strongly emphasized area in the proposed book is the current trends in AI, machine learning, and IoT. Industry automation has become a key issue for manufacturing companies. The strategies, principles, and broad applications of different automation plans and the relevant research in this area have been explored much meticulously with maximum thrusts given to the intelligence domain and research carried out there.

There are some important practical implications of the book for manufacturing companies, which are presented below.

Research on planning and strategizing in the field of intelligence and IOT, and in allied fields like healthcare, smart cities, electrical grid industries, etc. can broaden the economic benefits of the industries to greater extents. Several optimization techniques will obviously be of great help to the manufacturers in industries as these will effectively manipulate the resources and raw materials for improved and large-scale production purposes and technological growth.

Keeping in mind the research students of different streams of engineering domain, some additional aspects have also been addressed in this book. The most emphasized aspects are listed below.

1. Each chapter of the book contains relevant papers specific to the topic with the elucidation of problems.
2. Many references provided at the end of the chapter will be beneficial to the readers of the book.
3. Many website links relevant to the subject matter have been shared at the end of each chapter.
4. The problems related to the chapters have also been addressed with programs written in the Python language.
5. The broad discussion of all the concerned and relevant domains in the field of automation has been carried out with much deeper insights into the field of research.
6. Case studies related to different manufacturing companies addressing the real-life aspect of the industry have become the main feature of the proposed title.
7. All the up-to-mark and modern technological growth factors controlling the pathways of automation in human lives and industries have been broadly touched upon.
8. The extensive reviews of each of the technologically escalated research domains and the insights into the domain-specific aspect of application have become the primal focal and thrust area of this book.
9. The generalised concepts and specialised approaches in the concerned research domain have become the unique characteristic feature of the book.

The overall content of the book is divided into three different tiers. Fundamental, functional and advanced tiers. The fundamental tier caters to the students and comprises the basics of the subjects. The functional aspect on the other hand is broader with the advanced part more analytic and meant for the researchers and professionals.

We must express our sincere thanks with loads of acknowledgements to our colleagues, friends, and students for their innumerable valued suggestions and feedback to develop this book in the present shape. We must express our heartfelt gratitude to our family members, as without their support and patience, this book would have been an impossible task. Lastly, we must be very grateful and thankful to the editors of Bentham Science Publishers.

We wish every reader an insightful, perceptional, and informative journey into this book, presenting you the world of IOT and AI from different human perspectives, with respect to different societies and industries as well.

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CHAPTER 1

Advanced Rival Combatant Identification with Hybrid Machine Learning Techniques in War Field

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Abstract: This research shows how Hybrid Machine Learning (HML) techniques may be used in real-time to identify an Army's personal fighting zone or any other specified location in order to reduce safety risks *via* the detection of an invasion or enemies. Deep Learning (DL) techniques, such as Faster R-CNN, YOLO, and DenseNet, were used to find employees, categorize objects, and detect subtle characteristics in a variety of datasets. Testing showed that a 95% recall rate and a 90% precision rate were possible. This indicates high detection. A cleanness of 85 percent and a correctness of 80 percent were achieved in a real-world construction site application. To some things up: The recommended approach may enhance current safety management methods in conflict zones, borders, and beyond.

Keywords: Convolutional neural network (CNN), Deep learning (DL), DenseNet, Hybrid machine learning (HML), R-CNN, YOLO.

INTRODUCTION

Identifying the Army or the adversary is an essential component of combat. A fighting zone's potentially lethal nature makes it difficult for onlookers to pay

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attention to the movements of the adversary. The application of state-of-the-art Deep Learning (DL) base Machine Learning (ML) algorithms like DCNN, Fast R-CNN, as given in Fig. (**2**), and others aims to enhance computer graphics to identify individuals. Long-standing problems with combat zone safety monitoring might be addressed with it.

Deep learning (DL)-based computer vision surveillance systems for the detection of dangerous behaviour have already started to be developed. However, there are still problems with the visual recognition systems that are currently in place. A number of factors influence the ability to detect dangerous behaviour in the field of battle as shown in Fig. (**1**), including:

1. The need to detect unsafe conduct in real-time,
2. The difficulty in identifying small indicators that are important for safety management, and
3. The difficulty in recognizing small indicators.

Fig. (1). A few examples of blurry or otherwise undetected photographs of soldiers brandishing firearms.

There are several aspects that contribute to the dynamic and complicated environment of the combat field region, including moving equipment and armed people, changing temporary facilities, weather conditions that impact computer visualization, sunshine and shadows that change video photographs, *etc*. When a hazardous behavior is seen in a combat zone, it is not uncommon for an accident to occur quickly, negating the importance and use of the data collected.

It is difficult to do real-time visual recognition because of the computational efficiency of the visual recognition algorithm and the hardware that implements it. The present DL-based visual recognition algorithms paired with GPU processing devices are generally the bottleneck for real-time unsafe behavior identification because of the time it takes to correctly analyze the types of behavior (especially the minor feature alterations of target photographs) (*e.g*., army personnel or moving equipment).

Despite the use of additional techniques, the findings are still inconclusive. For the most difficult characteristics to be found in a target picture, one must concentrate on the more subtle ones. But the tiniest differences in an image's properties may often identify the difference between an army and an invading force.

Traditional CNN algorithms are reasonably fast in detecting features in a bounding box, but subtle characteristics are far more difficult to recognize. When it comes to modest variations between features in a photograph, YOLO techniques, which employ regression to identify attributes, are useless. To find the exact placement of anything inside a huge picture frame, DenseNet is less efficient than other algorithms but is quite successful at recognizing the subtle deviations in an image's properties.

AIM OF THE STUDY

The aim of the study is to find a way to establish an advanced rival combatant identification system with hybrid machine learning techniques in the war field.

MOTIVATION FOR THE STUDY

It was in June 15, 2016, that the National Science and Technology Council (NSTC) Subcommittee ordered the subcommittee on networking and information. Due to artificial intelligence military, which allows systems to become more autonomous, military strategists have a tempting sight of combat success but weapons and countermeasures that would be employed against them are yet unproven.

Rebuilt and streamlined armies in Russia and China are aiming to surpass the United States in the future *via* increased investment in weapons development. There are several factors that go into determining how these new weapons are to be used in the future, and doctrine is one of them. When a country has the false belief that it can win a fight due to an improvement in weapon design, this lowers the bar for a war to break out. We will increasingly rely on these systems to fight, suggest, and ultimately make judgments as wars become more prevalent.

CHAPTER 2

An IoT Based Battery Condition Monitoring System for Electric Vehicles

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Abstract: A brushless DC (BLDC) motor-based three-wheeled vehicle, known as three-wheeled battery-operated vehicles (TWBOVs), is a suitable alternate to public transportation. The TWBoVs are not only providing efficient short-distance transportation but also are a source of employment generation since 2008 in rural India. The TWBoVs operate mainly through the flooded lead-acid battery. To get the full benefit of lower operating costs, the life, and efficiency of the battery are important aspects. In such a scenario, battery monitoring and management for battery-operated vehicles are a prime aspect. Proper battery management and monitoring enhance the durability of the lead-acid battery in TWBoVs. In this chapter, the monitoring and management of Lead-acid batteries using the Internet of Things (IoT) is capitalized. Depending on the survey in rural Bengal, it is observed that the battery life cycle depreciation process needs to be decreased by properly monitoring the condition of drive-train of TWBoVs and the lead-acid battery ampere-hour discharge in the random drive cycle. A newly applicable design regarding the state of charge (SOC) estimation of the batteries along with terminal voltage and current measurement under different depths of discharge phase has been implemented through IoT-based real-time monitoring system. This developed system relates the distance traveled (in kilometers) by the TWBoVs with the condition of the battery concerning its SOC on an online basis *via* a Wireless battery management system (WBMS). Experimental analysis through hardware setup and simulation proves the feasibility of the approach in terms of battery utilization and monitoring.

Keywords: Depth of Discharge (DoD), IoT, State of Charge (SOC), Three-wheeled battery-operated vehicles (TWBoVs), Wireless Battery Management System (WBMS).

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INTRODUCTION

The battery is the most elementary component of electric vehicles [1] which is responsible for sustainable mobility. The performance of any electric vehicle depends on the operational characteristics and driving range of the battery. The performance of the battery is solely based on the reactions of the chemicals inside the storage cell battery when it is connected to a load [2]. The lead-acid battery is the oldest in the market today having extensive use in portable power systems and accounts for over 40% of the battery sales to date [3]. Its dependability and relatively lower cost have kept it in the spotlight for the diffusion of TWBoVs in rural and suburban areas of India [4]. In the case of a lead-acid battery, the electrolyte degrades with time and usage, reflecting the gradual reduction in the ampere-hour capacity of the battery. The battery selection and its resultant utilization are of paramount importance. In battery-operated vehicles, the cells are connected in a series or parallel combination to build up high-voltage and large-capacity battery packs. Factors causing battery voltage variation includes the deep discharge of the battery under different drive train, maintenance procedure, and aging. Due to unpredictable demands, the batteries are subjected to electric and thermal ill-treatment in various drive trains. Battery charging techniques [5] include the estimation of SOC, charging control optimization, fast charging technique, and series-connection method. SOC is defined as a ratio of current capacity to the maximum amount of charge that can be stored in the battery. The state of health of batteries depends on C-rate charging and discharging [6] and reflects the current capability of a battery to store and supply energy relative to that at the beginning of its life. It is calculated as the ratio of usable capacity to a depth of discharge and actual capacity. In general, for applications where the available energy in the battery plays a fundamental role, such as TWBoV, the remaining capacity is often calculated from the depth of discharge (Ah) which primarily accounted for the kilometer traveled for the drive cycle under the prescribed load and TWBoV dynamics. Most flooded Lead-acid batteries are considered to be at their end of life and therefore sentenced to replacement when they reach 80% of their initial, fully charged amp-hour (Ah) capacity or when their internal resistances double [7]. Over-discharging the battery for rapid variations in the tractive force created by the motor to overcome the vehicle's uphill and rolling resistance induces transient short circuits in the battery, reducing battery capacity [8]. Therefore, the prognostic of battery health concerns the overall performance of TWBoV to cover maximum mileage per kWh consumption and, therefore the removal of driver range anxiety as well as improvement of profitability. To ensure energy availability, and safety, preclude undue damage and prolong the lifetime of the battery, a real-time monitoring system is required [9]. To prevent the aforementioned problem, the battery management system [10] with a user monitoring interface can inform the user in real-time about the battery ampere-hour discharge, SOC status, and terminal voltage. This chapter proposes and evaluates real-time monitoring of several lead-acid batteries using the Internet of Things. A Battery Monitoring System is a smart system that monitors the vigor of a battery module. Our developed system computes the battery DOD, terminal voltage, current, remaining safest kilometre, and remaining charge capacity while operating in real-time drive-train and provides the information to the user in real time. Because each battery is examined individually, any deterioration can be detected and relevant warnings against the values pre-set by the server, and protective actions can be implemented, thereby extending battery life.

RELATED WORK

In India, passenger mobility is primarily reliant on the road, which accounts for 87 percent of all travel [11]. Three-wheelers, which are primarily used for hauling carrier goods and have become the major means of last-mile public transit, are preferred by 75% of Indians. According to a study conducted in many Indian cities, particulate matter 2.5, black carbon, and organic carbon are the most significant pollutants produced by diesel and two-stroke autos. Transportation emissions are a major cause of pollution in developing countries such as India. As a result, the Indian three-wheeler industry is shifting to the use of electric vehicles to reduce emissions [12]. The three-wheeled battery-operated vehicle (TWBoV) is a recent addition to the transportation sector in the twenty-first century, particularly in rural India. The proliferation of TWBoVs in rural India has a socioeconomic impact [13], accelerating the creation of jobs for rural unemployed people and thereby improving the rural economy's human development index [14]. The human development index (HDI) is the scale of measurement for development in a society or a nation. This index is the algebraic sum of three indices namely educational level, life expectancy, and income level described by the authors [15]. With the improvement of the standard of living the consumption of energy has become much more, thereby contributing additional load of greenhouse gasses. From the World Fact Book, the detailing about the net increment of primary energy consumption and corresponding per capita per year CO_2 emission in the atmosphere is obtained. Researchers have analyzed the feasibility of battery-operated autos as an alternative transport by analyzing power consumption, effects on national electricity supply, reduction of unemployment and socioeconomic aspects of people involved with it. An investigation of the apparent discrepancy between the purchase price and the Total Cost of Ownership (TCO) between internal Combustion Engine Vehicles and Battery Operated Vehicles [16] has already been conducted. Researchers [17] made a cost-competitive study between battery electric vehicles and internal combustion engine vehicles based on the total cost of ownership computation. In this era of

CHAPTER 3

IoT Covid Patient Health Monitoring System

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Abstract: Lack of healthcare or inaccessibility of doctors and caregivers is a major concern. The increase in COVID-19 patients is putting tremendous pressure on hospital management in urban areas. Therefore, the development of IoT (Internet of Things) based patient monitoring systems allows doctors to obtain patient data from remote locations. The Internet of Things is an evolving technology that takes healthcare to the next level by providing affordable, reliable, and convenient devices that can be carried or embedded with patients. There is a growing interest in wearable sensors and medical devices. Therefore, wearable monitoring systems will take patient monitoring to a new level. The IoT allows various devices to be connected over the Internet. Data is collected using sensors and sent to the cloud *via* IoT channels, where both patients and doctors can access the data (real-time and historical) through a variety of devices. Any deviations from the norm will result in alerts being sent to both doctors and patients. This enables doctors to monitor a large number of patients at once.

Keywords: IoT healthcare, COVID, Health monitoring, Remote patient monitoring.

INTRODUCTION

The Internet of Things (IoT) can interconnect different objects and sensors can be added to them to provide a certain level of digital intelligence to the device. By integrating the digital universe and the physical universe, we make the world around us smarter and more responsive. This enables things to be retrieved and handled remotely using existing network infrastructure, allowing for more direct interaction between the real world and computer systems, resulting in increased efficiency, accuracy, and cost savings. IoT-based systems use sensors, IoT gateways, and applications to support patient monitoring.

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Health condition monitoring is a technique that allows you to actively monitor system or structural integrity during operation and throughout its useful life to avoid failures and reduce maintenance costs. The suggested system uses non-invasive sensors to monitor COVID-19 patients' heart rate, blood pressure, and body temperature. It collects information and sends it to the IoT over a wireless connection as it requires continuous monitoring. The doctors can determine the patient's condition and treatment remotely and can treat more than 500 patients. The system enables the use of IoT, sensors, and microcontroller programs, providing better user interaction and efficient information transfer.

The idea is to support medical staff and physicians in the continuous monitoring of patients who are not completely bedridden, while at the same time providing information about their physical condition, reducing mobility, and improving comfort.

RELATED WORKS

NilakanthaPaudel *et al*. [1], have proposed an IoT-based patient monitor where the sensors collect real-time data, which is delivered to the IoT gateway, which does basic computations before sending it to the main server in the cloud. It states that computations should be performed on the received data to provide meaningful results based on different analytical tools and techniques.

Jose Alfredo Alvarez Aldana *et al*. [2], have proposed a distributed monitoring architecture that has a consensus method that allows it to aggregate and offer more accurate and relevant results. This design can yield promising results with higher precision, and the consensus mechanism utilised here allows various nodes in a network to work together as a cohesive group.

Mainak Adhikari *et al*. [3], recommended a rule-based regulation on local edge devices to detect a patient's risk factor instantly. It shows that employing multiple data mining techniques to build a more refined dataset for COVID-19 illness prediction could improve the efficacy of the data fusion strategy.

As the clinical manifestations of corona viral infection are high fever, fatigue, and difficulty breathing, Hafsiya T.H *et al* ., [4] created a handheld physiological pre-test that was conducted based on IoT to closely monitor the patient's heart rate, temperature, blood oxygen saturation, and blood pressure. It allows remote collection of data and transmission, thereby preventing disease spread and providing an effective solution to the patient's condition.

Hoe Tung Yew *et al*. [5] created an IoT-based real-time remote patient monitoring system that ensures the integrity of real-time electrocardiograms (ECGs) and transmits data to a web server *via* Message Queuing Telemetry Transport (MQTT). This enables zero package loss and packet error in both local and wide area networks, and it supports both real-time and store-and-forward modes. It also does not necessitate a high-quality network.

Mwaffaq Otoom *et al*. [6] created an IoT system to collect real-time symptom data from users in order to detect probable coronavirus cases. This enables us to track the treatment response of patients who have already recovered from the virus while also forecasting the treatment response of confirmed cases and learning more about the COVID-19 disease's characteristics.

Ibrahim Kareem Hanoon *et al*. [7] presented an inexpensive IoT-based application that helps patients check their health status by permitting clinicians to remotely monitor this information, with the goal of reducing the risk of COVID-19 virus transmission. According to the article, an Arduino-based device with sensors can be used to transfer data to a cloud server since it enables faster and more convenient diagnosis and supports a wide range of procedures.

Hasan K. NAJI *et al*. [8] established a system that offers access-monitoring services to COVID 19 mild-to-moderate symptoms and those who are in home quarantine. It claims that an alarm system that alerts healthcare personnel about abnormal readings and can reduce infection spread by avoiding contact between health professionals and the patient.

Geetanjali Rathee *et al*. [9], developed an ANN model for health monitoring and examined the findings with a biological scrutinizing method using BP, BR, and Viterbi algorithms to depict COVID-19 patients' progress and do monitoring in a timely manner. For specific patient categories, it is said to offer higher accuracy and a faster response time.

Olutosin Taiwo *et al*. [10], presented an example of a good home health assistance system to track patients' health and receive prescriptions from doctors while they remain at home. It recommends an Android-based mobile application that interacts with a web-based application for effective patient-doctor dual real-time communication, as well as sensors for automatic recording of patients' vital parameters.

METHODOLOGY

The solution we propose is an Internet-of-Things-based healthcare monitoring system that allows many COVID patients to be monitored remotely over the Internet. The system includes heart rate sensors, temperature sensors, and blood pressure transducers to monitor a patient's heart rate, temperature, and blood

CHAPTER 4

Artificial Intelligence in Healthcare

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Abstract: Artificial intelligence (AI) is referred to as machines that can mimic human cognitive functions. It usually engages various digital methods starting from computer programming to deep learning, thus making use of the enormous structured and nonstructured healthcare data. Artificial intelligence is gradually making a change in medical practice by using sophisticated algorithms, assisting clinicians to mitigate diagnostic and therapeutic errors and also using data intensive analysis for early diagnosis of various diseases.

The chapter provides us an insight into the relationship between artificial intelligence and healthcare, origin of artificial intelligence, different categories of artificial intelligence and its applications in our healthcare system, various diseases for screening as well as prognostic evaluation and eventually the issues pertaining to the implementation of AI in medical devices.

The main focus is on the two major categories of AI which includes machine learning and natural language processing. The former analyses the structured data such as genetic or electrophysiological data while the latter deals with unstructured data such as medical notes. In medical practice deep learning is mainly used to explore more complex data. Cardiovascular health, neurological deficits and cancer are the most challenging topics in AI.

AI technologies have created a stir in medical research yet it is facing various hurdles in the form of regulations and data exchange. Thus, ethical and legal concerns need to be addressed before the deployment of AI in the market.

Keywords: Biomedical signal, Deep learning, Data analysis, Electronic medical record (EMR), Electrophysiology, Machine learning.

INTRODUCTION

Artificial Intelligence (AI) has conquered every part of our lives starting from food delivery, face and fingerprint recognition for personal security purposes, the

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availability of smartwatches, growth of upgraded mobile phones and generation of various health-related applications. The complete diagnostic process in the healthcare industry, with present exponential growth in imaging technology, smart robotics and implants, thus makes it a proliferative platform for the application of AI. Our chapter takes the readers through the journey of AI in healthcare starting from its roots to exploring its prospects [1, 2].

Evolution of AI

The concept of AI originated from the paper published in 1950 titled ‘Computing Machinery and Intelligence’ by Alan Turing. Later in 1955, John Mc Carthy of Dartmouth University along with his colleagues officially proposed the concept of Artificial Intelligence (AI) holding a two-month workshop. Initially, there were periods called AI winters when algorithms and machine learning were deprived of proper funding though later there had been a huge evolution of AI and Machine Learning (ML) alications in the healthcare industry [3]. The various evolutionary stages of AI are summarized in Fig. (**1**).

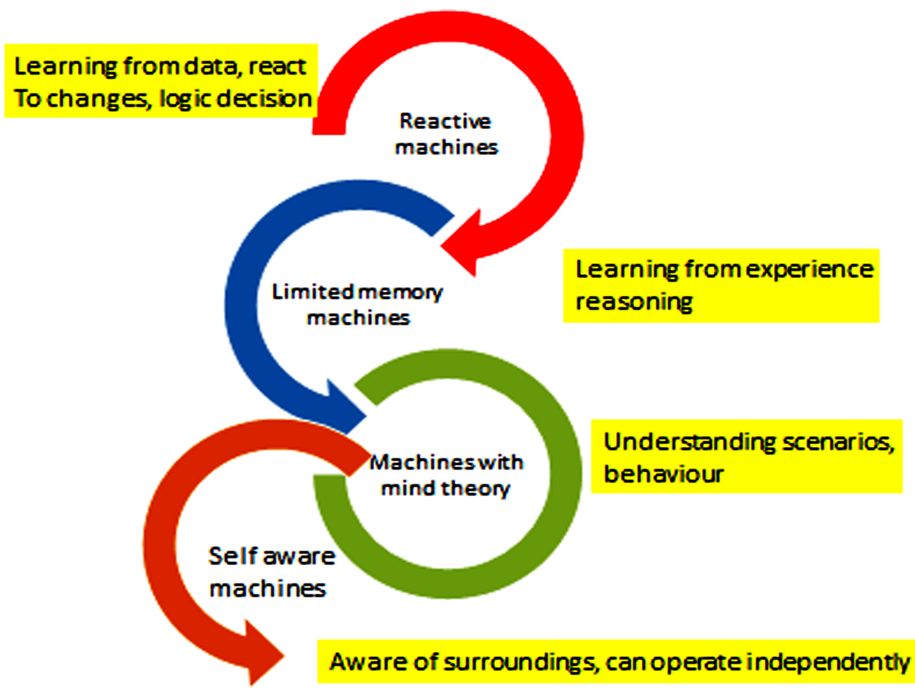

Fig. (1). Evolutionary stages of AI.

Concepts in AI

AI is defined by Mc Carthy as ‘the science and engineering that ties to make machines intelligent’. In other words, the complete goal of data acquisition, interpretation, reasoning, and processing of various information retrieved from data is to be achieved by certain systems designed by human beings. Now the question arises of how this system captures the data and further processes it [4, 5].To understand this, we have to know about the main elements of AI systems as illustrated in Fig. (**2**).

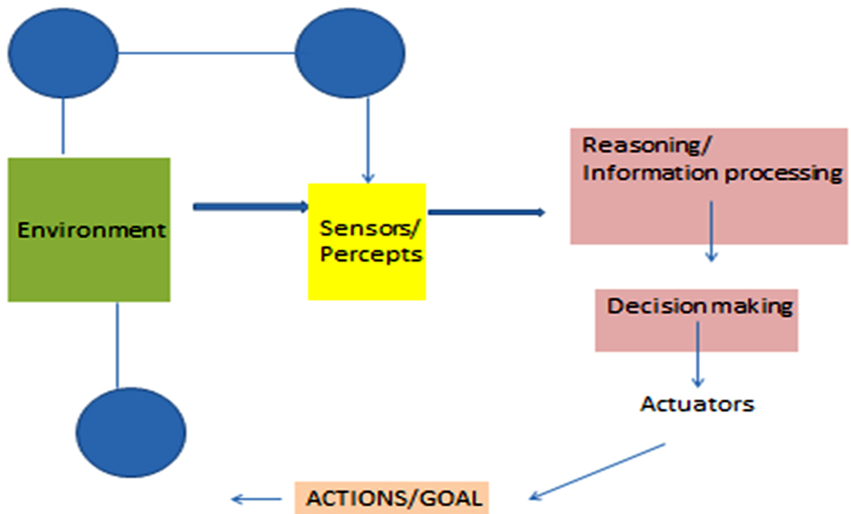

Fig. (2). Main elements of AI system.

The concept of 'agent' is very important in AI, as identified by Russel. The agent interacts with the environment through its sensors or percepts thus referring the input data to the processor for further reasoning and acting to accomplish the goal as guided by the input data. Here the desired action will resemble the exact human intelligent behavior [6].

CURRENT AREAS OF AI

Some of the established areas within AI are as follows:

- Reasoning- Here the algorithm is used to make use of symbolic rules and optimization of a problem is done to respond to the queries which arise from the input data.
- Learning- Machine learning does not adhere to symbolic rules to interpret data, rather the raw data need to be processed and interpreted to prorate the necessary outputs, as shown in Fig. (**3**).

CHAPTER 5

Image-Based Plant Disease Detection Using IoT and Deep Learning

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Abstract: Plant diseases act as a major threat to the both economy and food security of any nation. Despite being of such importance, the identification of plant diseases and approaches deployed to tackle them are mostly conventional/ traditional ones. Incubation of technology and advancement in computer vision and deep learning models have opened new ways for developing much better approaches to tackle such issues. In this work, the native plants of Jammu and Kashmir are taken into consideration. An IoT-based framework is designed for data collection and disease diagnosis. The data involves both diseased and healthy leaf images. A hybrid deep neural network is trained to identify the plant species as well as the diseases associated with it. The trained model achieves an overall accuracy of 96.35%. A comparison with other state of art approaches is also presented, along with suggestions for some related future developments. This approach can be deployed on a global scale to tackle plant diseases and to achieve global diagnosis.

Keywords: Computer vision (CV), Internet of things (IoT), Machine learning (ML), Neural networks (NN), Precision agriculture (PA), Rarefied flow.

INTRODUCTION

Diseases wherever they are present pose a challenge and threat to the overall growth and development. The diseases in plant leaves act as a major threat to agricultural production, as they not only hinder crop growth, but also diminish the overall economic value of the plant. Various factors are also accountable for affecting plant growth. Countermeasures are developed by plant pathologists to cater to these issues. The major deformities in plants are initiated by maladies and disorders where the major inlet sources are biotic factors like living organisms such as fungi, bacteria, algae and viruses and abiotic factors like temperature, moisture, nutrient deficiency. These factors interact with the overall process of

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plant growth like translocation, photosynthesis, *etc*. Appropriate and timely diagnosis of plant diseases can help in the prevention and control of plant loss. An institute named Integrated Disease Management (IDM) is responsible for handling the technical, mechanical, and biological aspects of monitoring and preventing the losses that occur due to pathogens [1, 2]. However, human interaction acts as an influential tool for noticing diseases, however, it is a very costly, tiresome and time-consuming method. Also, it is prone to certain human errors if one is not basically very much aware of the diseases and plant types.

Hiring an agronomic and plant pathologist is not a recommended way for everyday diagnosis as it is not cost-efficient. Therefore, shifting the way of taking assistance from a human expert to designing a machine which is capable of working as an expert can be much of a relief [3]. In this case, the Internet of Things and devices such as sensors, cameras, and mobile devices are used to develop an expert system for the timely diagnosis of the plant disease and type of the plant. In this work, a plant disease detection system is developed with concepts including IoT, ML and Image Processing.

The suggested study is motivated by the desire to:

1. Install a low-cost, real-time cloud-enabled system for disease detection from leaf images that require minimal human work.
2. Introducing artificial intelligence, smart devices, and the concepts of plant pathology technologies, which will serve as the foundation for precision agriculture.
3. Using the learning and optimization capabilities of neural networks and nature-inspired algorithms for the recognition and classification of diseases.

The following is the order and structure of the article. The introduction section is followed by related works, and the next section discusses the plant and the disease chosen for the study. It also reflects on the economic and medicinal importance of the plant. The next section named material and methods consists of the various methods and algorithms used in the proposed study, followed by the proposed work implementation and results.

RELATED WORK

Classification of sunflower leaf was done by developing a generalized softmax perceptron neural network and probability model selection algorithm. Ubbens *et al*. [4] in their work presented four stages *i.e.* segmentation using an RGB color model, followed by feature extraction, feature selection and then counting of the leaves using a neural network. Rosette plants were counted in this work. Both synthetic and real images of the plant were used in the experimentation of the proposed work. Augmentation plays a major role in this work as it helps in avoiding the chances of overfitting and underfitting. Liu *et al*. [5] demonstrated a neural network-based application for detecting fungal diseases on rice plant leaves. Principal Component Analysis (PCA) and vector quantization strategy are then used for the purpose of disease classification. Zhou *et al*. [6] introduced another unique sugar beet disease detection approach based on an OCM-based algorithm. SVM was also utilized by the author to classify the disease. Padol and Yadav [7] used a k-means algorithm to extract characteristics from images and SVM for classification to identify the grape leaf image disorder. The 'Web-Enabled Disease Detection System (WEDDS)' was offered by Aasha Nandhini *et al*. [8], to classify and detect the illness of plants from the plant leaves. The planned work was made real time by including a Raspberry Pi 3 board, which followed the IoT platform's mechanism. Finally, the SVM was used for disease classification in the image. In a study by [9] Kaur *et al*., the amalgamation of image processing techniques and a support vector machine algorithm was used for the classification of different categories of diseases from the plant leaves images. The picture segmentation procedure was carried out using the k-means method, while the feature extraction process was carried out using Grey Level Occurrence Matrices. Furthermore, SVM was employed in the classification of diseases.

Camargo and Smith [10], based on color images, proposed a model for plant disease detection and analysis. In the proposed work, the RGB image was converted into 'H, I3a, and I3b' color conversions. They focused their work on the detection of disease in the Banana leaves. Segmentation performed based on the histogram's intensity level is another benefit of the suggested work in detecting abnormalities with different intensity distributions. Dengwei Wang *et al*. [11] concentrated on pests and insects as a concern. The authors proposed an IoT-based methodology for early detection of pests and diseases based on visual references. To model design, the rough set theory algorithm and NN were utilized. For accuracy and efficiency, the suggested model was compared to current models. Three different levels of services *i.e*. connection, platform, and service were set up by the authors Sanjeevi Pandiyan *et al*. [12] in their proposed work. They developed an original platform that adopted an "Advanced Segmented Dimension Extraction (ASDE)" method for disease segmentation and Heterogeneous Internet of Things (HIoT) technology in setting up a network. The proposed work is efficient in collecting images of apple plants in real-time and also segments diseases like fungus, and bacteria. An early disease detection system for rice fields was developed by Nuttakarn Kitpo and Masahiro Inoue [13]. Drone-based IoT architecture was created with real-time data collection capabilities. GPS sensors were utilised to map the locations of drones in the fields. The device may provide the analytical data as well as the location of the plant

CHAPTER 6

Artificial Intelligence (AI): A Potential Technology in Healthcare Sector

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Abstract: In the present scenario, the contribution of Artificial intelligence (AI) has enhanced considerably in several fields including the healthcare sector. This growing technology has a bright future in medical research as well as in early disease diagnosis and its treatment by minimizing the risk factors and severity. Artificial intelligence is applied in a very smart way so as to make it a more superior and competent technology in comparison to the human brain *e.g*. by using AI, a robot makes the surgery in a more efficient way than a surgeon by reducing any possibility of failure and severity. Nowadays, AI has evolved as the most competent technique that helps patients and cares for them more efficiently by reducing the cost.

To work more effectively and precisely, AI requires instructions in the form of sets of algorithms. Two major key factors required for AI include natural language processing (NPL) and machine learning (ML). Both these techniques are required to fulfill the various tasks and challenges in the field of the healthcare sector. In the present chapter, an effort has been made to explore the advancements of AI in different fields of the health care system including radiology, dermatology, designing of novel drugs, and the early diagnosis and treatment of various deadly diseases like cancer and neurological disorders.

Keywords: Artificial intelligence, Healthcare, Machine learning, Natural language processing.

INTRODUCTION

Artificial intelligence (AI) is an emerging and rapidly growing computing discipline, and the search of deep learning techniques with lower energy overhead and processing resources appears to be moving machine learning towards AI. Despite the constant debate about AI replacing doctors, it is clear that AI is still in its early stages of development, and until an AI singularity occurs, it is safe to assume that AI will not replace physical doctors anytime soon [1].

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However, AI has the potential to revolutionize the way doctors make clinical choices, as well as the diagnosis and prognosis of various medical problems. As a result, AI may have the ability to replace human judgment in certain fields of medicine, such as radiology. Despite the fact that designing and implementing such technologies appears to be science fiction, the ongoing expansion in healthcare data, as well as the rapid development of big data analytics, will continue to drive AI applications in the healthcare business. Successful AI implementation can unveil latent clinical patterns within huge healthcare data, when used in conjunction with big data and the right optimization method. As of today, there's a good likelihood that some people in Australia or China will need emergency treatment for conditions that occurred in Cuba.

AI may be able to recommend successful medicines that have been previously delivered using pooled big data under the auspices of healthcare cloud platforms, reducing the amount of time required for diagnosis [2]. Such a system would be crucial and successful in making decisions and giving therapies in circumstances where death might otherwise be the result.

Given the significance and role of AI in healthcare and the future of medicine, it is critical to examine and investigate the current state of AI in healthcare while also evaluating its future applicability. The investigation comes as Industry 4.0 and its concepts continue to revolutionize several industries. Wireless sensor networks, for example, make use of the Internet of Things (IoT) to collect data in real-time while also allowing doctors to watch patients remotely [2]. In light of these possibilities, it is sufficient to provide research updates and current status on AI development, implementation, and application in the healthcare industry. The survey also looks into the reasons for utilizing AI in healthcare, the sorts of data that AI systems need, the methodologies and algorithms that AI systems need to generate actionable clinical outcomes, and the diseases that AI is now assisting in the detection, diagnosis, and prognosis processes.

TYPES OF AI

Artificial intelligence consists of three components namely deep learning, machine learning, and neural networks. Machine learning with the aid of artificial intelligence, enables the system to learn based on knowledge and experience *i.e*. being preprogrammed. Various types of learning processes are shown in Fig. (**1**) along with how such model/algorithm is trained:

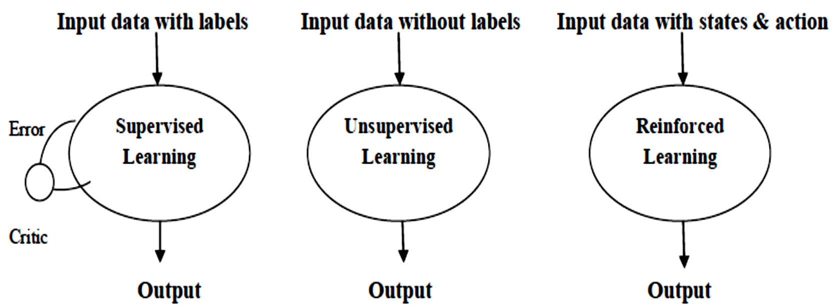

Fig. (1). Types Of machine learning process.

- Supervised type of AI
- Unsupervised type of AI
- Semi-supervised type of AI
- Reinforced type of AI

Supervised Type of AI

Supervised learning is the type of machine learning process that learns from back history and relates it to the advanced data set by applying labeled examples. For doing this, the result of the algorithm is required *i.e.* already known, while the data problem is used to enable the model with the right answers. With such outputs, the algorithm compares both the outputs and make the final decision in the form of output *i.e.* is final result [3].

Unsupervised Type of AI

In an unsupervised type of artificial intelligence, no data is required from past history. In this type of AI, no comparative analysis is made between the inputs and the outputs to solve any problem. This is a complicated type of learning and is applied fewer times as compared to supervised learning. This is a complicated type of learning and is applied less frequently in comparison to supervised learning. Neural networks, clustering and anomaly detection are the major components of unsupervised type of learning. Cluster analysis *i.e.* an important component of unsupervised learning is enabling the system to fetch hidden patterns from the data set [3].

Semi-supervised Type of AI

As its name indicates, its characteristics lie between unsupervised and supervised types. This type of AI is used, where the problem needs solution from both the supervised and unsupervised learning. As we discussed previously that supervised

CHAPTER 7

Precision Farming Using IoT for Smart Farming

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Abstract: By 2050, food production is expected to expand by 70% to feed 2.3 billion people around the world. New agricultural farming technology will be needed to feed the growing global population with safe and healthy foods. With this, in the last few decades, we have witnessed a lot of technological advancements in the farming industry. Agriculture is becoming smarter than ever before thanks to the deployment of disruptive technologies like the Internet of Things (IoT). Farmers have enhanced their control over the process of growing crops and rearing livestock due to the many smart farming IoT gadgets available on the market. The Internet of Things (IoT) is generating a lot of excitement in a variety of industries, including infrastructure, automotive, and retail. Precision agriculture is the IoT's most critical use case, yet it is not often discussed. With our globe on the verge of a food crisis, these new technology breakthroughs to boost harvests could prove life-saving. Precision agriculture is gaining traction as a new farming direction through the Internet of Things. In this chapter, we discuss the IoT technologies that are used to increase data quality, and how they are employed in the field.

Keywords: Internet of things (IoT), Precision agriculture, Smart farming.

INTRODUCTION

"Smart farming/Agriculture" is a new name for farm management that incorporates artificial intelligence (AI), the Internet of Things (IoT), automation, and drones to increase the volume and quality of items produced while minimizing the amount of manual work required. The Internet of Things (IoT) has enabled improvements in practically every industry. In agriculture, the Internet of Things (IoT) has changed the way we think about agriculture by not only providing ways to solve time-consuming and tiresome chores but also by completely transforming the manner in which we approach agriculture. However, what exactly is a "smart farm"? A review of precision agriculture and its impact on agriculture is given here. So we can say, that Precision agriculture (Smart far-

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ming) is the application of modern communication and information technology to farm management in order to maximize the amount and crop quality produced while lowering the amount of manual work necessary as shown in Fig. (**1**).

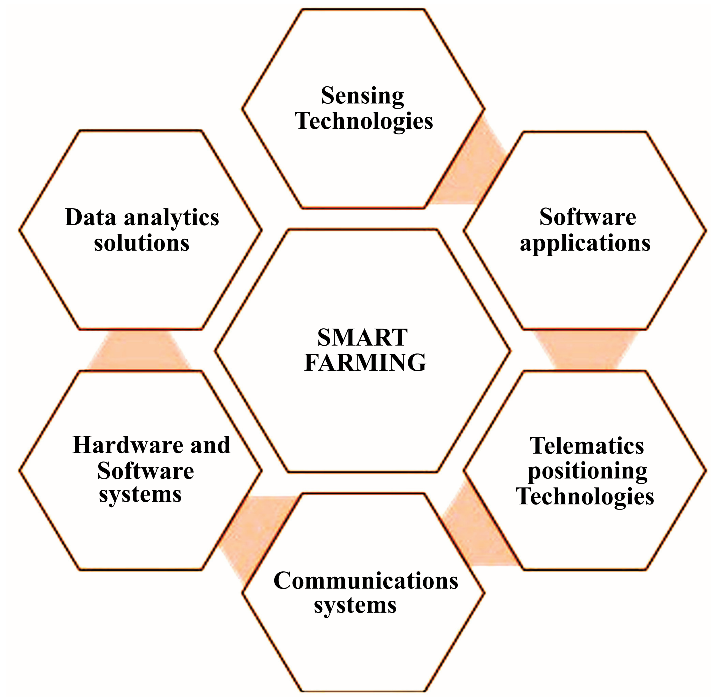

Fig. (1). Showing technologies in smart farming.

Without ever having to set steps in the field, farmers can observe site conditions and develop strategies for the entire farm or a solitary plant using such tools. Smart farming is based on the Internet of Things (IoT), which links sensing equipment on farms to make farming operations data-driven and automated.

LITERATURE SURVEY

According to statistics, the global population increased from 1.65 billion in 1990 to 7.4 billion in 2020. If current growth rates continue, the human population will reach 11.2 billion by the end of the twenty-first century. Individual arable land per person, on the other hand, decreased from 0.5 Ha in 1967 to 0.2 Ha in 2020. As a result of the global population growth rate, it is critical to revise traditional agricultural strategies and policies in order to increase productivity and meet basic human needs all over the world. Global climate change is another major threat to the entire world, particularly the agriculture field (*i.e.*, water scarcity), because water is one of the most important resources for irrigating crops. If it is not addressed properly, it has a negative impact on crop/food availability and the economy of most countries [1 - 5].

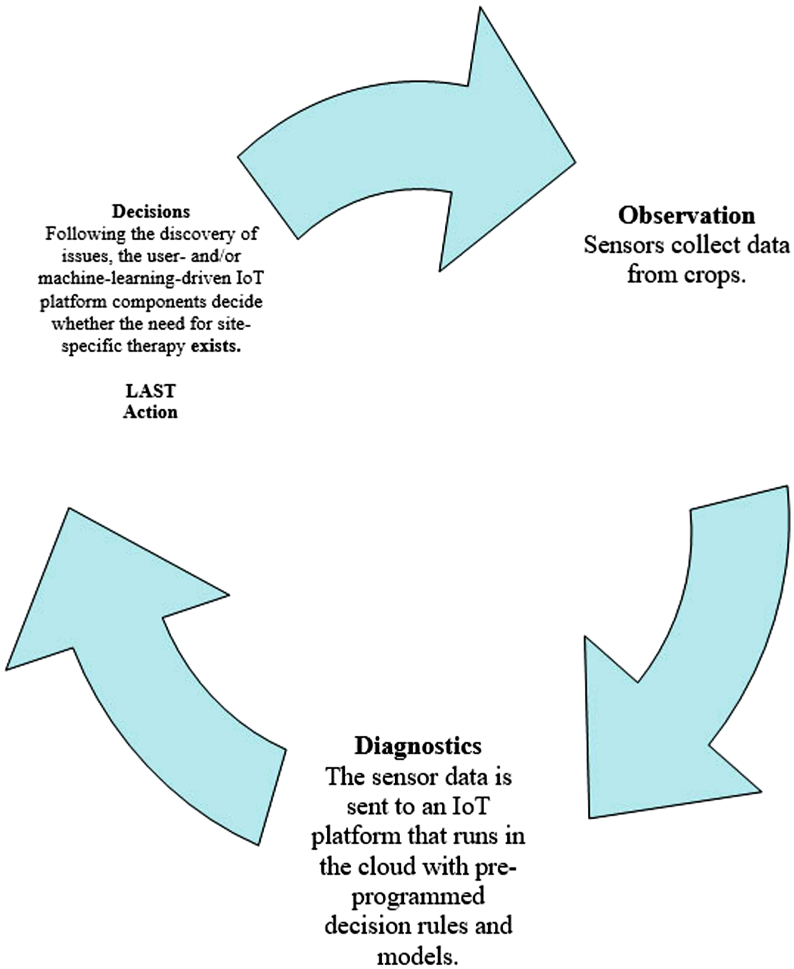

Fig. (2). Showing precision farming technologies that make use of the internet of things.

THE SMART FARMING CYCLE USING IOT

The Internet of Things is centered on the data that can be extracted from objects and broadcast online. In order to enhance the agricultural process, IoT devices installed on farms should collect and process data in a recurring cycle to enable farmers to react quickly to emerging challenges and changes in the surrounding environment as shown in Fig. (**2**).

CHAPTER 8

Impact of Artificial Intelligence (AI) and Internet of Things (IOT) On the Healthcare Sector: A Review

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Abstract: Recent developments in data generation, connectivity, and technology have caused the emergence of Internet of Things (IoT) and Artificial Intelligence (AI) programs in different industries. Artificial intelligence and IOT are strengthening current healthcare technologies whether they are employed to discover new relationships between genetic codes and auto control surgical operations assisting robots. This chapter explores and discusses the various modern-day applications of AI within the fitness domain. This paper studies the influences of IoT and AI in healthcare. Artificial Intelligence (AI) and the Internet of Things (IoT) can assist additionally in replacing time-consuming information tracking techniques. The findings also indicate that AI-assisted clinical trials are capable of managing large volumes of facts and producing exceptionally accurate effects. AI expands systems that assist patients at each stage. Patients' clinical statistics are likewise analyzed by using clinical intelligence, which gives insights to assist them in enhancing their quality of life. This study also highlights key insights into the top technological applications, which include connectivity, diagnosing the disease and discovering its treatment, patient care, defining gaps and further research directions related to modeling, the technology and regulations for data security and privacy, and also systems' proficiency and security.

Keywords: Artificial intelligence (AI), Current trends, Healthcare, Internet of things (IoT), Patients care, Technological innovation.

INTRODUCTION

It has been a few years since the healthcare industry began embracing the new age of information technology to improve diagnosis and treatment methods. Massive amounts of virtual statistics are generated by sophisticated tactics and scientific

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theories. The healthcare industry is in the midst of a major transformation. “As the cost of health care continues to rise, so does a shortage of qualified health care workers? In response to these challenges, the healthcare industry is attempting to embrace a new era primarily based on remedies. Advanced medical applications are the creation of recent advancements in information technology. Improved healthcare is also expected to have modifications to medical management, information improvement, and medical version extensions that are all included as part of these revisions [1]. Therefore, the subsequent changes are focused on satisfying the simple necessities of individuals in order to improve the talent of healthcare which in turn enhances health provider knowledge and suggests the destiny deployment of smart medication. Advanced clinical services are provided by numerous stakeholders consisting of medical doctors, patients, and scientific and studies facilities. For instance, mobile internet, Cloud Computing (CC), massive information, 5G structures, and microelectronics, IOT, and AI, together with smart biotechnology are assumed to be the milestones of the current healthcare sector. From patients' perspective, wearable or portable gadgets may be implemented for tracking their health situation whenever required. Using virtual assistance, they can look for medical advice and use distant facilities to manage their houses from a distance. A smart medical selection guide structure based on the concept of medical doctors can guide and adorn diagnostic procedures.

The Internet of Medical Things (IoMT) is a novel concept that has been gaining traction as a result of the rapid spread and deployment of hardware and clinical sensors for particular healthcare (IoMT). IoT-enabled medical devices and treatment methods are being reworked in order to generate more revenue in the future [2]. Because they do not have it at their fingertips, medical professionals rely on the findings of countless studies, the treatment plans of countless patients, and the cumulative experience of countless doctors [3]. With the advancement of technology and artificial intelligence, this necessitates its use (AI). The cognitive and cultural biases that clinicians are prone to as human beings can be mitigated to some extent, if not entirely, by incorporating a technology balancer into the companies' understanding base [4]. With the aid of surgical tools, combined fact programmers, and artificial intelligence (AI) models, analyses and treatments for illnesses are incredibly effective [5]. AI can be used to enhance clinical decision support systems (CDSS), such as hepatitis, lung tumours, and skin cancer analysis. It is no secret that artificial intelligence (AI) is showing up more and more in the healthcare industry, but the scope of the study is still restricted to particular disease categories (Fig. **1**). Moreover, the accuracy of AI diagnosis has exceeded that of manual diagnosis [6]. The use of the Internet of Things (IoT) in daily life is expanding along with public knowledge of it. As communication technology and information transmission speeds develop, more and more data can be transferred swiftly and efficiently [7]. In a study, although asset management and the mapping of IoT devices and sensors are essential components of a smart healthcare platform [8], threshold computing techniques offer promising ways to improve dependability and responsiveness in decentralised applications (2020). One sector where IoT and AI are having a big influence, either separately or together, is healthcare. This sector is always under pressure to cut expenses while addressing a problem that is becoming worse very quickly.

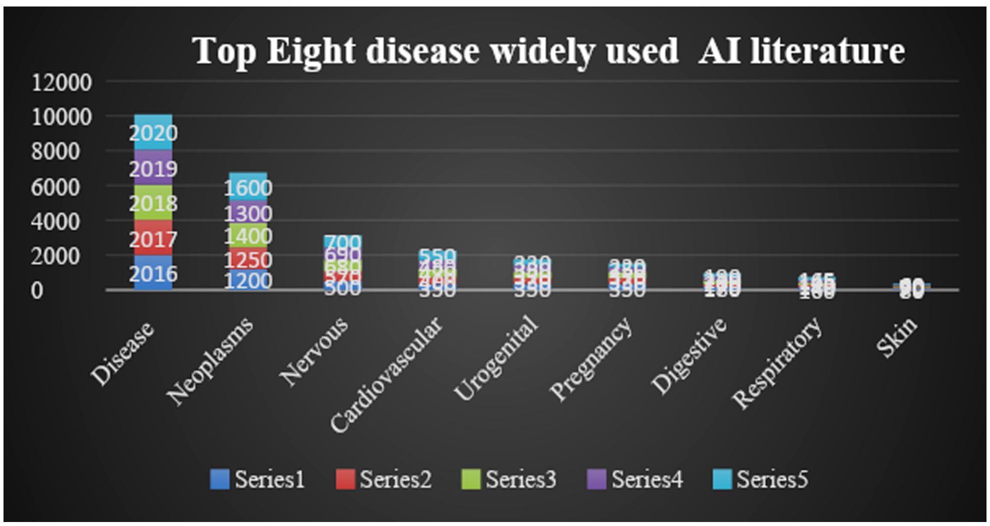

Fig. (1). Disease types are taken into consideration in the artificial intelligence (AI) literature. The assessment is acquired by looking at the disease types inside the AI literature on Pub Med.

There will be huge advantages for patients, physicians, payers, and drug producers as long as the organisation can produce “greater interconnection in a single environment” [9].

Healthcare providers can now gather patient data in real-time with wearable sensors and Internet of Things devices. Systems using Artificial Intelligence (AI) can assist in analysing this data to determine whether a patient's condition has changed, suggest new therapies, and uncover unanticipated findings. This expedites the development of novel medicines, enhances patient outcomes, and assists patients in following their treatment regimens [10]. A significant section of the AI literature looks at records from diagnostic imaging, genetic testing, mass screening, disability assessment, and electro-diagnosis during the analysis stage (Fig. **2**).

CHAPTER 9

Curvelet Based Seed Point Segmentation Methodology Using Digital Biomarker for Abnormality Detection in Fetal Spine Disorder

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Abstract: Objectives: The accuracy and early diagnosis of abnormalities in fetus Ultra Sound pictures will be improved with the use of a novel automatic segmentation technique. An essential area of study for medical AI is the real-time monitoring of prenatal spine disorders. The Internet of Things and medical AI are directly intertwined (IoT). The objective digital biomarker obtained by IoT devices could represent real-time data. IoT and digital biomarkers can be helpful in the spine based on the attributes. Methods: To increase the accuracy of anomaly detection using the K-means segmentation algorithm, the Curvelet-based Seed Point Selection (S-CSPS) methodology was created. Through seed point evaluation, which lessens the speckle and consequently improves the ability to detect abnormality, it is possible to accurately identify regions for each pixel in US images that belong to the objects. Findings: The ultrasound images of the fetal spine abnormalities dataset are used to build the suggested S-CSPS in the MATLAB environment. As part of the performance analysis, various fetus picture numbers are taken into consideration, along with noise levels, segmentation accuracy, anomaly detection rate, and segmentation time. Improvement: The findings of the simulation analysis demonstrate that, when compared to state-of-the-art techniques, the S-CSPS method performs better with an increase in segmentation accuracy and an increase in the rate of abnormality detection utilising digital biomarkers.

Keywords: Choosing the best-fit, Computer assisted diagnosis, Digital biomarkers, Internet of things, Spine, Segmentation using curvelet K-Means, Ultrasound imaging, Wearable tech.

INTRODUCTION

Big data, robotics, the Internet of Things (IoT), and intelligent systems (AI) are all examples of the fourth industrial revolution used for spotting fatal flaws, and they have just been ushered in by technical advancements. Digital image processing,

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radiological imaging, and machine learning are all parts of the CAD architecture. A study has been done on anomalies that arise during embryonic development and call for real-time imaging models and tools for automating image-processing procedures.

In the field of medicine, AI is applicable in three main ways, specifically: Initially, disease diagnosis or treatment outcome prediction using clinical or genetic data. In addition, the disease is automatically diagnosed from medical photographs, and disease prognosis is achieved by tracking biological signals in digital biomarker images. Segmenting spinal structures, classifying disc degeneration, and measuring various spinal curve parameters have been the main focuses of AI in the medical field. Real-time patient monitoring, which is linked to AI, is related to the Internet of Things and digital biomarkers.

In order to automatically segment objects in Ultra Sound (US) images, a technique known as Nested Graph Cut is employed (NGC). Assuming that each pixel refers to a different object in the hierarchical structure, it contains a nested structure with numerous objects. It distinguishes between items that have comparable intensity spectra and borders that are absent. For each nested region, the coefficients are assigned and weighted using a high frequency. A further benefit is that nested objects function well without the requirement for manual selection in the beginning. The rate at which irregularities are discovered is decreased by the incorrect identification of regions that don't belong to the nested items and by inaccurate labels.

The Internet of Things (IoT) is gathered *via* gadgets such as embedded sensors, gateways, clouds, analytics, and user interfaces. Continuous data collection and delivery are accomplished by embedded sensor devices using wireless networks. A passage is vital for delivering the social occasion information from the sensors of different gadgets to the cloud. There is a technology in the cloud that is used to gather, process, and store a ton of data from the devices. Artificial intelligence analytics devices employ unstructured data to extract patterns, and they then send that information back to the user interface. The user interface makes it easier to visualize feedback. IoT systems resemble the neural network of individuals systems of people. Different sensory organs are built into sensors, and the organs of balance are analogous to digital devices. The wireless network is analogous to the spinal cord and nervous system. The human brain is thought to be a cloud of AI.

With the help of digital biosensors, a digital biomarker may reliably measure and gather information on biological, physiological, and anatomical data [3]. The key advantage is that it allows for the measurement of daily changes in patients' lives in a real-time setting, which allows it to more properly reflect the patient's state. There are no restrictions on time or space. A pandemic catastrophe brought on by infectious diseases like COVID-19 could occur again, in which case digital biomarker development will be crucial for the medical industry.

Studying aberrant embryonic brain development involves a technology based on magnetic resonance imaging (MRI). Finding the APS-PTB (Anti Phospholipid Syndrome and Pre-Term Birth) model, exhibits signs of intrauterine growth limitation and inadequate placenta. MRI images have suggested the role of complement activation in placental insufficiency and abnormalities in the brain of the fetus brain. The APS-PTB paradigm, however, was non-intrusive. The term “digital biomarker” refers to APS-PTB data that was digitally collected from patients using IoT devices. As a metric and indication of biological and pathological processes, or as a representation of the pharmacological response to interventions, the biomarker is defined. As a result, the digital biomarker is measured impartially and quantitatively utilizing computerized tools and its results may be predicted for the APS-PTB. The rate of abnormality detection has no bearing on performance enhancement. The diagnosis of brain morphology is normal, but aberrant metabolism was seen.

The objective of this study is to make a fresh out of the box new procedure for dividing images and expanding the irregularity ID of fetal spine illness from US images and computerized biomarkers discovery pictures, which is utilized in segmentation utilizing Curvelet-based Seed Point Selection (S-CSPS) approach. The traditional sensor for computing real work is known as an accelerometer. A wearable gadget with an accelerometer decides the amount of the mechanized biomarker in the spine that is really not totally foreordained. After investigating the similar broadly utilized strategies, the primary focal point of this subject is picking a proper methodology for each phase of the plan. The phases of the proposed strategy change and involve obtaining images, the choice of a seed point in light of a curvelet, and the division of US images utilizing the selected seed point.

The segmentation of fetal spine US images using a novel technique is employed in this work to enhance the detection of abnormalities. For effectively segmenting the fetus spine in US images, the proposed method of segmentation using Seed Point Selection based on Curvelets (S-CSPS) is utilized. Through the examination of seed points, the precise regions for each pixel are first identified. It lessens the speckle, improving the ability to notice abnormalities. To locate the seed point at the next level, the K-Means Segmentation algorithm is used. This algorithm limits

CHAPTER 10

The Effect of the Internet of Things, Artificial Intelligent and Tracking on Smart Transportation

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Abstract: The life of an individual, an organization, and a country depends on the movement of products and services across international borders. International trade follows hallowed transportation lines; any disruption to these channels costs countries, organizations, and people millions of dollars and raises the cost of conducting business internationally. In order to ensure smart transportation, this study examined how artificial intelligence (AI), the Internet of things (IoT), and tracking will affect transportation. The introduction of these technologies (AI, IoT, tracking) into the transportation value chain will lead to smart transportation and improve efficiency in the area where they are introduced. The application of these technologies in the private sector of a developing market was the main topic of our study. 100 respondents were surveyed quantitatively in the private sector. SmartPLS was employed as a technique to clarify the ad hoc interaction between smart transportation and the independent and dependent variables of artificial intelligence, the internet of things, and tracking. The findings of this study indicate that tracking, the internet of things, and artificial intelligence have a good impact on smart mobility. The results of this study provide compelling evidence that smart technology investments are necessary if efficiency is to continuously increase. The findings from this study should help governments and businesses make the necessary investments in IoT and AI infrastructure to benefit from smart transportation, as this is the path to the supply of products and services. While considering smart transportation, it is also necessary to shield it from potential cyberattacks.

Keywords: Artificial intelligence, Internet of things, Smart transportation, Tracking.

INTRODUCTION

The transportation of products and services has been transformed by information and communication technologies (ICT) into what is known as smart transportation or transportation 4.0. IoT and AI integration in the transportation industry's supply chain operations has the potential to have a significant impact on performance.

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The expense and challenges associated with vehicular traffic have been decreased by implementing the most recent technology, which includes vehicle tracking, and this has improved organizational performance. People, products, and services may be transported more effectively to desired locations with the design and implementation of smart transportation systems that make full use of IoT, AI, and tracking. You must first comprehend IoT, AI, and vehicle monitoring in order to understand smart transportation. IoT can be defined as a wide-network extension that allows for little human intervention in the generation, exchange, and consumption of data by giving network connectivity and processing power to physical objects, machines, and sensors. IoT offers remote data administration, analysis, and collection capabilities [1, 2]. On the other hand, artificial intelligence (AI) is the use of machine and deep learning software to comprehend things on a network as devices that may communicate information about themselves, generating enormous amounts of data by optimizing the operation of these devices on a specific network. Transportation is made smart with technology to deliver people, commodities, and services to the delight of customers and consumers by tracking devices en route to a given location. Customers may track goods and services that are supposed to be on their way to them in real time. None of the research included in the literature review is quantitative in nature; the majority are reviews and models. Consequently, there is a knowledge and literature gap that this study aims to solve.

The first of this study's three main goals is to look into the tangential connection between IoT and smart transportation. Productivity depends on devices connected to a specific network interacting with one another to exchange crucial information that enables them to provide goods and services at the appropriate area at the appropriate time. Secondly, to look into the connection between artificial intelligence and smart transportation, and afterward, to look into the connection between tracking and smart transportation. The majority of IoT sensors and actuators were focused on: (i) the primary location tracking system in cloud data centers, which can be managed remotely by retrieving real-time data; (ii) GPS sensors widely used in vehicle tracking systems based on RFID technology; (iii) Wi-Fi networks were the most popular networks, GSM/GPRS and TCP/UDP protocols are the best transport layer protocols; and (iv) the cloud found to be the most popular storage method for smart devices.

According to the study's findings, IoT has a favorable impact on smart transportation. IoT is defined as when objects connected to a specific network or the internet perceive themselves as objects and are able to communicate with one another so they can exchange information. Second, AI has a beneficial impact on smart transportation, and third, tracking has a favorable impact. Future research and policy managers must consider the ramifications of these.

REVIEW OF THE LITERATURE AND DEVELOPMENT OF HYPOTHESES

Smart Transportation (ST)

Smart transportation (ST) refers to the use of road vehicle coordination, remote vehicle service and monitoring, traffic state notification and perception, traffic control and guidance, vehicle scheduling and positioning, and remote vehicle service and monitoring. This technology is supported by several infrastructures, including AI and IoT [3]. Route optimization, parking, street lighting, accident prevention/detection, road anomalies, and infrastructure applications are all included under the umbrella term ST [4]. ST applications can be divided into three categories, including infotainment, road traffic efficiency, and transport safety [5]. An information system that focuses on recording, processing, sending, and maintaining data generated for improved direction is connected to the smart transportation initiatives of a city. By using these tactics, the transportation process can be better planned, thanks to improved data processing capabilities. Once more, the advent of IoT has improved the effectiveness and efficiency of the transportation sector. Input data for smart transportation, according to a study [6] must come from the numerous devices installed in vehicles, road infrastructure, and traffic control infrastructure. Authorities then keep an eye on this data and make sure that commuters, drivers, and pedestrians are informed in a timely manner, helping all parties involved in decision-making. Because ST is more important in creating responsive logistics information systems, machine learning techniques help in identifying demand patterns and developing the appropriate replenishment strategies [7]. Although AI has recently played a big role in ST planning applications, data privacy and personal safety are still issues. Due to these moral considerations, it is possible that government and legal regulations may determine how quickly innovation and adoption occur in this industry [8]. Congestion, safety, pollution, and an increased need for mobility are the main issues with smart transportation. The answer is to use autonomous vehicles to address all of these issues. In terms of security, accountability, service reliability, conveniences, navigational issues, cost of service, and other issues, smart transportation is reportedly dealing with numerous issues that directly affect the development activity of the transportation sector. The increased demand for tracking and IoT is one of the key characteristics of smart transportation.

Internet of Things (IoT)

A collection of devices that are linked to the Internet or other communication networks and communicate data among themselves is known as the Internet of Things (IoT). Thus, by adding sensors and computing power, an object can be

CHAPTER 11

The Influence of Artificial Intelligent, Internet of Things and Cyber Security on Supply Chain Management Performance

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Abstract: The enhancement of supply chain performance is a hot topic in both practice and literature. In order to cut costs and boost efficiency, it is essential to invest in processes that enhance supply chain performance. The interaction between other structures and supply chain performance holds the key to releasing the hidden potential that Supply Chain Management 4.0 holds. The diffusion of "the Internet of Things into supply chain management" would boost productivity and facilitate the supply chain connections that connect industrial input to client delivery of goods and services. Artificial intelligence would improve productivity and efficiency if it were used to supply chain operations, procedures, and activities within and between enterprises. However, putting such devices online runs the risk of exposing performance because of cyber security problems. This paper investigates the beneficial effects of AI and IoT on supply chain efficiency and makes the argument that corporate failings in cyber security might have a detrimental effect on supply chain efficiency. This study employed a quantitative study with 91 respondents from organizations that substantially rely on supply chain operations. To determine the arbitrary associations between the independent and dependent variables, data were analyzed using Smart PLS. The findings imply that while AI and IoT have a beneficial impact on supply chain management performance, cyber security breaches are seen to have a negative impact.

Keywords: AI, Cyber security, IoT, Supply chain performance, SCM 4.0.

INTRODUCTION

Global supply chains are the conduits that allow commodities and services to conveniently reach their final destinations and satisfy customers and consumers' expectations. Effective supply chain management is essential for companies to

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thrive. The most distant areas on the planet primarily rely on these supply chain channels for their daily needs, including food supplies, medicines, necessities, machinery, and equipment parts. Global supply chains are crucial to international organizations like the UN and all of its subsidiaries ability to provide assistance, care, and protection to old-age populations around the world. Information and communication technologies (ICT) integration boosts performance by increasing supply chain efficiency [1, 2]. Time, efficiency, and speed are three crucial functions of ICT-enabled SCM [3]. The inclusion of IoT and AI into supply chain management has the potential to considerably facilitate the supply chain's wheels, hence improving the effectiveness and overall performance of these channels. It will be possible to facilitate the delivery of goods and services by enabling communications among these devices along the routes by viewing every component of the supply chain as a device with sensors. These gadgets utilize the machine and deep learning software (algorithms) to learn about their surroundings in relation to other gadgets, making it simple for them to share information with one another and optimizing their operation by recommending different ways to provide goods and services. The majority of research on the performance of the IoT, AI, and supply chain are literature reviews that suggest models; none of them are quantitative in nature, leaving the gap that this study aims to address [4, 5]. Global supply chain management operations are changing due to IoT and AI in robotics, autonomous vehicles, and adaptive manufacturing, ushering in supply chain 4.0. This revolution will need to be supported by quantitative research findings in order to influence future managers' and researchers' policies. Cybersecurity, however, has the potential to interrupt “supply chain” operations. “Supply chain management” may be the target of a worldwide cyberattack, which would have an impact on business operations and performance. Supply chain interruptions cost the US economy 228 million dollars in 2021.

Table 1. ‘Cronbach Alpha’, ‘rho A’, ‘Composite Reliability’ and ‘Average Variance Extracted’.

“Constructs”	**“Cronbach Alpha (CA)”**	**“rho A”**	**“Composite Reliability (CR)”**	**“Average Variance Extracted (AVE)”**
Artificial Intelligence (**AI**)	0.805	0.824	0.911	0.836
Cyber Security (**CS**)	0.760	0.780	0.859	0.754
Internet of Things (**IoT**)	0.866	0.897	0.901	0.646
Supply Chain management Performance (**SCMPerf**)	0.897	0.927	0.921	0.662

CA, rho A, and CR threshold values are >0.7, while AVE is >0.5.

The Table **1** above shows that CA, rho A, and CR threshold values were met, indicating that all constructs passed the reliability test. AVE values are also grater than or equal to 0.5.

The following are additional construct validity criteria, including HTMT (Table **2**), cross loadings (Table **3**) and the Fornell-Lacker criteria (Table **4**) all showing threshold requirement are met.

Table 2. HTMT.

Constructs	AI	CS	IoT	ScmPerf
Artificial Intelligence (**AI**)	-	-	-	-
Cyber Security (**CS**)	0.898	-	-	-
Internet of Things (**IoT**)	0.849	0.823	-	-
Supply Chain Management Performance (**SCMPerf**)	0.713	0.827	0.742	-

Threshold values HTMT is <0.9.

The results of this study provide a proof that IoT and AI have a positive impact on supply chain performance in a growing country. The numerous reviews and models that have been created based on the literature support this. By offering this proof, the vacuum in the literature is filled. Second, the diffusion theory describes how IoT and AI can lubricate supply chain activities and have a favorable impact on performance. Thirdly, the findings fill a knowledge vacuum in the literature by indicating that supply chain performance may be negatively impacted by a cyberattack. We demonstrate in reality how supply chain operations managers will use IoT and AI in their work to their advantage and formulate a strategy to reduce cyber threats.

A review of key literature, methodology, research findings, and managerial and practical takeaways for application constitute the remainder of this essay. This section examines the body of literature on IoT, AI, cyber security, and supply chain performance.

REVIEW OF THE LITERATURE AND DEVELOPMENT OF HYPOTHESES

Internet of Things (IoT)

According to a [6] research, it is a technology utilized in a worldwide network of interconnected "things" to communicate with one another and exchange information *via* information devices in accordance with set protocols. According to [7], IoT technology also refers to three other categories of technology:

CHAPTER 12

Automated Smart Prediction of Heart Disease Using Data Mining

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Abstract: In our hectic lives, we usually do not have enough time to check our health on a daily basis, and as a result, we disregard our health problems. The smart health prediction system presented in this research uses a new method that could aid us in taking care of ourselves. We can use the symptoms of our health problems as input to our system to help us predict the condition, and then we can contact a medical professional when necessary. The goal of this study is to use data mining techniques to forecast cardiac disease. Due to its ability to effectively forecast outcomes and store vast amounts of data, data mining is increasingly popular nowadays. Here, we examine the information and display each aspect of the dataset. We display the male-to-female patient ratio, the type of cardiovascular disease, type of chest discomfort, and maximum and minimum patient ages. Then, we employ a variety of machine learning approaches, including the Decision Tree Algorithm, Random Forest, Support Vector Machine, Logistic Regression, KNN, and others, to forecast the disease. The majority of the models offer us accuracy rates of over 85%. Additionally, it examines the matrix's recall and precision. Therefore, we can infer that it provides us with a positive outcome that will enable us to take the required precautions and lower the rate of mortality associated with a heart disease or heart attack.

Keywords: Decision-tree (DT), Data Mining, KNN, Logistic-regression, Precision, Random-forest (RF), Recall, Support-vector machine (SVM).

INTRODUCTION

One of the most valuable things in life is our health. It is directly reflected in any form of development. Nowadays, most of the people neglect this asset, due to lack of time, or busy life. According to the World Health Organization (WHO), cardiovascular disease is one of the major causes of death worldwide.

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In India, from 1990 to 2020, it has increased the death rates by heart attack by around 2.26 million. One in every four deaths in India occurs because of a heart attack or stroke.

Every year in the USA, more or less 61,000 people die from heart diseases. So we have to be more careful about CVD. Mainly, cardiovascular disease occurs due to weakened blood vessels, chest pain, or stroke. The patient who may have cardio-vascular disease has a risk factor due to high blood pressure (BP), higher levels of glucose, excessive weight, etc. Heart disease can also be caused by non-modifiable variables such as drinking and smoking. CHD is a condition that is closely linked to the patient's lifestyle and is extremely deadly; hence, prevention is critical. Any disorder that affects the heart is referred to as cardio-vascular disease (CVD). Several CVD patients experience symptoms including chest pain and exhaustion, which occur when the heart does not receive enough oxygen. According to a report, about half of the individuals have no symptoms until they have a heart attack. Doctors frequently perform an analysis with so many components to review CVD by examining a patient's current test findings. In most cases, a CVD is not discovered until a stroke, heart attack, angina, or heart failure occurs. As a result, it is crucial to keep track of cardiovascular parameters. Individuals who are at high risk of having CVD must be identified quickly in order to avoid uncertain death.

According to data science, data mining could be valuable for obtaining patient records and performing a quick, cost-effective analysis of the large amount of medical data. Data mining has introduced many techniques that may solve this problem very easily. Also, it guides us to emphasise both health and work simultaneously. As a result, data mining is useful for detecting patterns in massive datasets using methods that combine machine learning (ML), statistics, and database systems. This research focuses on the use of data mining techniques (DMTs) to analyse clinical data acquired during a medical exam in order to determine whether a person has a CVD or not. Various artificial neural network (ANN) approaches and machine learning (ML) algorithms can be used to evaluate and uncover hidden patterns in patient medical record data obtained during medical examinations linked to cardiovascular illnesses.

One of the most common data preprocessing processes is feature selection. Furthermore, selecting the optimal features before building a predictive model is a critical step. We determined the key features of the data by applying the feature selection technique, and then we applied different classification techniques.

Machine learning emerges as a major element for extracting information from massive databases and company operating records.

Machine learning is becoming a key research subject in medical health care for providing prognosis and a deeper comprehension of medical data. Here we have used many machine learning techniques: KNN, SVM, Linear SVM, Logistic Regression (LR), Decision Tree (DT), Random Forest (RF), Naïve Bayes (NB), Bagging Classifier, etc. To justify the accurate predictive analysis, we have used all these algorithms. After that, we get the best-fitted model. As a result, forecasting such diseases can help provide care, and prevention services and treatment programmes can help patients improve their quality of life while lowering their treatment costs and decreasing their chance of mortality.

LITERATURE REVIEW

There have been various types of work related to disease prediction systems using different machine learning algorithms and data mining techniques.

Polaraju *et al.* [1] proposed the method of multiple regression modelling for the prediction of CVD. It indicates that multiple linear regression is appropriate for predicting heart disease (CVD) risk. They worked on a data set with 3000 cases and 13 different attributes. Based on the results, it is obvious that the regression algorithm's accuracy is superior to that of other methods.

Ahmed I. B. ElSeddawy and Shimaa Ouf [2] proposed a 'paradigm for intelligent heart disease prediction system using data mining techniques'. They experimented with two datasets: one is the CVD dataset, which contains 70000 data points, and another is the UCI dataset of heart disease, which contains 303 data points. By using a neural network on CVD data, they obtained 71.03% accuracy. And by using UCI data, they obtained 89.01% accuracy with repeated random forest algorithms.

Divya Jain and Vijendar Singh [3] proposed "feature selection and classification systems for chronic disease prediction". By using feature selection and classification techniques, it gives more accurate predictions.

Purushottam *et al.* [4] proposed a "data-mining-based efficient heart disease prediction system". This system assists medical professionals in making decisions that are based on a set of criteria. In the testing phase, it offers 86.3 percent accuracy, and in the training phase, it offers 87.3 percent accuracy.

Gomathi *et al.* [5] proposed "Multi-disease prediction using data mining". This paper analyzes three disease symptoms and predicts the disease.

CHAPTER 13

Deep Learning-Based Detection of Defects from Images

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Abstract: Crack detection has vital importance for monitoring and inspection of buildings. It has great significance for structural safety. This is a challenging task for computer vision and machine learning, as cracks only have low-level features for detection. Convolutional Neural Networks (CNN) is a very promising framework for crack detection from images with high accuracy and precision. This paper is based on a deep-learning methodology to detect and recognize structural defects. The dataset is split into training and testing data which is used to train the model. Then this trained model is used to recognize and classify cracks in images. The dataset consists of concrete crack images. The data set used has two categories, images with cracks and without cracks. A Convolutional Neural Network model using Pytorch will be fit to predict the images if the images have any cracks or not. This paper compares the accuracy of various models.

Keywords: CNN, Defect detection, Image processing, Machine learning.

INTRODUCTION

In today's world, Image processing is one of the increasing areas. Day by day as technology advances, digital imaging system is increasing than analog imaging system. Every day in our daily lives, many images are captured by us but this is very difficult to maintain manually. So, the application of digital image processing is growing rapidly. Digital image processing helps us extract various types of features from images. This is automatically done by the computer. The most important function of digital images is to categorize many kinds of defects in the images.

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Literature Review

One of the most common methods for detecting faults is to process and analyse photographs of surfaces containing problems. Several papers on automated surface defect detection have been published, employing both classic image processing and machine learning techniques. When the types of surface errors are constant and differ from the background errors, the traditional image processing method gives the expected results. In such circumstances, techniques like edge detection, gray-scale image thresholding, and picture segmentation are commonly utilised to aid fault detection. Several studies [1 - 5] have used specific approaches to detect surface defects.

Methods and Methodology

In this study, the data set that is used here is Mendeley Data. The dataset contains concrete images with cracks and without cracks. The data set consists of 1000 images of concrete structures with cracks and 1000 images without cracks. Each image in the data set is 227 in width and 227 in height, with dimensions 227*227 pixels RGB images. The data set has a variety of images, different colors, different intensities, and different shapes. Each image contains Horizontal and vertical Resolution and the dpi of each image is 96. Some images are shown in Figs. (**1** & **2**) without cracks and with cracks.

Fig. (1). Surface images with crack.

Pixlr software is used to adjust dpi and the resolution of images. Python Programming Language is used to implement this Project. Jupyter Notebook is used for implementation.

Read the image folder dataset then visualize random images with cracks and without cracks as shown in Fig. (**3**).

Then two folder directories named Train and Val for training and testing are created, respectively. Followed by this, 85% of the data is randomly shuffled into a training set and the rest into the test set.

Fig. (2). Surface images without crack.

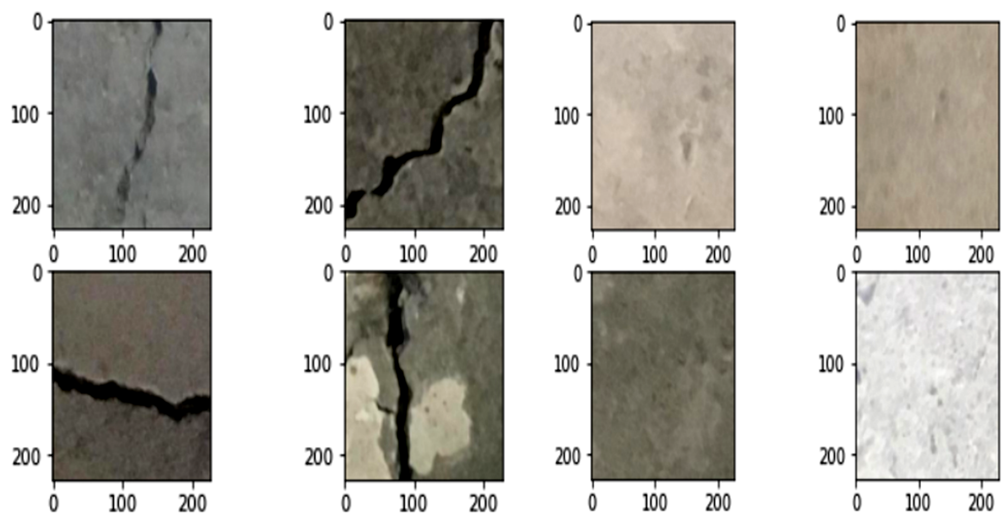

Fig. (3). Random images visualization with crack and without crack.

Image augmentation and transformation are applied. Deep learning model requires a huge amount of data but due to the non-availability of large datasets, predictions may be inaccurate. So, one of the ways is to increase our dataset size. This can be done through Data Augmentation (Fig. **4**).

The training photos are altered, and a new synthetic dataset is created, which may be fed into the model. It improves the performance of the model. This is a way to flip the training images both horizontally and vertically. All the transformations are made like Random resize crop, Random rotation, Color jitter (adjust brightness and contrast).

CHAPTER 14

Deploying XAI with IoT for the Protection of Endangered Species

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Abstract: As the modern world is progressing towards technological advancements year by year, the human species is endangering other species in land, water, and air. The very existing industrial advancement is focusing on human needs only and now the situation is worsening due to the natural impacts of animal species. Due to these compelling reasons, the Internet of Things has come to the rescue of endangered species. We are replacing IoT with explainable artificial intelligence due to the fact that XAI will address the black box problem of AI. In our paper, we incorporate the specific robust elements of XAI to provide a framework that will give results that are useful for researchers who are responsible for protecting endangered species. The XAI model has higher accuracy and is cost-effective during deployment which makes the proposed approach even more promising.

Keywords: Biodiversity, Explainable AI, Endangered species, IoT, Poachers, Sensors, Security.

INTRODUCTION

Endangered Species are species of animals and plants that are at risk of extinction if appropriate actions are not taken to protect them and their habitat.

From Polar Bear and tigers to Elephants and plants like Orchids, and Venus flytraps to the Cactus population, the species have become an alarming rate reminder, that part of human activities have a deadly impact on the planet and its resources. Immediate action must be taken as currently, 20 percent of species face extinction and the experts forewarn that it might rise to 50 percent by 2100 [1].

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The main reasons for the Endangerment of Species are:

Habitat Loss: This occurs mainly due to destruction, fragmentation, and degradation. The abrupt changes in climate, pollution, conversion of land for construction, *etc*. are the main causes of habitat loss [2]. Dinosaurs were unable to adapt to the hot and dry climatic conditions. They first got endangered and then became extinct.

Poaching: Poaching means the illegal trafficking of wildlife for food, money, religion, and pleasure at high rates to the international market. This trade of animal fur, tusks, horns, *etc*. leads to their extinction. Rhinos are mostly poached for illegal medicinal use since 1993 [3]. Their horn consists of keratin that includes amino acids such as cysteine, arginine, lysine, tyrosine, and histidine as well as salts such as calcium phosphate and calcium carbonate used for traditional Chinese medicine. The horns are ground into a fine powder, dissolved in boiling water, and then consumed. The main advantage is that the horn of a Rhino is not connected to the skull and it will grow throughout its life.

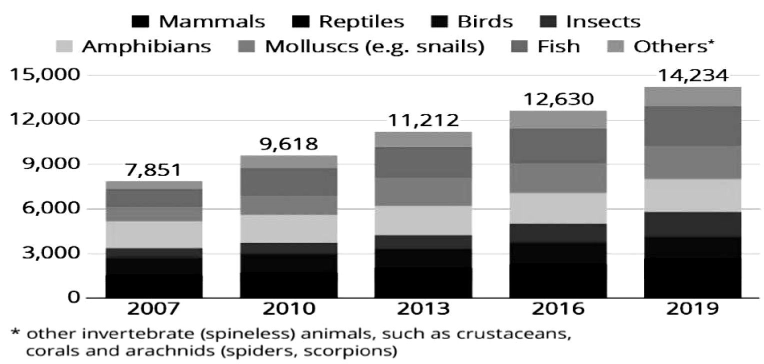

Fig. (1). Shows that the number of endangered species rising.

In Fig. (**1**), it can be observed that number of species that are classified as threatened (Critically Endangered, Endangered, or Vulnerable) has also increased, from around 8,000 in 2007 to over 14,000 in 2023. This means that more and more species are at risk of extinction.

Effects of Climate Change: The abrupt climate change is a major issue for all of us. These changes are due to the increasing level of carbon dioxide which leads to global warming. Natural disasters like wildfires, floods, heavy rains, melting of glaciers, *etc*. are a threat to wildlife [4]. Cheetahs and Polar bears are threatened by climate change.

Pollution: The pollutants in the air from industries cause direct mortality, organ injury, disruption of endocrine function, and low reproductive success. Mercury, a toxic heavy metal, is one of the most harmful pollutants faced by fish [5, 6]. Mercury alters the neurologic and reproductive systems in wildlife and humans. Contamination of aquatic wildlife is due to the extensive mining and industrial usage of lead.

Since protecting endangered species is expensive, and time-consuming for cash-strapped conservation groups, researchers developed algorithms using XAI with IoT.

Explainable AI (XAI) is a new domain in machine learning that is programmed to develop models that can describe the decision-making process. Shortly, XAI creates an environment where users can easily understand the algorithms and can confidently trust AI-made decisions. XAI explains the reasons behind the black-box models like neural networks or random forests [7].

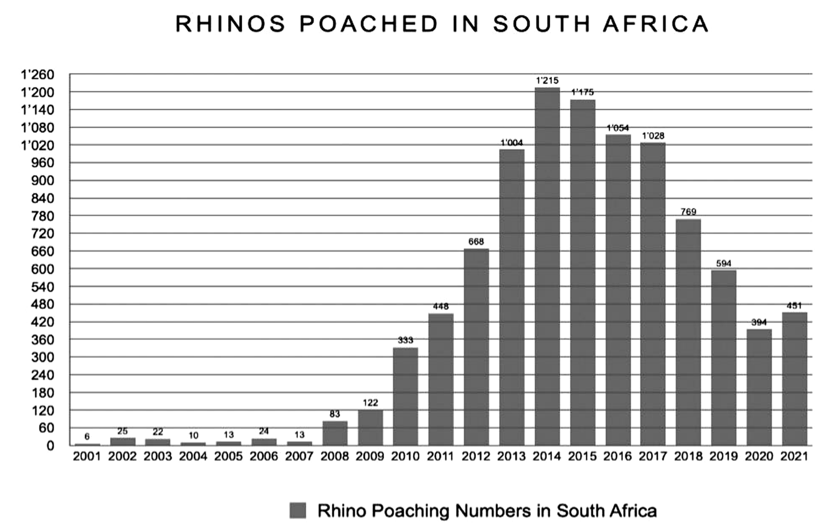

Fig. (2). Statistics showing Rhino Poaching in South Africa.

Fig. (**2**) shows a worrying trend of increasing rhino poaching in South Africa. From 2001 to 2021, the number of rhinos poached each year has increased significantly, with some fluctuations due to factors like high demand for rhino horn, weak law enforcement, organized crime.

AI-based algorithms aim to explain AI models like decision trees or logical regression to make better decisions [8]. However, humans may not understand

CHAPTER 15

Application of Machine Learning Approaches in Crop Management

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Abstract: Agriculture is considered one of the evergreen and blooming sectors which is continuously addressing the needs of the growing population around the world. In a country like India with hundred crore population, 37 million to 118 million still depend on farming. The use of machinery and modern practices in agriculture is still not followed by the majority of farmers. Adoption of modern farm practices can result in increased yield of the crop, reduction in pollution, less water consumption, effective pest management and pesticide usage. There is a need for a lot of research on new inventions that help farmers to overcome these challenges. Artificial intelligence and machine learning are two domains that need to be utilized to address the challenges. Even though many researchers have focused on these issues, it is still way war far behind. In this paper, I would like to propose some of the approaches of Artificial Intelligence and Machine Learning that address the challenges faced by farmers.

Keywords: Artificial intelligence, Agriculture, Machine learning, Pest management, Pesticide.

INTRODUCTION

Crop management is considered a collection of practices adopted in agriculture for the improvement of overall yield of the right from the collection of seed, sowing, monitoring, pest control and maintenance, harvesting, storage, and marketing of the crop. Many underdeveloped and developing countries in the world still follow the traditional way of farming, farmers are hesitant to adopt advanced technologies either due to the lack of knowledge, heavy cost incurred, or because of lack of awareness of the advances in the technology.

Farmer's lack the knowledge of the soil type of their farmland, prediction of crop yields, forecasting of weather, improper pesticide application, irrigation issues,

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incorrect harvesting, and a lack of market trend knowledge contributed to the loss of farmers or increased costs. Lack of knowledge at each stage of agriculture creates new issues or exacerbates existing ones, which raises the cost of farming. Daily population growth adds to the demand for the agricultural industry. There are significant overall losses across the entire agricultural process, from crop selection to product sale.

Machine Learning Approaches in Crop Management

Seed Management

Computer Vision is one of the prominent technology that provide methods to deal with real-time situations such as seed pre-processing. This scenario requires the fastest image-capturing techniques to capture the features of the seed in order to classify seeds from that of other contaminants, as well as the quality of the seed. This approach involves feature extraction, and classification/clustering. Machine learning approaches like Convolutional Neural Networks (CNN) can be adopted in this approach.

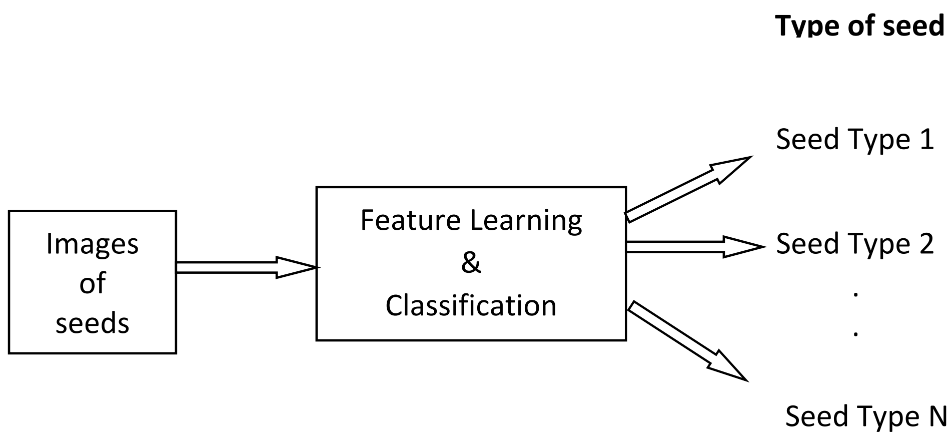

Fig. (1). Deep learning approach to the classification of seed.

To measure the factors of soil, seed quality, fertiliser use, pruning, genetic and environmental variables, and irrigation, machine learning is applied. It is crucial to reduce manufacturing losses overall by concentrating on each component. In this section, a few key pre-harvesting components are discussed, along with how neural networks and machine learning are utilised to capture the parameters of each component.

By compiling and analysing historical climatic data spanning more than 30 years, the AI mechanism may be used to calculate the crop-sowing period and find the best time to sow seeds. This mechanism uses a moisture adequacy index (MAI) to determine the best time to sow seeds. The degree to which rainfall and soil moisture are adequate to satisfy the prospective water needs of crops is evaluated using the standardised index (AI).

Pest management

Finding the location of items is the goal of object detection. The three components of object detection models in a given image are region selection, image extraction, and classification. The three stages of feature extraction, informative region selection, and classification are the main divisions of conventional object detection models.

Insect biodiversity should be protected due to the significant role that these species play in ecosystems. Image-based systems, audio sensor-based systems that use the distinctive noises of insects, and olfactory devices that use volatiles emitted from their bodies have all been successful in identifying insects (*e.g.*, brown plant hoppers and stink bugs). Because entomologists primarily rely on visual evidence to identify insect species, image-based systems are among the methods that are frequently used to distinguish between various insect species [1].

With several downstream applications in insect identification, including pest control and biosecurity, computer vision is a field of computer science that is fast progressing. One of these areas where computer vision has seen considerable progress is object detection.

Visual recognition systems, which include picture categorization, localization, and detection, have attracted a lot of research interest because they are the foundation of all these applications. These visual recognition algorithms have acquired exceptional performance as a result of substantial advancements in neural networks, particularly deep learning.

The goal of generic object detection is to identify and categorise any items that are present in an image and to mark those objects with rectangular bounding boxes to indicate the degree of certainty that they are there. Generally speaking, there are two basic categories to place generic object detection frameworks. One follows the conventional approach to object identification, first producing region recommendations before classifying each proposal into several item types. The alternative views object identification as a regression or classification problem and uses a unified framework to arrive at the desired findings (categories and locations) immediately.

CHAPTER 16

AI and IoT-Enabled solutions for Protection of Species on Earth

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Abstract: Ecological balance is a term describing the co-existence of species with other species and also with the environment ensuring the organization of ecosystems in a state of stability. Each species has a contribution to maintaining the ecological balance. Major disturbances of ecological balance are due to careless activities by human beings like faulty usage of land, soil, water, and forest resources, and industrial and vehicle pollution. The proposed study focuses on two major resources namely soil and water which affect human, animal and plant lives both terrestrial and aquatic to a very large extent. Soil degradation is the loss of soil quality that diminishes yield. Water degradation refers to the quality of water being degraded with the introduction of unwanted chemicals and making it unsuitable for use. The world is surely going to suffer from the problem of hunger if man does not make efforts to conserve the soil and water. The need of the hour is to devise technological solutions that can measure, predict, and analyze the degradation, recommend suitable procedures either to prevent the damage, or control the damage, and suggest the means to achieve better crop productivity. The concept of Precision agriculture using IoT and AI can help in measuring, and analyzing the soil conditions, the requirements of temperature, water, pesticides, and fertilizers and provide guidance on soil management, crop rotation, and optimal planting and harvesting schedules in order to reap better yield and satisfy the food requirements of all species on Earth.

Keywords: AI, IoT, Precision agriculture, Precision agronomics, Sensors.

INTRODUCTION

The modern agriculture management approach known as Precision agriculture (PA) uses information and communication technologies in order to achieve optimum health and productivity of crops by ensuring that the crops and soil receive what they require timely and in exact proportion. Precision Agriculture aims to improve profitability, sustainability, and protection of the environment. It is also known as Satellite Agriculture or Precision Agriculture.

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Precision agriculture uses many tools and technologies like i) GPS or more accurately Global Navigation Satellite Systems (GNSS), ii) Mobile Devices in the form of smartphones and tablets, iii)Artificial Intelligence and Robotics (Robots accomplish many agricultural tasks), iv) Precision Irrigation technologies, v) Internet of Things (interconnected devices), vi) Wireless Sensors, vii) Variable-rate application (VRA) seeding, viii) Weather modeling, and ix) Nitrogen Modelling.

Internet of Things (IoT) refers to physical objects with sensors that are capable of sensing different types of data and possess processing ability, software and other technologies through which they are able to connect and exchange data with other devices and systems over the Internet or other communications networks.

Precision agriculture needs equipment, software, and IT services. There is a need for accessing real-time data about the conditions of the crops, soil, air, weather predictions, labor costs, and equipment availability. Analytics of the data collected guides farmers regarding optimal planting times, crop rotation, harvesting schedules and management of soil.

Sensors are distributed in fields and they are able to measure the temperature, moisture content of the soil and surrounding air. The images of individual plants in real-time are captured by satellites and robotic drones and are provided to the farmers. These images are processed and the information gained is integrated with sensors and other data for immediate and future decision-making with respect to crops.

There are agricultural control centers that process and integrate data from various sources thus *helping* the farmers to identify the requirements of crops in terms of water, pesticides, temperature, *etc*. for the optimum yield. This can significantly reduce the wastage of resources and ensure better yields.

Motivation to use Artificial Intelligence and the Internet of Things

Studies across the globe have projected that the world's population is expected to reach 9.6 billion by 2050 and current food production must actually be doubled to satisfy the hunger of each person. The dependency of over 60 percent of the population on agriculture for food has created pressure to meet food demand. The rapid climate change, global warming, rising levels of carbon dioxide, and frequency of droughts and floods coupled with increasing labor and production costs have challenged the future of agriculture.

Over the years, farmers have gained knowledge about the variability in the yields of the individual parts of their land/s. Farmers have learned that various factors like soil properties, environmental characteristics and management practices are responsible for the variability in yield. The characteristics of soil such as organic matter, moisture, texture, structure, nutrient status and landscape position influence the yield. The characteristics of the environment influencing yield are weather conditions, weeds, pests, and diseases. However, nowadays farmers find it difficult to maintain the knowledge of their fields because of large farm sizes, changes in the area of farming due to leasing and a lot of changes in soil, weather, or climatic conditions. Farmers typically follow a set of procedures without much innovation which results in over/under usage of resources, and unpredictability resulting in losses or wastes. Farmers are not able to scientifically analyse the reasons for crop loss and even if they do, it would be late and hardly any remedial action could be taken.

These difficulties can be overcome by use of technologies that have the potential to automate the process of data collection and its subsequent analysis for quick decision-making in fields. The use of technologies in agriculture is no longer constrained to only larger fields with proper Information technology infrastructure and other technological resources. The analytical abilities of the recent technologies in terms of hardware, and software have raised the hope of increasing productivity in a sustainable way.

Recent technological advancements like smart sensors, mobile apps, drones and cloud computing have made use of technology for small farms also. The advancements in the fields of artificial intelligence, robotics, big data analytics, IoT, and satellite imagery have boosted the help of the agriculture sector. Rapid digitalization has reduced manual work which is error-prone and time-consuming. The digitilization of the economy has empowered the users to easily accomplish their financial transactions.

Regunandan *et al.* [1] analyzed the possibility of collaboration between Indian and African economies for agriculture and allied activities with the integration of big data into climate-smart agriculture in order to increase productivity and ensure efficient utilization of resources.

Yousefpour, A. *et al.* [2] summarized and categorized the efforts on fog computing and its related computing paradigms and also discussed challenges for research in fog computing.

Zamora-Izquierdo *et al.* [3] proposed a platform that is capable of coping up with the soilless culture needed in full recirculation greenhouses using a moderate type of saline water. The system has been implemented in a real prototype in frames of the EU DrainUse project, which allows the control of a real hydroponic closed system through software for farmers connected to the platform.

CHAPTER 17

Air Pollution Detection in Covid-19 Ward: An Artificial Intelligence Approach

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Abstract: The world has faced a pandemic situation due to COVID-19. The dearth of understanding of germs, the scope of the phenomena, and the rapidity of contamination highlight many points in the new techniques for studying these events. Artificial intelligence approaches could be helpful in assessing data from virus-affected locations. The goal of this research is to look into any links between air quality and pandemic propagation. We also assess how well machine learning algorithms perform when it comes to anticipating new cases. We present a cross-correlation analysis of everyday COVID-19 instances and ecological parameters such as heat, humidification, and contaminants in the atmosphere. Our research reveals a strong link between several environmental factors and the propagation of germs. An intelligent trained model using ecological characteristics may be able to forecast the number of infected cases accurately. This technique may be beneficial in assisting organizations in taking appropriate action about inhabitants' protection and prevalent response. Temperature and ozone are adversely connected with confirmed cases whereas air particulate matter and nitrogen dioxide are positively correlated. We created and tested three separate predictive models to see if these technologies can be used to forecast the pandemic's progression.

Keywords: Air pollution detection, AI, COVID-19 pandemic, Related analysis.

INTRODUCTION

COVID-19 is generated by the new virus called SARS-CoV-2. The MHC of Wuhan reported a group of instances in Wuhan to the WHO on the 9th of January 2020. The expansion of COVID-19, proclaimed a worldwide epidemic by WHO on March 11th, 2020 [1]. The World Health Organization revealed on April 8, 2021, that the affected cases of COVID-19 globally have increased to 132 million, with 3 million demises. More than 3.6 million positive cases and about 112 thousand deaths were registered in Italy at the time.

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COVID-19's public health emergency is unprecedented and undoubtedly has a major redundancy program. The increasing development of the worldwide epidemic has prompted significant concerns, necessitating a coordinated investigation to prevent the disease's progression. Based on the above parameters, the AI model is a great assistance to organizations in terms of providing a statistical structure that gives the details about the germs spreads and potentially, the approaches that should be used to combat it more effectively.

Machine learning methods, if appropriately integrated and deployed, can aid in the analysis of data relevant to some of the infection's impacted areas (see for instance [2 - 4]). Machine learning models can be trained using past data to forecast how the epidemic will develop and what effects it will have on the inhabitants.

Precepting a complicated model like the transmission of the epidemic is a critical problem in a country's long-term growth. The idea of sustainable development has acquired significant support in recent years and frequently combines communal, productive, and habitat goals. In order to achieve these aims, policymakers play a critical role in these circumstances, but they must be adequately informed in order to make the best decisions. The entire world has been engaging in this challenge. For example, a group of scientists and technologists has launched CORD-19, a global partnership that compiles thousands of scientific papers on the novel coronavirus [5].

One of the major public health priorities is to identify the primary elements that lead to the transmission of the SARS-CoV-2 germ. However, due to the phenomenon's intricacy and the scarcity of data, this research is particularly difficult.

The authors show in a study [6] that places with high pollution concentrations are usually associated with a huge number of COVID-19 patients. Unfortunately, the time window employed in the two statistics differs due to misleading of data on pollutants for some countries. However, this finding has piqued attention in looking into the probable links between air quality and daily verified COVID-19 cases. This leads us to believe that there is a link between the temperature of the environment and the propagation of the pandemic.

LITERATURE SURVEY

A relational analysis has been conducted to highlight probable links between the number of daily cases and different air quality parameters in this study. By building and comparing three distinct supervised learning models, we can take advantage of these relationships. We used these models to forecast the number of new COVID-19 cases, demonstrating that the number of infected cases can be calculated with high accuracy in advance. These tools are supported to supplement the details required by organizations in order to assist them in making decisions that will safeguard the public and stop the pandemic. Accurate prediction models could, in fact, aid in the modelling of probable situations, allowing government agencies to better handle the epidemic. In paper [7, 8] a common and simplest method for creating networks is regression analysis.

The author of a study [9] preprocessed PM2.5, PM_{10}, SO_2, NO_2, CO, and O_3 data, and extracted features using a wavelet transform. The feature-reconstructed data was trained through multi-task and multi-channel frames in parallel using NLSTM. The output result will be able to predict the presence of those data in the form of a matrix. The author of a study [10] shows that dust emission data is given to the GEP to predict the dust emission distance. Monte Carlo (MC) is used for simulating prediction. The fuzzy data is analysed with the RMSE 90.91 fordistances of 5 to 68 meters. NO_2, SO_2, and O_3 will cause health issues during COVID-19. It will be affected by the respiratory system.

METHODS

Intelligent mathematical methods called artificial neural networks (ANNs) can be used for complex, non-linear systems. ANNs can replicate how the human brain functions. For forecasting and simulating the intensity of pollution exposure, ANNs have been employed successfully [11 - 14]. Additionally, ANNs are frequently utilised for anticipating pollution in both long- and short-term applications. It is acknowledged that some studies employed classifiers for contamination forecasting without taking into account other environmental elements, including parkland. A common and simplest method for creating networks is regression analysis. MLR analysis, or multi-linear regression, is a method for assessing the association between the variables.

The aim of this inquiry is to anticipate the levels of NO_2 concentration as a determinant of the photochemical smog in the Haryana state. These methods are chosen to be compared in order to assess predictive performance for this objective. We ultimately came to a conclusion that one model was the most effective at forecasting NO_2 concentration levels because a variety of environmental factors supported the model's outputs. Model variables were prioritized achieved by performing a model sensitivity analysis.

Stepwise application of multi-linear predictor variables was used. The link between influential variables as independent data and the daily quantity of NO_2 in the atmosphere with reliant data was examined using this method [15 - 18]. Based on statistical metrics such as the highest reliability test, the smallest (RMSE) root,

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