

THE ROLE OF AI, IoT AND BLOCKCHAIN IN MITIGATING THE IMPACT OF COVID-19



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PREFACE

Almost every country has been affected by the COVID-19 pandemic, which has had a significant impact on human lives and economic activity. The pandemic of COVID-19 was still significant in 2022, when millions of people around the world were getting sick. There has been an enormous and widespread impact on healthcare due to the COVID-19 pandemic; this has resulted in a significant and rapid increase in digital technology adoption. Luckily, digital technologies like Artificial Intelligence, the Internet of Things, and blockchain have unique characteristics such as immutability, decentralization, and transparency and can be used in many different fields like maintaining records, maintaining social distance, record maintenance, measuring mental health, and clinical analysis of infected people. Chap. 1 discusses artificial intelligence models in the battle against covid -19, with data preprocessing of three different datasets like weather dataset, air pollution dataset, and movement restriction dataset. Chap. 2 examines and describes how 3D printing technologies can be used as a weapon in the dangerous pandemic situation. Chap 3 discusses IoT, and IoT tools in preventing and controlling the virus. The chapter discusses several technologies that can be used in conjunction with IoT to combat the COVID-19 pandemic. The human society benefits from technologies during coronavirus outbreaks in terms of symptoms' diagnosis, contact tracing, quarantine monitoring, and social distancing. Numerous applications utilizing artificial intelligence in conjunction with the Internet of Things have been discussed. Chapter 4 illustrates the impact of artificial intelligence and the Internet of Things (IoT) in the healthcare domain, as well as the challenges that healthcare professionals face, particularly when dealing with a pandemic situation, and proposes some potential healthcare developments through the use of AI and IoT. The purpose of Chapter 5 is to raise awareness about the importance and role of social media platforms in preserving social distance between people. When discussing social media and the COVID-19 pandemic, there are usually three main points made: the importance of social media platforms in establishing and improving social distancing, the importance of social media platforms in maintaining social connections and interactions among individuals, and finally the impact of Coronavirus on social media use. Chapter 6 looks at AI techniques that are up to date in terms of COVID-19 in a number of different areas of interest. Treatment, diagnosis, prognosis of recovery, severity, and death of patients, chest X-Ray and CT-based analysis, pandemic prediction, control and management, pharmaceutical research and COVID-19 text corpus processing and virus detection are all performed with AI. A better understanding of various applications is needed to shed light on the current state of artificial intelligence in this pandemonium. Some suggestions and remarks about how to deal with the disaster are discussed in a better way. A better society can be achieved through the use of Industry 4.0 technologies and applications, which are explained in Chapter 7. Also, how Industry 4.0 contributes to sustainable manufacturing and the management strategies used to increase the company's efficiency, as well as COVID-19's impact are discussed.

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CHAPTER 1

Artificial Intelligence (AI) in Battle Against COVID-19

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Abstract: In Wuhan China, the world's most dangerous virus is discovered, which is named COVID-19 by World Health Organization. Social distancing is one of the powerful methods to control this virus as it is realized that lockdown is not a permanent solution. This research chapter aims to identify the major activities influencing the transmission of the coronavirus spread using Artificial Intelligence bound models. To conduct this research in the right direction, movement control restriction, meteorological parameters, and air pollution levels information are collected from various valid websites. End-to-end data pre-processing steps are carried out in detail to handle the outliers and missing values and investigate the correlation between dependent and independent variables. Multiple linear regression, neural networks, decision trees, and random forests are chosen to fulfil the objective of this research by identifying the most influential activities and other parameters. Here, the model's performance evaluation is done using the R^2 value, mean absolute error and mean squared error. The predicted values are plotted against the actual value to illustrate the error patterns. Among all models, random forest and decision tree models are proven to give the highest accuracy of 93 percent and 91 percent respectively. Prescriptive analysis has been further analyzed by performing feature importance extraction from the highly accurate models to identify the most impactful parameters the government authority and healthcare front-liners focus on to mitigate the number of COVID-19 cases daily.

Keywords: Artificial Intelligence, Coronavirus, COVID-19, Data Preprocessing, Dataset, Decision Tree, Feature Scaling, Linear Regression, Lock Down, Mean Absolute Error, Mean Square Error, Missing Value Imputation, Model Accuracy, Model Estimation, Model Performance, Neural Network, Outlier Treatment, Particle Swarm Optimization, Predictive Analytics, Random Forest.

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INTRODUCTION

The world's most dangerous virus was discovered in late 2019 in Wuhan China, and was named COVID- 19 (SARS-COV2) by the World Health Organization, where 'CO' stands for corona and the 'VI' refers to the virus, and 'D' represents the disease. During this pandemic, veto-power countries like the United States and China accuse each other of spreading the virus. Many types of coronavirus present in the world can only cause mild sickness, but this COVID-19 is not like the previously identified virus [1].

The World Health Organization immediately decided to grab international attention by announcing this outbreak as a public health emergency. It is not a practical way for pharmaceutical companies to invent antiviral drugs right after a new virus is detected. So, the only option in politicians' hands to control the transmission is by implementing the movement restriction such as gathering cancellations, social distancing, sanitizing, corona patient contact tracking and isolation, non-essential business activities and the school shutdown, travel bans, and many more [2]. The intensity of movement restriction is based on the politician's decision and the seriousness of the corona cases in their country. The transmission of COVID-19 can be controlled during the initial stage of restriction, which shows a significant improvement.

However, the real problem only occurs when all business activities shut down, causing the country to hit an economic crisis due to an imbalance between the demand and supply of goods and services. This prolonged situation makes the country's financial sector unstable, leading to not having sufficient money to conduct research and development on vaccine creation, and the medical facilities in quarantine will be affected [3]. Even in the worst-case scenario, the country's economy needs to make money to keep the financial sector stable to retrieve the human community from a health crisis.

The coronavirus is known as a global crisis. Social distancing rules were recently introduced to the public to slow the spread of coronavirus cases, and the results show great improvement. However, the politicians and the business tycoons are not satisfied with the country's economy since most of the companies are shutting down and leading to the bankruptcy stage [4]. Even today, much research is involved in identifying the exact damage to the global economy due to this pandemic. The primary reason for the economic damage is the reduction in demand, which means there needs to be more customers to fulfill all the supplies of services and goods. For example, the restrictions to mitigate the news cases of COVID-19, especially in the tourism industry, were terribly affected, where the travelers could not buy flight tickets for their vacations or business trips. This

issue forces the aviation industry to reduce the number of employees to cut operational costs. The same imbalance between supply and demand applies to almost all industries. Since the companies decided to lay off their employees to halt the revenue loss, the worry becomes worst among the unemployed who could not acquire the goods and services for their daily needs, and leads to a negative trend or impact on the economic graph. This indicates the clear damage, and the economist predicted that the value of gross domestic products globally would drop from 3°/c to 2.4°/c in 2020 [5].

Furthermore, the mortality rate due to coronavirus infection shows a significant spike in senior citizens with respiratory medical complications. So, air pollution is becoming a major factor in increasing the mortality rate because it affects the patients' willpower in their respiratory cycle. Moreover, certain meteorological conditions help the virus transmit easily through the air. Some proven researchers prove that the optimal temperature and humidity levels decrease the seriousness of coronavirus infections [6].

AI-BASED TECHNIQUES IN THE BATTLE AGAINST COVID-19

Since the outbreak has spread globally, AI approaches can help the medical community manage every step of the crisis and its aftermath, including detection, prevention, response, recovery, and research.

Particle Swarm Optimization (PSO) Technique

There are numerous studies being conducted on COVID-19 cases. The researchers are putting a lot of effort into innovating new techniques and utilizing several optimization techniques to save humankind from this pandemic. Particle Swarm Optimization techniques are one of the well-known optimization approaches that Eberhart and Kennedy introduced in 1995. The idea of this technique is taken from the birds swarming and flocking behaviour [2]. In the real-time application, this procedure becomes eyes catching among the data scientists due to its simplicity. Other researchers have proved the particle swarm optimization on almost 28 different non-linear regression analyses. Moreover, the result indicates that more accurate results can be obtained with the minimum mean squared error (MSE) with fewer iterations. So, the regression analysis performance can be increased using the PSO techniques, and regression problems can be solved easily [7]. On the other hand, a comparison has also been made between the particle swarm optimization techniques and the statical techniques and it was concluded that the Mean Absolute Percentage Error (MAPE) is decreased by around 7 percent on the PSO than the ordinary statistical regression method. In the search

CHAPTER 2

Impact of 3D Printed Components and Ventilators on COVID-19

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Abstract: The disease caused by a virus known as the novel Coronavirus, also known as “COVID-19” by the public, was classified as a major epidemic by the World Health Organisation in 2019. Each country across the globe is affected by COVID-19. While writing this, over 150 million people were affected by the fast-spreading deadly pandemic, and over 3.5 million deaths due to COVID-19 were reported worldwide as per WHO’s official COVID-19 dash panel-<https://covid19.who.int/Economy> and social life of no territory on earth was left unaffected by the COVID-19. Now vaccines are ready, it may take a reasonable amount of time to complete the vaccination process. One major challenge was the need for more support equipment like Beds, Oxygen Cylinders, and Ventilators. Improvisation in the mass production of many critical components, especially those supporting 3D printing technology, has shown some well-managed results in handling the shortage of many critical components. This chapter examines and describes how 3D printing technologies were used during the dangerous pandemic. It aims to describe many 3D-printed devices like face masks, face shields, various valves, etc. It also makes an effort to point out the dominant drawbacks of additive manufacturing technology in this area and examines the options for a future pandemic.

Keywords: 3D printing, Additive Manufacturing, Additive Printing Materials, Assistive respiration, Berating machine, Coronavirus, COVID-19, Extrusion based 3D printing, Lamination based 3D printing, Life-supporting devices, Lung disease, Materials Jetting, Pandemic, Photo Polymerization 3D printing, Powder-based 3D printing, Pulmonary infections, Shortage of ventilators, Ventilator components, Ventilator valves, Ventilators.

INTRODUCTION TO CURRENT CORONAVIRUS DISEASE (COVID-19)

Coronavirus Disease 2019, also known as COVID-19, was declared a pandemic by the World Health Organisation in 2019. So far, it has claimed the lives of peo-

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ple from nearly every country on the planet. Over 150 million people were infected with COVID-19, and 3.5 million died as a result of the virus, although the figure is likely to be higher because many people died from complications after treatments, even if the virus was negative after treatment.

This pandemic was lethal and affected almost every corner of the world. The economy and social life of people changed and even destroyed. Though vaccines are now ready and all the countries are vaccinating their citizens, we can simply understand that it may take more months to complete the vaccination process. Many countries are yet to start vaccinating citizens under 18 years of age. Safe vaccination for children is still under trial. Lockdowns and other restrictions are still there in place. Many countries still insist on travel restrictions for different countries, and even restricted movement between states. The health departments are working day and night to control the pandemic. Mass production of many weapons like masks, sanitizers and other personal protective kits started in many countries, and now are adequate. However, now the globe is facing another problem, the unavailability of enough support equipment like beds, oxygen cylinders, and ventilators. Oxygen cylinders and ventilators were extremely required because most deaths were due to multi-organ failure, which was the effect of severe pulmonary infections. All medicines other than preventive vaccines have been made available till now.

Recent studies reveal the presence of a delta variant of Coronavirus which is more harmful and may affect the children critically and cause a fast blowout in schools when unvaccinated faculty members and other staff have close indoor proximity to the children. It should be noted that the majority of the children have not yet been vaccinated, and they have had indoor contact with unvaccinated children. Even though children are less affected than adults, they can get sick and spread it to adults who come into contact with them. Making the children obey the social distancing rules in schools is challenging. These facts show that COVID-19 will stay with us on the globe for at least several months. Proper support is needed for the people suffering from COVID-19. Governments are supposed to support healthcare workers by making available the required equipment to combat the pandemic.

THE UNPRECEDENTED SHORTAGE OF LIFE-SUPPORTING DEVICES AND VARIOUS COMPONENTS

The novel Coronavirus enters into our body mainly through the droplets from an affected person when they cough or sneeze, or at times, these droplets may be released from the mouth when a person talks. The virus thus moves down the affected person's respiratory tract. The respiratory tract includes the lungs.

Several researchers have been focusing on a protein known as the angiotensin-converting enzyme 2 (ACE2) “receptor,” which allows the coronavirus to latch on to and attack many types of cells in the human body. There is high chance that COVID-19 can travel deeper than other viruses that cause the commonly known cold because it has more ACE2 receptors in the lower airway. This condition may lead to pneumonia, which is actually due to the contamination of the alveoli (miniature air balloons) present in the human lungs. It is in these tiny air sacs where the blood exchanges carbon dioxide and oxygen [1].

Most patients who lost their lives due to COVID-19 were hit hard with lung infections by the novel Coronavirus. A critical issue in the respiratory system of humans appears to be the reason for vulnerability to mortality in case of many people who were identified with COVID-19. Lungs of the patients were observed with diffuse alveolar damage and capillary fibrin thrombi. A study by Roden *et al.* (2019) reveals that acute bronchopneumonia and aspiration pneumonia also cause death in COVID-19-affected cases.

Acute lung injury seems to be the most difficult condition of SARS-CoV-2 infection, and the resulting related disorders, coronavirus disease 2019 (COVID-19), which causes pulmonary damage and even death in some people [2].

In most cases where severe lung problems occur, and breathing becomes difficult, medical practitioners recommended using a mechanical ventilator.

A ventilator is a mechanical device that helps a person to breathe in case they have difficulty breathing; medical professionals might call it a “mechanical ventilator.” Common people may quite often address it as a “breathing machine”. It is a bedside mechanism with tubes connected to the airways of patients who need breathing support. It moves breathable air, with some additional oxygen, if required, into and out of the patient’s lungs. Fig. (1) below shows the mechanical setup of a standard ventilator.

A novel coronavirus has caused the COVID -19 pandemic, a highly contagious disease. The work by Zhu N *et al.* describes it as a highly infectious disease found for the first time at the end of December 2019 in Wuhan, China [3].

Based on the data selected from government health ministries, “The New York Times,” and other credible sources, 213 million instances of COVID-19 are reported, with 4.44 million mortalities worldwide.

A study [4] by Iyengar *et al.* (2020) shows how a very mild infection like the common cold or a severe respiratory issue like pneumonia may even lead to the death of the patient.

IoT Innovation in COVID-19 Crisis

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Abstract: The COVID-19 pandemic is a current global threat that surpasses provincial and radical boundaries. Due to the onset of the pandemic disease, the whole world turned entirely in a couple of weeks. Its consequences have come across the personal and professional life of human beings. The current situation focuses on precautions such as wearing a mask, maintaining social distancing, and sanitizing hands regularly. An innovative platform, and smart and effective IoT technology may be applied to follow these steps. This platform fulfills all critical challenges at the time of lockdown situations. IoT technology is more helpful in capturing real-time patient data and other essential information. IoT allows the tracing of infected people and suspicious cases and helps diagnose and treat patients remotely. It also paves the way to deliver essential medical devices and medicines to quarantined places. In the present ongoing crisis, IoT technology is inevitable in monitoring patients infected with COVID-19 through sensors and intertwined networks. The consultations are given to the patients digitally through video conferencing without meeting the medical expert in person. After the diagnosis is made digitally, IoT devices are used to track health data. Smart thermometers are used instead of traditional ones to collect valuable health data and share it with experts. The IoT robots are now a proven technology used for cleaning hospitals, disinfecting medical devices, and delivering medicines, thus giving more time to healthcare workers to treat patients.

Keywords: Agriculture, Artificial intelligence, COVID-19 Pandemic, Cardiovascular, Contact tracing, Computed tomography, Deep Learning, Digital technology, Global positioning system, Healthcare data, IoT technology, IoT robots, Perception layer, Respiration rate, Random forest, Support vector machine, Temperature, Machine learning, Magnetic resonance imaging.

INTRODUCTION

The concept of the “Internet of Things” was revealed by Kevin Ashton to implement RFID-radio frequency identification in supply chain management for

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Procter and Gamble [1]. The Internet of Things (IoT) is a powerful technology that connects multiple smart objects in remote network places. Nowadays, IoT technology has transformed hospital-centric healthcare systems into patient-centric healthcare systems [2]. The clinical data can be received from a faraway area with the help of such services hence improving healthcare services' efficiency. In recent years, COVID-19 (Coronavirus Disease 2019), a vast pandemic, has taken away lives, jobs, joy, *etc.* of many people around the world. It is an unprecedented challenge where the entire globe is struggling to come out of this. COVID-19 gets transmitted directly by respiratory droplets through contact with an infected person or indirect contact with contaminated surfaces [3]. Maintaining social distancing, wearing masks and eating a healthy diet are the measures to control the spread of COVID-19. When social space is implemented, it impacts the economy, where it is pronounced more in developing countries. Inequality in income is high in such countries, and economic issues lead to the relaxation of social distancing and thus increase the number of virus-affected cases in Brazil [4]. The patient data about COVID-19 is stored in a cloud and further used for analysis. IoT records the regular activities of COVID-19 patients and warns them of health issues. IoT gives utmost care during this pandemic and improves the livelihood of people. The virus-affected patients with health complications such as asthma, diabetes, blood pressure, lung infection, *etc.* are monitored effectively by intelligent medical equipment. The equipment is linked to a smartphone to effectively communicate essential medical information to the doctors. It also captures important information on weight, sugar level, oxygen level, *etc.* Accurate and trustworthy medical information are the major problems in healthcare during COVID-19, and IoT settled this issue. IoT offers industries a market to fight effectively with COVID-19 and accelerate the healthcare systems' digitalization. Further developments in IoT could predict future pandemics by applying statistical methods and incorporating artificial intelligence (AI) and big data.

IOT TECHNOLOGY IN COVID-19

Since late 2019, the globe has been fighting a new Coronavirus disease spread in China by severe respiratory syndrome [5]. In March 2020, WHO (World Health Organization) announced the disease as a pandemic since more cases have been registered worldwide. There were about 21,991,954 cases by August 2020 [6]. The disease was spreading significantly faster among human beings. Common symptoms of this disease are fever, sore throat, dry, and respiratory problems. Most people have faced symptoms at a very low level, but people who have an illness or are over 60 years of age have a high risk of death. Government organizations have made several efforts to stop the further spread of COVID-19 and find a vaccine. Most efforts are made to develop a medicine for coronavirus

and find ways to control its spread. Hence, there is a considerable demand for monitoring virus-affected patients globally. Currently, IoT has been playing a significant role in healthcare systems, where it helps in different phases of diseases. IoT becomes feasible to achieve effective prevention and control of COVID-19 with the support of other emerging technologies such as AI, big data, and fog computing. An IoT-established system [7] is implemented during COVID-19. In this platform, a computing architecture is adopted consisting of four layers: perception layer, networking layer, fog layer, and cloud layer.

Perception Layer

The perception layer is implemented in homes, hospitals, or outdoors to collect all types of data, such as symptoms or vital signs of human activities, with the help of IoT sensors. Various sensors in the perception layer receive data in the surrounding environment and individuals. These IoT sensors investigate human activities and non-clinical healthcare. The layer consists of the following devices.

Camera—It is an essential and commonly used sensor in IoT devices. The camera captures image and video data. Data collected from the camera are analyzed for COVID-19, *i.e.*, non-contact monitoring and identifying human activities.

Internal sensor – It is a sensor that is built into smartphones and wearable devices such as accelerometers and gyroscopes. An accelerometer measures the acceleration along three axes. From the acceleration measurements, a device's dynamic force, such as vibrations, gravity and movement, are detected. Gyroscope, another sensor, has a rotating wheel with three axes of rotation. It measures the position and talks about how the device is tilted. Attributes of human behaviors are obtained from the readings of this internal sensor.

Magnetometer– Another important IoT sensor that detects magnetic fields along the perpendicular axes. Information from the magnetometer is applied to screen contact tracing and social distancing.

Microphone– It is an acoustic sensor that measures ambient sound signals. Recent IoT devices are made up of MEMS - micro-electro-mechanical systems. MEMS provides SNR - high signal-to-noise ratio and consumes low power. Most research utilizes microphones for the recognition of human activities. A microphone is used along with speakers to transmit acoustic and reflected signals.

Commodity WiFi–To facilitate sensing, the measurements of WiFi such as RSSI - Received Signal Strength Indicator and CSI - Channel State Information are used. During the propagation of WiFi signals, the attenuation is characterized by RSSI.

CHAPTER 4

Potential Applications of AI and IoT Collaborative Framework for Health Care**Lija Jacob^{1,*}, K.T. Thomas¹ and Samiksha Shukla¹**¹ Department of Data Science, CHRIST (Deemed to be University), Pune Lavasa Campus - The Hub of Analytics, Maharashtra 412112, India

Abstract: Digital technology has infiltrated the entire planet. Artificial Intelligence (AI) and the Internet of Things (IoT) are the two buzzwords that became popular in the current digital world, especially in recent decades. Both these technologies have their contribution in various domains. The existing frameworks will benefit from the AI-IoT collaborative system, which will assist them in having more intelligent or smart responses. Furthermore, these collaborative systems can provide improved devices with better decision-making capacity to facilitate the users. AI can work with IoT to increase functional precision in the healthcare domain by automating and tracking, monitoring, managing, optimizing, and predicting processes in 24x7 mode. Health professionals are the people involved in activities whose primary commitment is to improve the wellbeing of the community. They are a group of people who face various obstacles, including their health and safety concerns, especially during pandemic outbreaks. This book chapter aims to illustrate the impact of AI and IoT on the health care domain and the challenges that healthcare professionals face, especially when dealing with such a pandemic and suggests some potential health care advancements through AI and IoT.

Keywords: Addiction Management, Artificial Intelligence, AI-IoT Collaborative Framework, AI-IoT Convergence, Community Units,, Cybersecurity, Disease Management, Electronic Health Record (EHR), Pandemic Outbreaks, HealthCare, Healthcare Workers, InClinic Segment, Intelligent Drones, Internet of Things, Internet of Medical Things (IoMT), In-home Segment, On-Body Device Units, Personal Emergency Response Systems (PERS), Smartphone Applications, Smart Wearables, Smart Kiosk, Telemedicine.

INTRODUCTION

The majority of healthcare practices are encounter-based, which means they are focused on the treatment of illness rather than its prevention.

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As the population grows, there is a need for Artificial Intelligence (AI) based solutions to fasten the examination process and quickly provide the required medicine.

Digital transformation is bringing forth new tools and techniques to ease individuals' life. With the latest research and development in AI and the Internet of Things (IoT), this transformation is happening. The rise in new diseases led to an increase in healthcare expenses worldwide. There are various avenues in healthcare where AI can help and improve the medical facility. AI will help automate the process to provide context-specific information, analysis, and recommendations to patients, their relatives, and caregivers.

Many AI-based health services include identifying tumors, improving decision-making by looking into the previous data set, remote monitoring, and associated care.

The main concern in adopting the AI-based healthcare system is the ethical concern to be followed during the data collection and treatment period. On the one hand, patients are concerned about the privacy and confidentiality of individual data. On the other hand, practitioners face challenges as they need to equip themselves with new tools and technology. Technology is a blessing; at the same time, it may become a nightmare if not utilized correctly; it can harm the patient's life and the caregiver. Conclusion: many collaborative AI models offer better treatment and unprecedented opportunities to improve patient care and treatment outcomes. With the invention of AI-based medical care, patients, family members, and healthcare providers can get the recommendation and visualization of the information for collective decision-making.

There are many healthcare applications where AI is used, but it is crucial to adapt them with caution, or else we may end up with the user's disappointment. It is essential to involve various stakeholders in the development phase. Along with AI, IoT also plays a crucial role in healthcare systems to deliver high-quality services at a low cost. It is used for data collection, tracking, monitoring, identification, and authentication. Exponential growth has been observed in the field of IoT in healthcare [1].

This chapter discusses the various AI and IoT aspects. Section II & III present applications and frameworks available for healthcare professionals. Section IV explains some of the major contributions of AI in the field of healthcare. Section V presents smart health using AI and IoT. Section VI talks about the IoMT and its contribution to pandemic outbreaks.

AI IN HEALTHCARE

AI and other advancements in digital technology are playing a significant role in the community. AI growth is taking over many traditional models of healthcare. Patient care is taking a new dimension through AI in clinical analysis, surgery, and medicines. There are various types of research suggesting AI as a precision model in health care services. It is an opportunity as identifying disease in an early stage can help us in treatment before it becomes incurable [2].

Robots are leading the surgery, algorithms beating the pathologists and radiologists to identify harmful tumors in the initial stage. They are acting as a guide to physicians and other healthcare service providers. Although technology advancements are taking place, it is not easy to get acceptance, as there are incidences where patients prefer experience over technology. AI is helping in many fields to ease life, and healthcare is one among them. Fig. (1) shows the functions of AI in the healthcare domain.

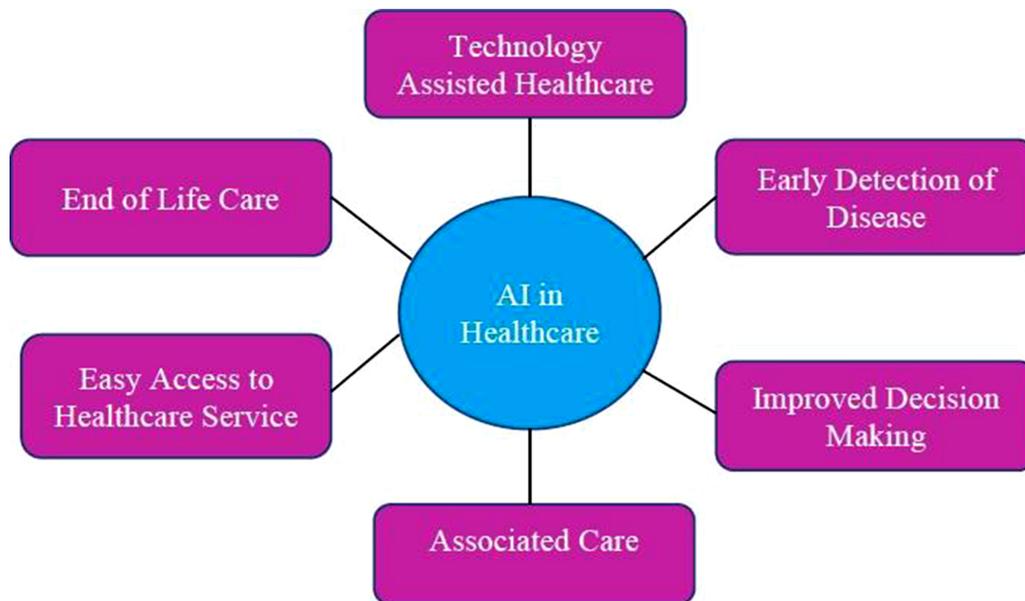


Fig. (1). Functions of AI in Healthcare.

Early Detection of Disease

AI is widely used in the early identification of diseases, such as tumors, and infections. According to the research, the sooner the disease is identified, the better is the treatment. The identification at an early stage leads to better treatment

CHAPTER 5

Role of Social Media Platforms to Maintain Social Distancing in COVID-19 Pandemic**Sivakumar Vengusamy^{1,*} and Danapriya Visvanathan¹**¹ *School of Computing and Technology, Asia Pacific University of Technology and Innovation, Kuala Lumpur, Malaysia*

Abstract: Though it has been some time since the outbreak of the novel COVID-19 disease, it still poses a threat to many people worldwide. Connections have been lost due to the practice of social distancing, both on a personal and a societal level. Due to the global prohibitions on large-scale face-to-face meetings and activities, social media platforms have emerged as a lifesaver for humanity. The role of social media platforms has grown increasingly important for people to express themselves and communicate with others. Besides, the world has also witnessed large-scale events being organized on social media platforms, making connections and interactions with friends, family, and the community *via* social media networks, as well as the transformation of educational activities into digital activities. Thus, it is pertinent to comprehend the role of social media platforms in maintaining social distancing and online connections during the COVID-19 pandemic. This research aims to generate a discussion on the importance and role of social media platforms to maintain social distancing among individuals. It typically emphasizes three main themes: (1) the importance of social media platforms in establishing as well as improving social distancing during the COVID-19 crisis, (2) the role of social media platforms in maintaining social connections and interactions among individuals during the pandemic, and (3) the impact of Coronavirus towards the use of social media.

Keywords: Communication, Coronavirus, COVID-19, Disease, Facebook, Infection, Instagram, lockdown, Medical information, Pandemic, Physical distance, Role, Social distancing, Social isolation, Platforms, Social media, Virtual gathering, Virus, WhatsApp, YouTube.

INTRODUCTION

The Coronavirus disease 2019 (COVID-19) is a virus-related sickness that is now known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. COVID-19 is an infectious disease that causes mild to moderate respiratory

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sickness in most persons who are infected and recover without needing specific treatment. However, older people with medical issues such as cancer, chronic respiratory disease, diabetes, and cardiovascular disease are more prone to be infected with COVID-19 that can become a serious illness [2].

As a result, being well-informed about the virus is the safest method to avoid its transmission, the health issues it causes, and how to slow down its transmission. It is vital for people to protect themselves and others around them from being infected by washing hands, frequently using a hand sanitizer, wearing a face mask, and practicing social distancing. Social distancing is becoming an extremely important practice to be carried out in the course of slowing down the transmission of the virus mainly because when someone infected with the COVID-19 virus sneezes or coughs, the virus spreads predominantly through saliva droplets or nasal discharge.

Furthermore, experts from the health departments have analyzed the previous pandemics that have taken place and found that the spread of the virus is followed by the consequences of having large gatherings such as festivals and events, whereby people tend to spend more time physically close to each other. Thus, health experts believe that implementing interventions by banning people from being present in crowded places would significantly slow down the transmission of the disease [3], consequently, importance is given to social distancing.

The term social distancing also known as physical distancing is a public health practice that typically points out the measures to be taken for keeping a physical space between persons to avoid the spread of the contagious disease. The technique is primarily meant to prevent sick people from getting into close contact with healthy people. Besides, as COVID-19 can spread in a poorly ventilated environment in indoor settings, in which people usually spend a longer amount of time, physical distancing is vital to safeguard us from the virus.

Apart from that, another important reason to practice social distancing is mainly the lack of information and surety about who has been infected with the disease. One of the studies conducted based on the Wuhan statistics indicated that an estimated 59% of infected individuals were out and about, unknowingly infecting other individuals around them [4]. Many of the individuals who are infected with the virus did not show any symptoms. In that sense, there is a high possibility that 50% out of all COVID-19 cases could stay unnoticed as there are no insignificant symptoms. Therefore, people must practice social distancing by staying at home.

Staying at home can be practiced in various ways, such as closing schools, not allowing dining in at restaurants, having people to do work from home instead of being physically present at the workstation, and hosting a virtual party instead of

having mass gatherings [5]. Besides, while these measures secure physical distance between individuals and reduce contact with contaminated surfaces, it eventually encourages virtual connections among individuals with families and communities in the outside world *via* the help of the platforms for social media.

SOCIAL MEDIA AS DISEASE CONTROL IN TIMES OF PANDEMIC

The majority of countries across the globe have been managing the COVID-19 pandemic *via* the implementation and practice of social distancing strategies. Subsequently, this led to an increase in the utilization of social media platforms, whereby many started depending on platforms such as Microsoft Teams and Zoom to stay connected for social, educational, and work purposes [6]. Social media typically describes the creation and exchange of information, ideas, and other kinds of expression through a virtual network or community using computer-mediated technology [7].

Examples of major social media networks are Instagram, Facebook, Twitter, LinkedIn, WhatsApp, WeChat, YouTube, Netflix, *etc.* With social media platforms playing a fundamental role in every individual's daily life, the way people communicate has been dramatically altered. It has become one of the most important tools for the government and public health organizations to provide people with accurate information mainly because social media has become increasingly important in spreading health information and policy announcements,.

A qualitative analysis has been carried out by Li *et al.* [8] to find out how government officials have utilized Twitter for anything related to the COVID-19 pandemic. The findings of the analysis revealed that out of 203 tweets, 48 tweets were more related to resources from the official government, while 166 tweets were informational, 19 tweets were related to boosting self-confidence, and 14 tweets were more politically related. Furthermore, another study carried out by Merkley *et al.* [9] shows that the term 'Coronavirus' has become the recent trend from the searched terms.

This is where importance was given more related to the measures to be taken in practicing proper hygiene as well as maintaining physical distancing to cope with the COVID-19 pandemic.

Apart from that, Wang *et al.* [10] also found that some studies investigated in their research show that a huge number of YouTube videos were created about the COVID-19 disease prevention methods, whereby it is categorized into four different groups such as washing hands, face mask-wearing, social distancing, and risk assessments.

CHAPTER 6

AI based Clinical Analysis of COVID-19 Infected Patients**Mohamed Yousuff^{1,*}, Rajasekhara Babu¹, R. Anusha¹ and M.A. Matheen¹**¹ *School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India*

Abstract: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is an unknown beta coronavirus that comes under the B genus, which causes Coronavirus Disease 2019 (COVID-19), a declared universal epidemic, posing a serious menace to human health irrespective of the nationality. According to the World Health Organization (WHO) statistics, as of September 10, 2021, there were 223,022,539 positive cases of COVID-19 with 4,602,883 fatalities reported worldwide. A total of 5,352,927,297 vaccine doses have been facilitated since September 5, 2021. This pandemic has become a ravaging illness because of its highly contractible nature and mutations. Many types of research in diverse fields of science have been initiated to suppress the effects and manage the havoc. Artificial Intelligence (AI) is classified as a subdomain of science, which most certainly contributed to numerous applications in confronting the present state at a broader level. In this chapter, we have tried to explore state-of-the-art AI techniques implemented in the perspective of COVID-19 across multiple subjects of concern. The AI approaches are utilized in the treatment, diagnosis, prediction of recovery, severity and mortality of patients, chest X-Ray and computed tomography-based analysis, pandemic prediction, its control and management, pharmaceutical research, COVID-19 text corpus processing, and virus apprehension. Thus, the comprehension of various applications is meant to enlighten the status of AI in this pandemonium. Finally, we conclude with some suggestions and remarks to tackle the disaster in an improved way.

Keywords: SARS-CoV-2, Artificial intelligence, Machine learning, Deep learning, COVID-19 treatment, COVID-19 diagnostics, Mobile application, COVID-19 text processing, COVID-19 recovery, COVID-19 mortality, COVID-19 disease severity, Forecasting AI-models, COVID-19 risk evaluation, COVID-19 safety measures, COVID-19 false information, Pandemic energy services, COVID-19 drug repositioning, COVID-19 immune system analysis, COVID-19 vaccine development, COVID-19 contagion pathogen.

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INTRODUCTION

COVID-19 is an exceptional disorder caused by a deadly pathogen named SARS-CoV-2. An initial confirmed case was discovered by the end of December 2019 in the Wuhan region, China. Subsequently, the infection has disseminated swiftly, resulting in a pandemic [1]. According to World Health Organization (WHO) statistics, as of September 10, 2021, there were 223,022,539 positive cases of COVID-19, with 4,602,883 fatalities reported worldwide. A total of 5,352,927,297 vaccine doses had been facilitated since September 5, 2021 [2]. The flu-like signs of the disease include coughing, fever, exhaustion, breathlessness, lack of odor and appetite, migraine, and muscle discomfort are the common indications of the infection [1].

The virus's primary genesis is still unknown, but investigations on the virus's genome sequence have revealed that it belongs to the β -CoV genus under coronavirus species originating from mammal hosts, more specifically bats and rodents. SARS-CoV-2 spreads *via* direct touch and air. It enters respiratory cells by bonding to “Angiotensin-Converting Enzyme 2 (ACE2)”. As the virus mutates, it causes numerous issues in all aspects of human existence, and new challenges arise as time passes. Each day, advanced innovations are designed to tackle these quickly increasing difficulties [3].

The exploration and implementation of technologies that mimic human intellect are called Artificial Intelligence (AI). AI is proving itself as an effective technology in a broad spectrum of sectors, notably hoax detection, computer vision, digital advertising, robotics, and autonomous driving vehicles, and so on. With its achievements in fields such as the diagnosis of diseases, medication, patient observation, drug development, epidemiology, and so on, there is a great aspiration that AI will become a flourishing field of research to address the difficulties that humanity is currently experiencing [4].

It is believed that AI will be critical in aiding medical and academic research on COVID-19 and subsequent events. For example, at the start of the pandemic, China implemented a series of anti-virus measures, including using AI-based technology. In this endeavor, they investigated using facial recognition sensors to detect diseased individuals, drones to sanitize spaces, bots to transport food and medicines, *etc* [5]. Constituent elements of AI are depicted in Fig. (1).

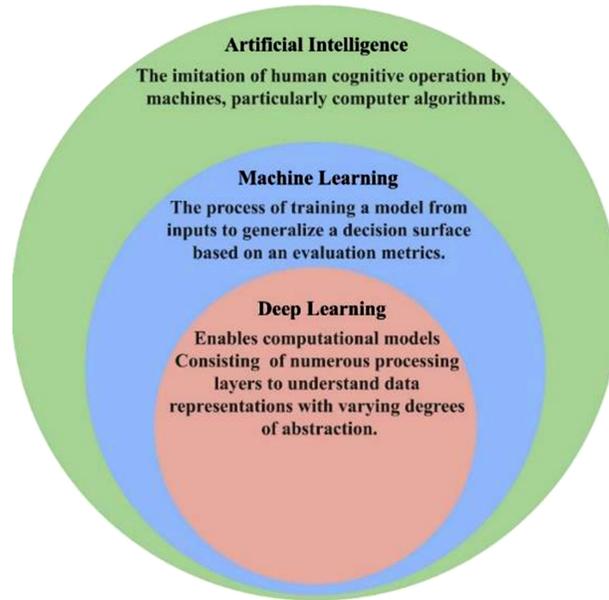


Fig. (1). Relationship between AI, ML and DL.

Machine Learning (ML)

ML is a data analysis technique that facilitates the creation of analytical models. It is a subfield of AI predicated on the premise that algorithms can learn from data inputs, spot patterns, and decide things with little or no human interference. Increasing data quantities and variety, cost-effective, more efficient computing and processing, and low-cost data storage are the motivating factors for ML evolution. Hence, the models can be created rapidly and autonomously to evaluate larger, more complicated information and offer faster, more precise results, even on a massive scale. An organization improves its chances of recognizing valuable possibilities or avoiding unexpected risks by developing detailed models [6].

ML is broadly classified into five subsections, as shown in Fig. 2 This chapter. mainly involves supervised, unsupervised, and DL. A dependent variable in statistics is referred to as a label in ML. Similarly, a variable in statistics is referred to as a feature in ML. The ML algorithm is trained using a set of features and their corresponding labels to predict the label of new features. The process of categorizing a given dataset into class labels is known as classification. For example, discriminating between cancer and normal data points. Logistic Regression (LR), Naïve Bayes (NB), Stochastic Gradient Descent (SGD), K-Nearest Neighbors (KNN), Decision Tree (DT), Random Forest (RF), Support Vector Machine (SVM) and Multi-Layer Perceptron (MLP) or Artificial Neural Networks (ANN) are most commonly used classification algorithms. Accuracy

Case Study: Impact of Industry 4.0 and Its Impact on Fighting COVID–19

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Abstract: The emerging development in industrial technology for automation and data sharing is known as Industry 4.0. It incorporates the Internet of Things, Cyber-physical systems, and Cloud computing, all of which contribute to the development of a “smart factory”. Customers, distributors, vendors, and stakeholders in the supply chain would be capable of connecting and can exchange data easily through Industry 4.0. The COVID-19 pandemic is quickly spreading and posing a threat to people all over the world. Employment and activities in all markets have been disrupted, putting economies all over the world in serious jeopardy. To combat the pandemic, retailers will benefit from Industry 4.0 because it will help to mitigate the impact of identified risks. I4.0 executives were focused on gaining a competitive edge, rising efficiency, lowering prices, and, ensuring profitability as their primary aim was to enhance the productivity of business during the time before the COVID-19 crisis. Our Government has imposed new behavioral trends including social distancing, isolation and, lockdown. The Government needs additional financial resources to combat pandemics as a result of these actions, there has been a global economic slowdown. This chapter enlightens the significance and technologies of Industry 4.0, showing how those technologies and applications help in attaining a better society. It also explains how Industry 4.0 helps in accomplishing sustainable manufacturing and the management tactics it used to boost the company's efficiency, as well as the effects of COVID-19.

Keywords: Artificial Intelligence, Automation, Bigdata Analytics, COVID-19, Customer, Cloud Computing, Cybersecurity, Digital Manufacturing, Government, Global Economy, Industry4.0, Internet of Things, Manufacturers, Pandemic, Robots, Retailers, Supply Chain, Sustainable Manufacturing, Technologies, Virtualization.

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INTRODUCTION

COVID-19 (coronavirus disease) pandemic has impacted nearly every country and had a substantial impact on healthcare facilities. The spread of COVID-19 was like wildfire posing a serious threat to 213 countries and territories all over the world [1]. This pandemic has disrupted employment and activities in all marketplaces, putting economies all over the world in significant peril [2]. The vision and implementation of a smart factory are made easier with Industry 4.0.

The German government first proclaimed Industry 4.0 as the start of the 4th industrial revolution during the Hannover Fair in 2011 [3]. The fourth industrial revolution is a novel degree of organization and control that encompasses the entire value chain of an item, from raw resources to production, distribution, assistance, and recycling. It is focused on the real-time intelligent management of all data available throughout the product and production system life cycle. The goal is to create a high level of product customization in a highly flexible mass-production environment. The basic idea of Industry 4.0 is to integrate machines, systems, and smart work pieces. Businesses create intelligent networks that can interact with each other independently along the whole value chain.

Industry 4.0's ultimate aim is to make manufacturing and allied industries more productive, quicker, and customer-centric, as well as to explore new business prospects and models beyond automation. Industry 4.0 promotes production efficiency by gathering information wisely, making sound judgments, and carrying them out without reluctance. Retailers will also benefit from Industry 4.0 to combat the pandemic because it will help to mitigate the impact of identified risks [4].

Industry 4.0 can transform the manufacturing industry to the next level. It also has the potential towards becoming a reality in which factory automation is widespread and factories are significantly more intelligent than it has been ever. Industry 4.0 aims to collect massive amounts of data from a variety of sources. The production planning tool is a crucial factor in translating acquired data into an actionable outcome that nourishes the networked supply chain inside the manufacturing environment.

The procedures for gathering and evaluating data will be made easier by utilizing the most current technologies. In Industry 4.0, the interoperability operational capability serves as a “connecting bridge” to ensure a stable manufacturing environment [5]. To deal with global difficulties and raise industrial levels, Industry 4.0 uses emerging technologies and the rapid progression of equipment and tools. By using technical expertise, production can run more quickly and smoothly with less downtime [6].

The drive to implement Industry 4.0 poses a wide range of technological obstacles, with significant implications across a wide variety of aspects of the manufacturing industry. As a result, developing a plan for all the actors of the complete value chain, as well as accomplishing an agreement on security issues and appropriate design before implementation begins, is critical.

COVID-19 and Technology

Various technologies have been employed to track the COVID-19 pandemic progression. All of these techniques and activities have been created in the hopes of slowing the spread of the disease. It has been used to keep an eye on public venues and patients, create new, effective vaccines, ensure the continuation of the education system and small and large businesses, and lessen the impact of quarantines on citizens, and relieve pressure on overburdened healthcare professionals [7].

The Enterprise Resource Planning (ERP) software is used at the corporate level. A business strategy, operations management, accounting, marketing and distribution, management of human resources, and other enterprise-wide marketing plans are all supported by ERP [8]. Artificial intelligence and drones have been performed to analyze public areas to determine whether or not social distancing was being reflected. Cloud-based platforms like Google Hangouts, Google Meet, and Zoom have now been deployed all around the world to make it simpler for employees to work and students to continue their education online. This chapter enlightens the significance and technologies of Industry 4.0, showing how those technologies and applications help in conquering a better society. It also explains how Industry 4.0 helps in accomplishing sustainable manufacturing and the management tactics it uses to boost the company's efficiency, as well as the COVID-19's effects.

CONCEPTUAL FRAMEWORK FOR INDUSTRY 4.0

Introduction

The use of emerging and rapidly evolving digital technology to tackle specific problems is referred to as digital transformation. It is rapidly becoming a top concern for enterprises around the world, and the planning phases have sped dramatically, particularly during the COVID-19 epidemic [9]. The core technology trends and design concepts have facilitated new production methods as a result of the digital transformation of manufacturing industries [10]. Manufacturing firms, service, and operational environments have been paying

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