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IoT Based Smart Applications

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Preface

The Internet of Things (IoT) is emerging as one of the most prominent technological concepts in the twenty-first century. We live in a world where new objects are connected to the Internet with the aim of improving and facilitating people's lives. In addition, objects that we did not even imagine a few years ago as part of the network are now beginning to be connected, offering a new immense range of possibilities. The main motive of this book is to provide insights into IoT, its applications, and implementation techniques. Today, IoT has become a promising technology that connects the different objects embedded with sensors and software to exchange information without human intervention. Here, various IoT-enabled technologies and applications will be discussed along with their pros, cons, and future directions.

This book will also cover the future of IoT in various sectors and will discuss how IoT will be proven to game-changing technology. In this book, the IoT design methodology to define the domain model will be discussed. The designing process using Arduino that offers smart, connected, and secure elements will also be emphasized in this book. The integration of IoT with blockchain, cloud, machine learning, big data, embedded software, and sensors will be covered here. At last, we also intend to cover the various technologies that can be integrated with IoT to get the optimized use of this technology. That is why this book, *IoT Based Smart Applications*, has been written with the collaboration of international scientists who provide different visions and solutions to some of the most important current problems from the point of view of the Internet of Things community and from an even more interesting mixed point of view.

Chapter 1 is entitled "A Study on COVID-19, Its Origin, Phenomenon, Its Variants and IoT-Based Framework to Detect the Presence of Coronavirus." In this chapter, the authors focus on finding out solutions for the detection of this contagious viral infection at the earliest. Computer-based artificial intelligence can be used to monitor and detect the symptoms of coronavirus. For detection of coronavirus infection, computers or smartphones can be embedded with biosensors that will perceive the information and will convert the information into digital data. In this chapter, a study on the coronavirus is done and an IoT-based framework is proposed to detect the coronavirus using IoT-based sensors. The proposed approach will be

able to detect the pandemic in its early stages, and so better options will be there to prevent and cure.

Chapter 2 is entitled "Blockchain for Internet of Things (IoT): Research Issues, Challenges and Future Directions." The authors explain the importance of the blockchain for the Internet of Things. Traditional electronics has become smarter as a result of seeing things on the Internet. Whereas this era known as Blockchain appears as a first-rate deliver of presenting safety to this new age of technological programs, the speedy evolvement of smart devices demands trusted security for the maintenance of the IoT containing application's knowledge safety, security, and authentication. This research inspects the IoT protection answers by using integrating IoT programs with blockchain. The evaluation consists of blockchain basics, kinds, and layout for the Internet of Things. It will also look at the hurdles and problems of IoT in blockchain adoption, particularly in terms of security, privacy, throughput, block size, multichain management, and social control.

Chapter 3 is entitled "Smart Healthcare by Harnessing the Internet of Things (IoT): Applications, Challenges and Future Aspects." In this chapter, the authors discussed IoT-enabled devices that have helped in solving many problems in the healthcare sector. The improved potential to keep patients safe and healthy has empowered physicians to provide superlative care. These devices range from sensors that monitor patient's gluten and glucose levels in the blood, blood pressure, and heart rate to even monitoring food and water intake. This chapter intends to provide a detailed overview of how IoT has spread its branches far and wide into the field of healthcare. The real-time applications of IoT, such as the diagnosis of diseases, surgery, and clinical trials, have been explained in detail. Moreover, various important aspects like biosafety, security, and legal challenges with respect to its commercialization have also been discussed.

Chapter 4 is entitled "Applications of IoT in Smart Homes and Cities." This is a summarized chapter in which the authors focus on some of the most interesting concepts behind IoT, like the different possible applications of IoT in smart homes and smart cities, the components related to IoT architectures, the importance and type of sensors, the main network technologies, implementation of IoT, the most relevant current challenges, and some possible lines of future work.

Chapter 5 is entitled "Gesture-Based Smart Assistive Device for Elderly and Disabled People Using IoT." In this chapter, the authors introduce the design in a manner that many elderly people and people with disabilities receive daily benefits. This is done using sensors and microcontrollers to achieve automation with the widely used Android mobile operating system. Home appliances and electrical devices can be controlled via Bluetooth wireless communication protocol and Android mobile from anywhere outside of the house when the appliances are not switched off. Numerous home appliances and electrical devices such as fans, refrigerators, and lights can be controlled via the Android OS. Home automation can include the control of HVAC (heating, ventilation, and air conditioning), lighting, security locks of gates and doors, home appliances, and devices to provide and improve convenience, comfort, energy efficiency, and security. Home automation can provide a better quality of life for those who may need care or nursing facilities,

people with disabilities, and the elderly. To address the problem, solutions and related technologies are reviewed and presented.

Chapter 6 is entitled "IoT-Enabled Intelligent Traffic Management System." In this chapter, the authors address the problem of rapidly rising vehicle count and propose intelligent transportation problem using various sensors. The chapter focuses on providing a review of some challenges and emerging trends, and compares various sensor frameworks in terms of cost, reliability, accuracy, performance, and maintenance. The number of automobiles on the road has risen dramatically in recent years. Traffic congestion is a rising issue that everybody deals with daily. Manual traffic control by traffic cops has not proven to be successful. The signal's fixed set time in all conditions (low and high traffic density) hasn't solved the issue. The use of the Internet of Things (IoT) is proposed as a model for effectively solving the problems described above. For Internet-based computing, we use the cloud, which provides various resources such as servers, storage, and application for traffic management. To track the number of vehicles and traffic congestion on a road, a network of sensors is used, and rerouting is done according to the traffic density on the lanes.

Chapter 7 is entitled "A Survey and Challenges: Embedded System on IoT." An embedded system is made up of electronic hardware and software. It contains a sensor to sense the environment and actuators to respond. There are millions of such embedded devices available in the environment, but interoperability between them is a significant issue. IoT is a technology that provides communication between such embedded devices over the Internet. Therefore, the existence of IoT is an outcome of the fourth industrial revolution of disruptive communication technologies. It is integrated with sensors, embedded systems, computing, and communication technologies. Embedded system is the heart of IoT. IoT computes and communicates data and stores it in the cloud for future data analysis. IoT is mainly used to provide seamless data storing and analyze the environment. This chapter addresses the design aspects of a system required for IoT to use in any general application. This chapter presents system architectural comparison, interrupts, task execution, scheduling, switching tasks and latency, prioritization of tasks, real-time tasks, real-time operating system, multitasking, sensors, actuators, memory footprints, and communication standards. This chapter summarizes the architecture and its processors recommended for IoT.

Chapter 8 is entitled "Integration of Big Data and IoT in Modern Era." This is a summary chapter in which the authors focus on some of the most interesting concepts about big data, existing attacks, and an integration technique of big data and IoT that will help reduce the data generated in an IoT environment.

Chapter 9 is entitled "Internet of Things (IoT) for Sensor-Based Smart Farming: Challenges and Opportunities." In this chapter, the authors talk about the implementation of IoT in the smart farming and agriculture industry and its various applications in the field of technological advancements. In the past couple of years, the agriculture sector has grown a lot because of the advancements in technology. For instance, with the assistance of the Internet of Things (IoT), farmers can now monitor soil humidity, crop health, and many other parameters using various sensors

without even going to the field. Thus, by reducing human intervention through automation, Internet of Things (IoT) technology can make the agriculture industry more efficient and effective, and can lower the production cost. Internet of Things is a gateway to the solution of smart farming which will certainly mitigate problems like famines.

Chapter 10 is entitled "Implementation of IoT in Various Domains." In this chapter, the authors discuss IoT for industrial applications and how these systems are being implemented in various fields. Moreover, the authors focus on the implementation, advantages, disadvantages, and applications for Industry 4.0. The authors also analyze the usage of artificial intelligence (AI) that has moved H-IoT to almost the next level in various domains in which a range of different sensors is commonly used.

Chapter 11 is entitled "Application of IoT in Wearable Technology." According to the authors, Internet of Wearable Things is among the expert improvements that have adapted to the digital age. Wearables are finding a wider range of applications in our everyday lives. A wide range of digital gadgets referred to as "wearables" includes sensors that offer the thrilling possibility for features used in tracking and sending alert signs. Wearables are grouped into four dominating bunches: (i) wellness, (ii) sports exercises and ordinary distraction, (iii) observing and confinement, and (iv) security. They depict how different sensors may provide a wide range of readings that could be useful for a range of methods. Wearables come in a variety of shapes and sizes; they all have a certain purpose to perform in different sectors. One of the important attacks on the wearable era is the authentication among other troubles viz-a-viz erroneous sensors, battery/energy problems, limiting the users in monitoring location/space, and lack of interoperability. This chapter furthermore addresses the chances and applications and also discusses the circumstances identified with executing.

Chapter 12 is entitled "Role of IoT in Smart Homes and Smart Cities: Challenges, Benefits and Applications." In this chapter, the authors describe IoT and its application to smart homes and smart cities, how to create and use these applications using IoT, the various hardware and software features required for IoT use, the challenges and weaknesses of IoT usage for smart homes and smart cities, and benefits of using IoT in smart homes and smart cities. This chapter examines the current and future examples of IoT, and it will show readers how IoT will interact with our lives in the future

Chapter 13 is entitled "Investigating Role of IoT in Development of Smart Application for Security Enhancement." This chapter presents IoT solutions to enable the customers to automate, analyze, and integrate their systems to a greater extent. The Internet of Things includes sensors, networks, and robotics, and it employs both old and new technologies. The Internet of Things makes use of software breakthroughs, lower hardware costs, and a contemporary approach to technology. This research has focused on IoT-based smart applications that could be used for security enhancement in industries as well as homes. In other words, this research has introduced smart applications to maintain security from threats such as theft, fire, and other unexpected events that may result in financial loss.

Chapter 14 is entitled "Role of Augmented Reality and Internet of Things in Education Sector." In this chapter, the authors outline the role of augmented reality and IoT in education systems. The research on the role of augmented reality in education systems is relatively at an early stage, and IoT is expected to improve the quality of education through the development of innovative applications. Using this technology, one can gain insights into why it is a part of everyday learning and teaching methods. The right approach is to integrate IoT and AR to make AR scalable, allowing for more perceptual coverage of a wider range of educational systems and interactions via IoT around the world. This chapter explains the use of augmented reality in the IoT. The authors also deal with some common applications of the related technologies together with the benefits and the expected growth of IoT.

Chapter 15 is entitled "Raspbian Magic Mirror: A Smart Mirror System to Assist on IoT Platform." In this chapter, the authors introduce the design and build a smart mirror that can be used for home automation and has a user-friendly interface for data monitoring. The smart mirror displays information such as the current date, time, and temperature in addition to the image. A future trend is towards implementing a smart mirror that can gather and obtain data via IoT devices and serve as a platform for home automation. The experiment results reveal that utilizing a Raspberry Pi is significantly more cost-effective and offers excellent results to construct a smart mirror.

Chapter 16 is entitled "Use of Machine Learning and IoT in Agriculture." This chapter provides the latest insights into current research initiatives that significantly impact smart agriculture and farming. It provides a detailed impact of IoT, machine learning, and data analytics that can be used for disease control, monitoring the climate, measuring soil temperature, nutrient value, moisture levels, controlling and analyzing water consumption, and much more. These shall help follow the scientific procedures for plant growth and increase of crop yield. It refers to the latest work of researchers to provide the solutions to various agricultural challenges, using several ways to automate and maximize agricultural produce.

Chapter 17 is entitled "Intelligent Technology, Systems Support, and Smart Cities." This chapter explores all the facilities supported by the latest technologies and their role in supporting the functioning of smart cities. The authors present a review of IoT issues and challenges in the emerging stages of the design of smart cities in India. Some of the issues addressed by the authors include legal, regulatory, economic, infrastructure, security, and privacy aspects. The chapter also deals with network communication models used in establishing connection between devices and the Internet.

Chapter 18, entitled "Deep Learning Approach for IOT-Based Multi-Class Weed Classification Using YOLOv5," discusses the deep learning approach for IOT-based multi-class weed classification using YOLOv5, and the quality information about soil, local climate, and the crop in an IOT environment is captured by the sensors. Furthermore, it is possible to obtain statistics that go beyond human observation. They enhance and speed up data collection, perform commands automatically or remotely, and perform remote tasks and actions in real time.

Chapter 19 entitled "Intelligence and Cognitive Computing at the edge for IoT: Architecture, Challenges, and Applications" discusses the intelligence and cognitive computing at the edge for IoT with its Architecture, Challenges and Applications where the cognitive computing is the development of computerized models to mimic human behavior. The best examples are virtual assistants such as Siri, Alexa, and Cortana. Cognitive computing and AI play a big role in solving problems and building applications to support several domains in Internet of Things (IoT). The downside to AI and cognitive computing is the complexity of the architecture involved in building models that support IoT.

Chapter 20 is entitled "IOT Sensors-Based Smart Agriculture Using AGRO-ROBOT" that discusses the current investigation and research innovation of Agro-robot to define the technical work in the form of project and prototype which illustrates how Robots are capable and useable in field of farming and other works to solve the challenges of agriculture by using robotics.

Chapter 21 is entitled "Role of the Internet of Things (IoT) in Digital Financial Inclusion." This chapter aims to identify the underlying factors affecting the role of IoT in digital financial inclusion. The chapter is based on a sample size of 120 respondents from the National Capital Region of India. The principal components analysis method is used to find the factors. Many of the significant factors are identified, viz. IoT awareness, financial service awareness, usability, benefits, trust, security, and privacy, as well as accessibility.

Chapter 22 is entitled "Diagnosis of COVID-19 Using Low Energy IoT-Enabled System." This chapter focuses on Web of Things / Internet of Things (IoT) which is an innovation used to give data and check the framework during COVID-19 scourge. This innovative stage can be utilized to handle difficulties during lockdown-like circumstances. IoT would assist in giving a mechanized and straightforward treatment procedure to handle COVID-19 epidemic (pandemic situations) circumstance. With Internet of Things (IoT), machine learning and artificial intelligence, the distributed computing phase is highly accurate as it enables to provide active feedback from management and evaluators. For additional useful applications, we can also point out the most checked slots and ranking reasons.

The editors are indebted to Almighty God for giving blessings to complete this book. Completing a book is not an easy task; it starts with consuming many hours, months, and more. We can attest that during that time, we were working closely with publishers, editors, and authors. We are very much thankful to our beloved Eliska Vickova, Managing Editor, European Alliance for Innovation (EAI), for having faith and giving us a chance to edit this book. From proposal submission till completion, your support was very helpful to us. We are sincerely thankful to the EAI Springer Group. We want to convey our thanks to all the authors who participated in this book project; due to scope and quality, we could not accept many good chapters, but we are sure that the work included in this book will prove helpful to young researchers and industry entrants in the field of IoT and big data. Our book will help them build their planning strategy and will prove to solve their real-time problems. We will be very happy to hear your feedback about this book. Though utmost care was taken in selecting the chapters and authors' work, which was

closely monitored and revised with rigorous peer review, authors' or readers' reviews and feedback will be very useful for us, to ensure their points are addressed in our forthcoming books. We request you to purchase this book for your institution library and research lab, and to take advantage of the cutting-edge technology exploration information throughout this book.

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Contents

Chapter 1
A Study on COVID–19, Its Origin, Phenomenon, Variants, and IoT-Based Framework to Detect the Presence of Coronavirus

Vikas Menon, Digvijay Pandey, Dishant Khosla, Mandheer Kaur, Harshit Kumar Vashishtha, A. Shaji George, and Binay Kumar Pandey

1.1 Introduction

In 1965 a common cold named B814 came into existence when Tyrrell and Bynoe were studying samples of human embryonic trachea taken from the respiratory tract of an adult. At the same time, Hamre and Prock now obtained samples from medical students with cold and cultured a virus in tissue culture showing unusual properties they named it Hamre's virus, later on known as 229E. The relationship between B814 and 229E viruses with myxoviruses or paramyxoviruses known at that time was not found to be close enough. In the late 1960s, morphological constraints were found to be having similarities between certain animal viruses such as mouse

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hepatitis virus, swine flu, gastroenteritis virus, and infectious bronchitis virus with some human strains as studied by Tyrrell along with a group of virologists working together. This new group of viruses having the crown-like appearance of the surface projections was later officially accepted as coronavirus. Research studies conducted on the coronaviruses revealed that in humans living in temperate regions, the occurrence of respiratory coronavirus infections was more often observed in the winter and spring as compared to the summer season [1, 2].

Coronaviruses are enveloped viruses with a positive-sense single-stranded RNA genome and a nucleocapsid of helical symmetry constituting the family Coronaviridae, subfamily Orthocoronavirinae, and order Nidovirales. Coronaviruses are the largest among known RNA viruses with genome sizes ranging from approximately 27–34 kilobases. Coronaviruses can cause severe illnesses ranging widely in any age group. China has been said to be the forefront country where the emergence of viral infections occur, and this may be due to the consumption of poultry, bats, snakes, and other wildlife animals. In 1997, China witnessed avian influenza in 2003, the severe acute respiratory syndrome (SARS caused by a coronavirus), and in 2010 a severe fever with thrombocytopenia syndrome (SFTS). In 2012 a severe illness outbreak began in Saudi Arabia with the Middle East Respiratory Syndrome (MERS). On 12 December 2019, 27 cases of viral pneumonia with an unknown causal agent as an outbreak were reported in the city of Wuhan, China, by the Wuhan Municipal Health Commission (WMHC). On December 31, 2019, Chinese authorities declared the outbreak of a novel strain of coronavirus causing severe illness and named it SARS-CoV-2. WHO declared 2019-nCoV an epidemic for world public health on 30 January 2020 [3]. The basis of their studies summarized that the genetic makeup of bat coronavirus has most similarities with 2019-nCoV and has maximum similar codons as with snakes. They also, depicted that viral receptor-binding spike glycoproteins are responsible for homologous recombination that determines cross-species transmission. The information derived from their evolutionary analysis can be highly significant in the future for effectively controlling the pandemic 2019-nCoV [4, 5].

The COVID-19 has proven a big challenge since 2019 for the whole world. Human civilization needs to battle the COVID-19 with effective measures and precautions. Researchers and doctors from all over the world are consistently working on generating solutions for the problem. One of the biotechnological reports revealed that real-time PCR used for COVID-19 can de reframed with the Internet of Things (IoT). This trial will collect real-time data from users which can further be used to identify the suspected cases. This methodology will monitor the post-virus recovery response. This system is composed of five main components: data collection system and sensors for uploading, isolation spots, algorithms for data analysis, health workers, and cloud infrastructure. Various algorithms used are vector machine, neural network, Naive-Bayes, K-nearest neighbor, decision table, decision stump, One R, and Zero R. This experiment has given effective and reliable results with 90% accuracy. Based on this study, we believe that this real-time data and IoT-based framework have the potential for identification and management of COVID-19.

Another IoT-based COVID-19 detection model is based on the body components framework. In this context, the parameters considered for IoT-based diagnosis are body temperature and respiratory quotient. Along with these physical parameters, some biochemical factors can also be included like total leukocyte count. This data can be accessed over Wi-Fi and with the Internet also. Assisting accessories like breathalyzer will be sanitized automatically and automatic loading of injection needles can be done and is convenient. This product would be commercially economical and reliable.

1.2 Origin of 2019-nCoV

The first outburst of pneumonia transmitted person to person having an unknown causal agent was reported in Wuhan City, Chinese Hubei Province, on 31th December 2019 [3], and pathogen identification was done later on. For identification of the causal agent, a large number of plausible pathogenic constraints were screened and then ruled out, including the *Middle-East respiratory syndrome coronavirus* (MERS-CoV), the *severe acute respiratory syndrome coronavirus* (SARS-CoV), avian influenza virus, and other common pathogens causing respiratory problems. According to the scientific literature and medical history, there was no evidence of contagious transmission as thought to be [6]. The first-ever "super-spreading" evidence came into knowledge when two local 2019-nCoV infected patients visited to Guangdong Province of Wuhan on the 20th of January 2020, and 14 medical staff who attended these patients got infected by 2019-nCoV which concluded the human-to-human contagion [5]. Further laboratory investigations were done in four different Chinese research institutions: the Academy of Military Medical Sciences, the Chinese CDC, the Chinese Academy of Medical Science, and the Chinese Academy of Sciences and Wuhan Institute of Virology. Laboratory testing specimens were taken from the upper respiratory tract of the patients admitted with the symptoms of 2019-nCoV and maintained in COPAN Universal Transport Medium. RT-PCR Diagnostic Panel was used to confirm the 2019-nCoV infection onset by qualitative detection of nucleic acid taken from respiratory specimens. Laboratory tests done on all the throat swab specimens revealed their deduction of lymphocytes in most patients [7, 8]. This result suggests that 2019nCoV was affecting T lymphocytes, as SARSCoV does, thus weakening the immunity of the person been infected. A further conclusion was drawn that this virus generates a cytokine disturbance in the body, inducing a cascade of immune responses, leading to changes in white blood cell count and cells responsible for immunity such as lymphocytes spreading through the respiratory mucosa [9, 10].

Studies done on infected persons suggested person-to-person transmission occurs commonly during the close exposure of a normal person to a person infected with COVID-19. Studies revealed that respiratory droplets are produced when the infected person coughs or sneezes. These respiratory droplets produced due to coughing or sneezing can land on the surface or body nearby and when the normal

person comes in direct contact can get transmitted either through eyes, nose, and mouth or possibly be inhaled into the lungs of those within close proximity [11]. However, the probability of airborne transmission from person to person over long distances is not verified (CDC 2020). 2019-nCoV is an RNA virus, having a high mutation rate, due to genome-encoded exonuclease mutation rate in the coronaviruses might be somewhat lower than that of other RNA viruses. This mutation rate increases the possibility for this newly introduced epidemic viral pathogen to become more virulent and more efficient to be transmitted from person to person [12, 13].

1.3 Current Situation of the Epidemic and Preventive Measures

Until April 2020, 2019-nCoV positive cases were increasing throughout the world. As of 9th April, there were a total of 14, 90,790 cases confirmed in the whole world, including 88,982 deaths and 3, 32,486 cured cases. For combating epidemic 2019-nCoV, the central and state governments of all countries throughout the world have taken a series of desperate measures. All government agencies have started to conduct laboratory exploration for characterization and treatment of the disease, including quarantining of suspected patients, monitoring clinical status of patients individually, and developing diagnostic and treatment protocols [14–16]. Africa Task Force for the Novel Coronavirus on Feb 3 was established by the Africa Centres for Disease Control and Prevention [17]. A lot of countries including India have gone for 1–3 weeks lockdown so that patients infected with the coronavirus remain in quarantine to minimize the spreading of the virus.

For the status in India, as per statistical survey analysis till 2019, 88.5% of caseload was observed in states such as Maharashtra, Delhi, Tamil Nadu, Madhya Pradesh, Gujarat, Rajasthan, and Uttar Pradesh. In comparison to these stats, very few state and union territories of India affected by this disease are Northeastern states like Meghalaya, Mizoram, and Nagaland and union territories like Andaman Nicobar, Dadra and Nagar Haveli, and Daman and Diu. Maximum expression of this disease was reported in Maharashtra (107958) followed by Tamil Nadu (44661) and Delhi (41182). The fatality rate concluded was 2.9%.

The key factors which contribute to the progression of the disease are migration and population density. Delhi, Uttar Pradesh, Madhya Pradesh, and Maharashtra have shown maximum migration of labor.

The maximum cases reported of cases are between the age group 25–59. Telangana has reported maximum COVID-19 cases due to migration in the earlier part of May 2020. Another promising factor responsible for disease transmission is population density as shown in Fig. 1.1. Highly dense states and localities were declared 123 hot spots by the government of India based on census.

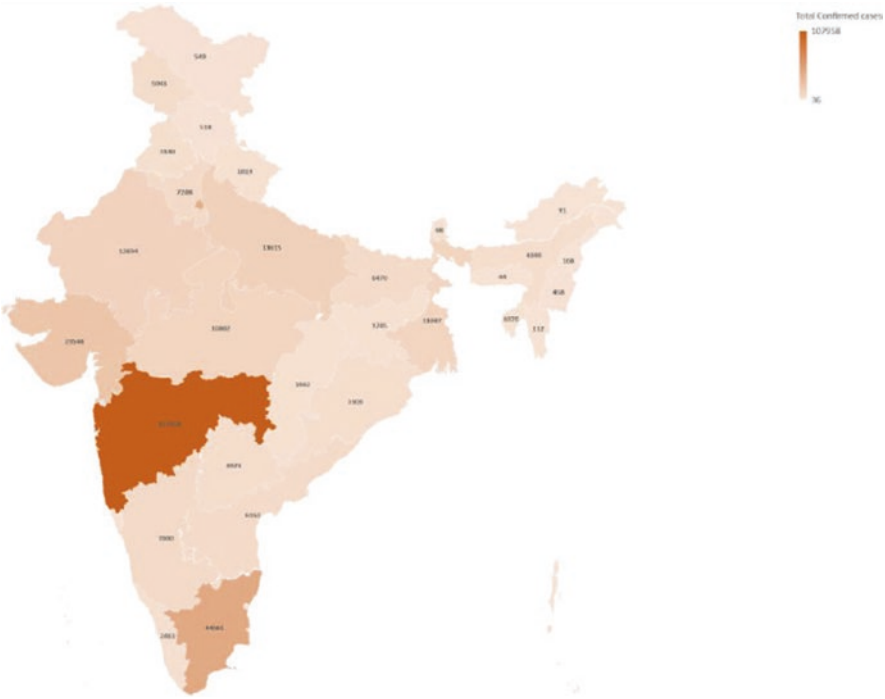

Fig. 1.1 Map showing caseload of COVID-19 statewise

Preventive Measures: COVID-19 got transmitted from person to person in many ways such as through droplets and aerosol via cough and sneeze. Close contact between people also increases the transmission rate. Poor ventilation and crowded indoor maximize the disease progression. In India, different states government has taken many actions to slow the disease spread rate. One study reported that Kerala has got early slowdown in spread rate by applying the following measures:

- Insistent testing and checking of all travelers from China and other countries
- Powerful contact and tracing 28 days follow-up
- Proving sampling collection centers in the district and local levels
- 28 days quarantine period
- Establishment of isolation centers near the communities
- Superior hospital readiness to prevent disease progression

1.4 IoT-Based Framework to Detect Coronavirus

For smart network and proper health management systems, IoT-enabled interconnected devices are very crucial for fighting with pandemics. With the decisions-making process, the system can track and alert the patient to improve security. IoT can be used as countermeasure technique for COVID-19 pandemic. Table 1.1 shows IoT application.

The framework based on the Internet of Things (IoT) [18–20] is explained which are cheaper, user friendly, and readily available [21–24]. In the first step, for a suspected patient, the symptoms of SARS-CoV-2 are to be detected properly and accurately. The common symptoms of SARS-CoV-2 are breath soreness, fever, dry cough, pain, drop in SPO_2 level, and weakness. In the proposed framework, IoT-based sensors can take input from the user, measure the level of each symptom explained, and provide data processing for analytics. In the framework, IoT-based sensors include a heart rate sensor, temperature control, microphone, and proximity sensor which enable the system to detect the symptoms of coronavirus easily.

> Each sensor reading has the application of a different algorithm owing to the different symptoms of the disease. For example, fever can be detected with the help of an IoT-based temperature sensor. The human fatigue can be detected using the IoT-based camera where a human is asked to do 30 sit-ups and the situ-ups can be analyzed. Also, samples of lung CT scans and x-rays of the chest can be uploaded via the same IoT-based camera [25]. The IoT-based microphone sensor can be used to identify the cough type whether it is a dry cough or not.

In the proposed framework, the abovementioned sensors have been used. Using the sensors to collect the data and analyze and gather the results, the prediction of symptoms is done. The data is stored for analysis purposes.

> After collecting the records and data from various patients, they are used as inputs to the various techniques of machine learning. The techniques of machine learning in the medical field include neural networks and k-nearest neighbor. There are various deep learning [26]

Table 1.1 IoT application in health care

S. No	Application	Description
1	Internet-connected hospitals	IoT-based systems can be used to connect hospitals to the Internet, where corrective measures can be taken if some emergency is raised
2.	Automated treatment process	It helps in the appropriate handling of cases and treatments
3.	Smart tracing of infected patients	With the use of RFID devices, the movement of patients can be tracked
4.	Real-time information	During the spread of this infection, on-time information sharing can be done
5.	Geospatial AI-based application	The data can be taken of affected areas using a GIS system and areas can be put in a contamination zone

methods in the machine learning techniques which are quite accurate and come under the family of neural networks. CNN and RNN are the two main algorithms for deep learning which are used for recognition and classification.

Recurrent neural network (RNN) and convolution neural network (CNN) imply recursive neural network [26, 27]. In RNN, the next layer input will be the output of the previous layer saved. The measurement of signals and tests is mostly done by RNN. CNN is used for spatial data whereas RNN is used for saving temporal data. Figure 1.2 shows the proposed framework.

In the first step, the collection of the data IoT sensors is done. For example, the computed tomography (CT) scan of the lungs, x-ray scan of the chest and lungs, and videos are captured through an IoT-enabled high-quality camera sensor, and stand-sit measurements of the suspected patient is collected by it; through the IoT-based microphone, the cough sound is taken and identification can then be done. Using the IoT-enabled heart rate sensor, heart rate can be recorded, the oxygen level of a person can be detected using SPO2 sensor, and the IoT-based temperature sensor is used to measure the degree of temperature. In the next step, for further processing of the data, the received data in the analog form is converted into digital form. After digitizing the data, the next step includes the preprocessing and standardization of the data which is moved to the cloud network. Then, the analysis and management

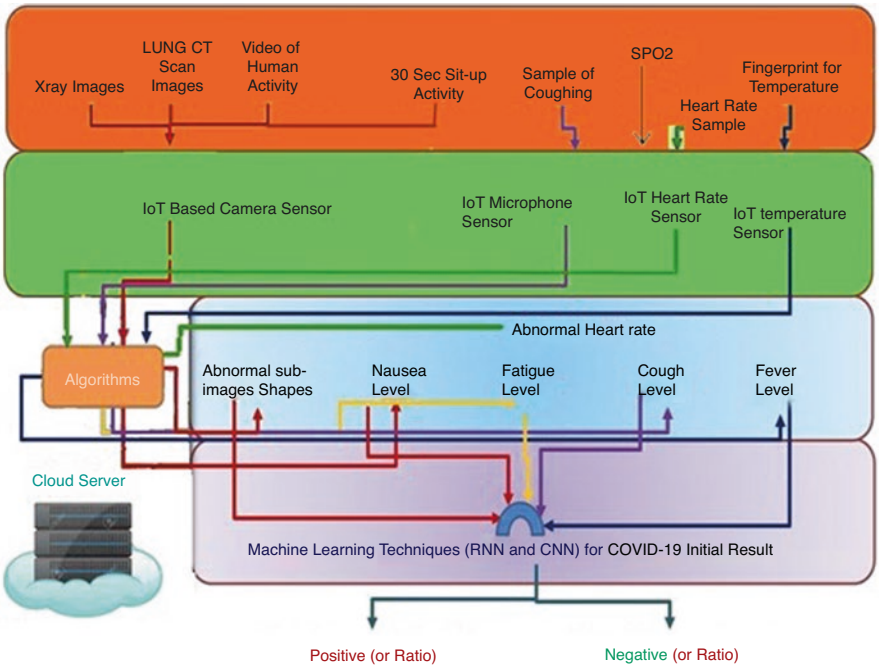

Fig. 1.2 Proposed framework to predict COVID-19 using IoT

of data are done. This is done when the health-care [28] personnel receive the symptoms of the patient through a cloud network in the form of data. The doctor who is authorized to access the cloud network detects the symptoms and diagnoses the disease COVID-19 to be either positive or negative [29]. The progressive CT scan images of the lungs are shown in Fig. 1.3.

Using x-Ray images, the presence of coronavirus with the use of deep learning is possible and being used with the accuracy of training model of 99% and 98% of the confusion matrix [30]. With the presence of coronavirus COVID-19, the epithelial cells of respiratory systems are affected. So, x-rays can be used to analyze the presence of COVID-19. In the work to detect the presence, the dataset of x-rays of COVID-19 affected and x-rays of normal people is used to train the model for deep learning. Then with deep learning and CNN, the model was able to detect the presence of COVID-19 virus through x-ray image [25, 31]. Figure 1.4 shows the x-ray dataset of normal and COVID-19-positive persons, and Fig. 1.5 shows the detection of COVID-19 using algorithm.

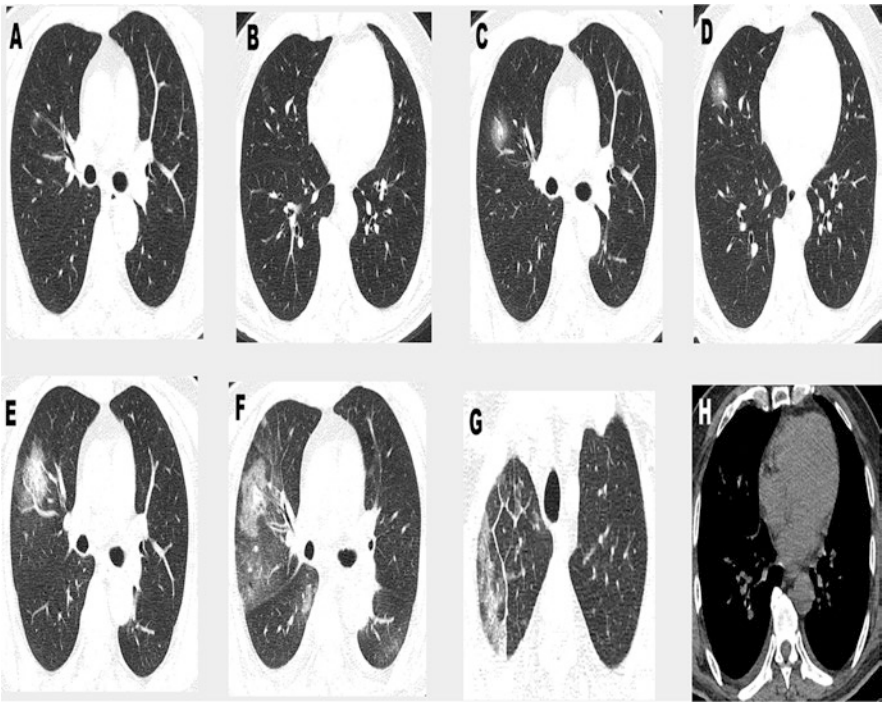

Fig. 1.3 CT scan images of a suspected COVID-19 case

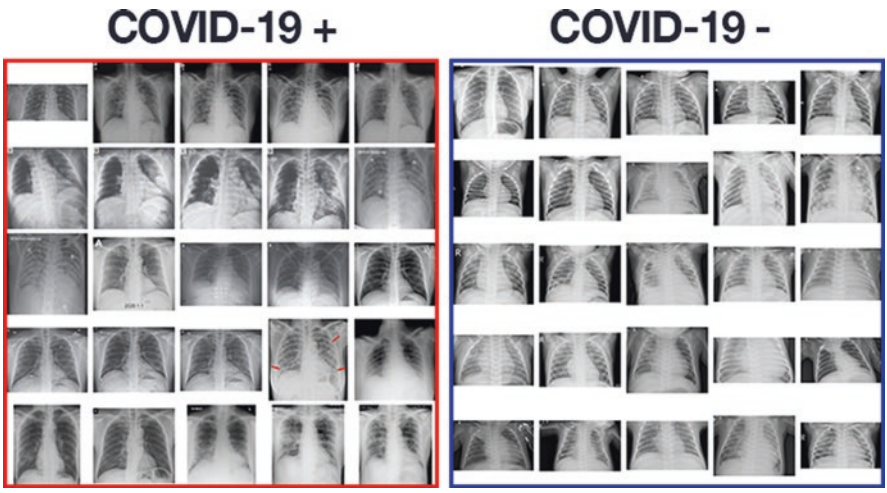

Fig. 1.4 Dataset of normal and COVID 19 persons

Fig. 1.5 Detection of the presence of COVID-19

1.5 Remote Screening Magnitude

Diagnosis methods are used for checking the absence and presence of disease. The screening objective is to detect the potential indicators with high sensitivity.

In addition to this screening, a methodology is sometimes carried out to remove any suspicion or doubts of diseases. As screening is economical, it becomes

beneficial to diagnose a large target population that may contain fewer and small potential cases. Successful screening results in accurate identification and precise investigation and treatment of patients at risk. Seeing the prevalence and impact of coronavirus disease, rapid and effective methods are highly advantageous. This method is also useful for places where advanced and sophisticated facilities cannot be found. So by adopting the novel methods, we can overcome the hurdles like lack of medical equipment and experts in disease management. The nonexperts from remote areas can transmit the data to the expert via IoT-based technology. In the paper, a framework for remotely screening COVID-19 using wearable sensory devices similar to some of the prior approaches. Our proposed method, however, differs from previous techniques in that it includes several innovative aspects for starters, the sensors we are using are less expensive and can be simply incorporated to sense a variety of symptoms. Our devices sensors are inexpensive, costing only a few dollars each. The advantage is that if a gadget is found to be contaminated, it may be quickly discarded. The sensors can be replaced into a better gadget because they are generic. Second, method is unique in that the assessment can be performed by both professionals and nonexperts, and the findings may be deduced by anybody. The sensors and the supporting framework handle all of the processing. Third, the outcomes can be tracked and analyzed from afar [32]. That means the wearable device has application over long distances while the findings are monitored by professionals in medical centers and clinics across the country. Because the virus is spreading all over the world, governments have partial resources to deploy medical personnel to remote places; this is an extremely crucial part of disease diagnosis. With this method of solution, the signs may be patterned. This method is beneficial as a big variety of sufferers may be screened for the infection in a brief time.

Wi-Fi is connected to sensors which are required for transferring and sending the received information to the target without the manual intervention where the transferring is completed at near places in real time. The use of IoT infrastructure ensures efficient stream processing and data. The algorithm of this tool is faster and has a better response for any data scale. In addition, our scheme can be useful in identifying segments of the population in need of urgent treatment. By analyzing the data of many people in one area, the authorities can assess the severity of the disease and take urgent action depending on the result [33–39]. Finally, because the technique includes transportable devices, it is straightforward to move them from location to location, easily. The rules and regulations are code tips extracted from professionals to change a professional or lower the intervention of a professional, in scientific decision-making. These regulations permit categorizing someone as healthful or having a possibility of contamination with the aid of using the coronavirus [40]. The gain of the use of regulations for patient's category is that the regulations may be up to date and advanced with dynamic expertise from the mixing of latest scientific recommendations as new findings emerge from time to time.

1.6 Conclusion

Coronavirus or COVID-19 or 2019-nCoV is a contagious disease caused by a new virus. The disease affects the respiratory system with indications such as a cough, sneezing, high temperature, and lack of oxygen and in extreme cases, difficulty in breathing [41, 42]. It spreads from person to person when they cough or sneeze or through a surface or from objects that have the virus on them. As the disease has become epidemic, it is infecting more and more people day-by-day. It needs to be detected at the earliest and for that, the need of the day is to develop new methods and equipment. Computer-based technology is growing at a very rapid pace. The proposed framework with artificial intelligence and IoT-based sensors can be used in the medical field to visualize the medical information of patients in the presence of COVID-19.

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Chapter 2
Blockchain for Internet of Things (IoT): Research Issues, Challenges, and Future Directions

Shreya Karagwal, Sarvesh Tanwar, Sumit Badotra, Ajay Rana, and Vishal Jain

2.1 Introduction

The IoT market, which is largely unregulated, offers opportunities for device hacking. At a glance, the absence of safety can be a serious problem, particularly with smart home or smart car applications. [1–3]. For example, a hacker could steal an autonomous vehicle from someone or buy it according to the level of access granted to the IoT system. Increased security is essential, along with all data collected and transferred between IoT devices. As we are aware of some security-related recommendations such as dual authentication and biometrics, one of the potential solutions is IoT blockchain security [4]. The most well-known blockchain such as Bitcoin and Ethereum grants a powerful solution for IoT security. The blockchain includes powerful protection for data modulation, which can lock access to IoT devices and shut down corrupted devices in IoT networks [5–7]. The name "blockchain" was derived by its form of technicality (chain blocks), which refers to the union of every block in association with the previous one. The whole blockchain idea is to interlink the relationship of data within clusters. By cluster, we mean a data structure including several monetary transactions, people, or entities [8]. The transactions are monetary and typical (smart contracts). Any institution can play the

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role of blockchain participants that takes protocol strings and assist in their development. These network organizers or those accountable for the maintenance of software do not share the blockchain.

Blockchain technology has evolved to provide convention validation technology over a network to ease peer-to-peer transactions and all monetary transactions. The procedure then minimizes the involvement of third parties in transactions that are monetary like banks, agents, intermediaries, or any other authorities required for the confirmation and completion of the data [4]. It is then ensured that every transactional currency is right and recorded as a fresh transactional block. Transactions recorded within the chain cannot be rewritten or canceled requiring a high level of needed transparency as well as security.

2.1.1 Key Characteristics of Blockchain

Figure 2.1 shows the characteristics of blockchain technology.

2.1.1.1 Decentralization

Through a believed agency (taking an example of a bank or government) in an earlier established transaction managing system, the transaction management has taken place. The result that comes with this centralization manner includes additional cost, single-point failure (SPF), and performance bottleneck at centralized service providers. The benefit of blockchain is that transactions can be validated between two peers without the need for authentication, jurisdiction, or intervention by the central agency, which results in a lower cost of service, SPF risk, and a reduction in performance bottlenecks [4, 8].

2.1.1.2 Immutability

As it has been studied that a blockchain comprises an associated chain of blocks, where every link is crucially an inverse hash point of the last block. The changes of any kind made on the last block will invalidate every consequent generated block.

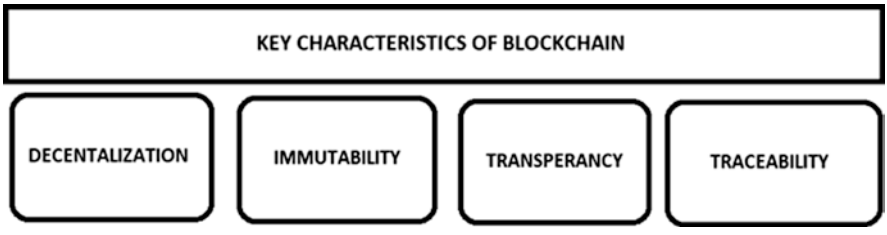

Fig 2.1 Various characteristics of blockchain technology