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The Integral Role of Intelligent IoT System, Cloud Computing, Artificial Intelligence, and 5G in the User-Level Self-Monitoring of COVID-19

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Abstract: This study presents internet of things (IOT) and artificial intelligence technologies that are critical in reducing the harmful effects of this illness and assisting its recovery. It explores COVID-19's economic impacts before learning about new technologies and potential solutions. The research objective was to propose a solution for self-diagnosis, self-monitoring, and self-management of COVID-19 with personal mobiles and personal data using cloud solutions and mobile applications with the help of an intelligent IoT system, artificial intelligence, machine learning, and 5G technologies. The proposed solution based on self-diagnosis without any security risk for users' data with low cost of cloud-based data analytics by using handsets only is an innovative approach. Since the COVID-19 outbreak, the global social, economic, religious, and cultural frameworks and schedules have been affected adversely. The fear and panic associated with the new disease, which the world barely knew anything about, amplified the situation. Scientists and epidemiologists have traced the first outbreak of COVID-19 at Wuhan, China. A close examination of the genetic makeup of the virus showed that the virus is zoonotic, meaning that the virus changed hosts from animals to humans. The uncertainty associated with the above features and characteristics of the virus, as well as the high mortality rates witnessed in many parts of the globe, significantly contributed to the widespread global panic that brought the world to a standstill. Different authorities and agencies associated with securing the public have implemented different means and methods to try and mitigate the transmission of the infection as scientists and medical practitioners work on remedies to curb the spread of COVID-19. Owing to different demographics, different parts of the globe have attempted to effectively implement locally available resources to efficiently fight and mitigate the adverse effects of the COVID-19 pandemic. The general framework provided by the World Health Organization (WHO) has been implemented or enhanced in different parts of the globe by locally available resources and expertise to effectively mitigate the impact of COVID-19. There is currently no effective vaccine for COVID-19, but new technology can be available within weeks to reduce the spread of the disease; current approaches such as contact tracing and testing are not secure, and the cost of testing is high for end users. The proposed solution based on self-diagnosis without any security risk for users' data with low cost of cloud-based data analytics functions by using an intelligent internet of things (IOT) system for collecting sensors data and processing them with artificial intelligence to improve efficiency and reduce the spread of COVID-19.

Keywords: COVID-19; IoT system; global economic impact; pandemic; IoT; 5G; AI and cloud computing

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1. Introduction

COVID-19 is the ancestor of all the coronaviruses. RNA viruses with only one positive DNA strand, fever, exhaustion, coughing, and difficulty in breathing are all symptoms that the host receives when exposed to this virus. Researchers have identified this virus as a member of the COVID-19 family despite that this virus has not been linked to a known

source [1]. Its DNA is mainly derived from rodents and bats. On 19 December 2019, authorities in Wuhan, Hubei Province, China announced a human infection with this virus and notified the WHO of the virus [2]. At least 213 countries and independent territories have been isolated due to COVID-19 [3]. Approximately 461 million confirmed cases of COVID-19 [4] were reported as of 4 April 2022, with 6.1 million deaths. Figure 1 displays the number of people who died and those who were affected in the worst-affected countries. To avoid the global pandemic caused by COVID-19, immediate action is required. This study presents technologies that are critical in reducing the harmful effects of this illness and assisting its recovery. It explores COVID-19's economic impacts before learning about new technologies and potential solutions. The research objective was to propose a solution for self-diagnosis and self-management of COVID-19 with personal mobiles and personal data using cloud solutions and mobile applications with the help of artificial intelligence (AI), machine learning, and 5G technologies. The study is conducted to determine the integral role of mobile handset data, cloud computing, AI, and 5G information technology in user-level self-management and mitigation of COVID-19.

Name	Cases - cumulative total	Cases - newly reported in last 7 days	Deaths - cumulative total	Deaths - newly reported in last 7 days	Total vaccine doses administered per 100 population	Persons fully vaccinated with last dose of primary series per 100 population	Persons Boosted per 100 population
Global	**761,402,282**	**534,869**	**6,887,000**	**4,243**	**171.04**	**65.55**	**31.35**
+ By WHO Region							
+ By World Bank Income Group							
United States of America	102,697,566	152,968	1,117,054	2,084	200.82	68.72	34.99
China	99,238,143	503	120,894	70	238.97	87.3	56.67
India	44,707,525	9,407	530,841	28	159.89	68.99	16.57
France	38,677,413	42,503	161,857	122	234.5	78.98	60.91
Germany	38,338,298	21,329	170,493	51	232.3	76.42	62.68
Brazil	37,204,677		699,917		238.05	79.94	51.59
Japan	33,421,785	36,194	73,747	185	302.89	81.72	68.26
Republic of Korea	30,773,460	45,403	34,223	36	264.56	83.8	65.62
Italy	25,673,442	7,436	188,933	64	251.9	82.97	75.3

Figure 1. Statistics of COVID-19 as of 3 April 2023.

This paper is an extended version of a paper presented at an international conference on *Health Information Science* and published in Springer Nature Switzerland in 2021. The title of the conference proceeding was "Toward a User-Level Self-management of COVID-19 Using Mobile Devices Supported by AI, 5G and the Cloud." The extended version covers the current technologies used in different countries to control the spread of COVID-19.

1.1. Background

According to the WHO, public health is at risk of the spread of coronavirus [4]. According to scientists, RNA viruses with a diameter of 600–1400 nanometers are known as "Covids." Several coronavirus epidemics have occurred in recent years. A SARS-CoV epidemic occurred from 2002 to 2004, whereas a MERS-CoV outbreak was discovered in the Middle East in 2012. SARS-CoV had spread to 37 other countries. Approximately 761 million COVID-19 cases have been reported. More than 6.8 million people have died, and 65.5 persons are fully vaccinated with the latest dose of primary series per 100 [4,5].

1.2. How Are People Living with the Coronavirus?

There has never been such a time in human history. All people are aware of the threat posed by coronavirus. Many people have been vaccinated against this strain of influenza and follow the standard operating procedures. Although coronavirus has evolved to become more dangerous and potent, humans have developed resistance. Because of the worldwide decrease in coronavirus-related mortality, social fear of the disease has diminished. However, population growth rarely follows a straight line.

There are many advantages to cloud computing with 5G. The COVID-19 outbreak has had a substantial impact on healthcare, education, and transportation, and 5G networks are critical for investigating COVID-19. The initial selection of businesses affected by pandemics was chosen to indicate the magnitude and complexity. They now require telecommunication networks to support their remote activities, which has put a strain on current networks. It was imperative that the present networks be examined quickly to guarantee that business as usual could continue in the impacted industries due to an increase in demand for services. Most pandemic-related issues can be addressed owing to the increased bandwidth and improved technologies of 5G networks. We emphasize the importance of 5G and comparable technologies to address the challenges associated with COVID-19 and the limitations of the current network architecture. Predicting future diseases and building a civilization that can handle pandemics by increasing digitalization and adopting large-scale automation can be achieved using 5G networks. We can avoid being caught off guard. It was also mentioned how the epidemic affected the network design.

China has been the source of several of these initial COVID-19 cases, as reported by the WHO. The rapid spread of COVID-19 has been connected to SARS. A person infected with this virus may go for 14 days without exhibiting any symptoms. This virus has a high potential for rapid spread. The ability of the virus to multiply is boosted if an infected individual becomes a silent carrier.

The signs of this disease may range from undiagnosed to life-threatening respiratory distress syndrome (MODS). Symptoms such as conjunctivitis, breathing problems, and sore throat are common in patients with COVID-19. Meanwhile, symptoms such as nasal congestion, diarrhea, and hemoptysis are only observed in a limited number of patients, including nausea and vomiting. The vast majority of infected people did not show any symptoms of sickness. Only 6% of the patients were deemed critically ill by physicians [5]. COVID-19 poses a threat to adults over 60 years of age, those with pre-existing medical disorders (e.g., hypertension or cardiovascular disease), and people with asthma. Despite multiple studies demonstrating the genesis of COVID-19, its spread remains unclear. Researchers are particularly interested in whether this virus may spread from person to person because the epidemic was linked to contact with sick animals or the consumption of their products. Coughing and sneezing are the most prevalent means of spreading infection. While still capable of spreading the virus, asymptomatic individuals do so at a lower rate than those who are ill. A droplet can fly up to six feet. Even if they do not show any symptoms, people who live close to someone with COVID-19 are more likely to have the disease. In addition to direct and indirect contact with infected surfaces, several transmission methods have been developed. This virus can infect steel, plastic, and copper surfaces for up to 3 days. It can last for a few hours even on cardboard. The nose is a common entry point for infectious pathogens that attach to the cell receptors in the body. By penetrating the cell membrane, spikes on the SAR-surface Cov-2 urge cells to reproduce SAR-Cov-2. Infected cells multiply more rapidly when a virus escapes from a damaged host cell and infects the uninfected cells. Subsequently, it attacks the air sacs in the lungs with viciousness and passes through the bronchial tubes.

The novel approach is the major extension in this paper as the research work is required to work on a possible solution with the help of AI, 5G, and cloud computing. The initial draft of the paper was completed in the first few months from the date of the COVID-19 cases in Wuhan. The vaccination process for such pandemics always takes years, and, during that period, disease control can be managed using available technologies. Similar to

Apple fall detection, which was proposed in early 2000, real implementation was performed after 15 years in a similar manner. With self-management and without privacy risks, users can mitigate the spread of COVID-19.

The remainder of this paper is organized as follows. A few people mentioned below have investigated the current COVID-19 outbreak and updated their findings. During the last century, several epidemics have occurred. Section 2 discusses related work, Section 3 discusses past epidemics, and Section 4 presents preventive measures. Section 5 is an important part of the paper and discusses what should be undertaken during a pandemic. Emerging technologies, such as AI and 5G networks, can aid first responders during a disaster. The most important section of the paper is Section 6, which covers the novel approach and discusses future work to mitigate and self-investigate COVID-19 with the help of handset data using 5G and cloud.

2. Related Works

On 31 December 2019, a hospital in Wuhan sounded the alarm by reporting a case of pneumonia within a perplexing cluster. The Wuhan public health authorities took swift action and shut down the suspected source—a bustling seafood market. On January 7, the 2019-nCov was confirmed as a virulent strain of coronavirus in the afflicted patient. The World Health Organization subsequently declared COVID-19 an epidemic and the coronavirus a public health emergency of international concern, emphasizing the severity of the situation. COVID-19's worldwide outbreak sparked a worldwide research effort to develop vaccinations, medicines, and other therapeutic methods. There have been many publications and articles published recently that examine the properties of the virus. The clinical signs of COVID-19 were examined by the authors of [6] in Wuhan, China, which included 170 patients. The authors of those deaths described the lethal impact of the virus on the body's numerous organs in laboratory investigations. They used big data and contact tracking to make sure that each victim received treatment that was customized to meet their individual requirements. The preliminary findings from the period spanning 1 January 2020 to 20 January 2020 divulged that 99 patients had been diagnosed with COVID-19 through the employment of the reliable RT-PCR technique. These afflicted individuals, whose mean age was approximately 55.5 years, were found to be suffering from a myriad of chronic diseases, with a staggering 50% of the patient population grappling with these underlying conditions. Symptoms of pyrexia, cough, dyspnea, confusion, myalgia, thoracic pain, enteritis, and emesis were detected in a significant proportion of the infected cohort. Heartbreakingly, elderly patients with pre-existing respiratory afflictions encountered acute respiratory distress syndrome, which ultimately proved fatal. According to researchers in [7], ninety-nine people died in the outbreak of COVID-19, which had a direct link to Wuhan's exotic animal market seafood supply. The study detailed the virus's clinical, radiological, and epidemiological characteristics. Patient mortality rates were 11 percent due to ARDS and 17 percent due to multiple organ failure (ARDS). According to [6], six published studies have identified COVID-19's clinical features. Short descriptions were provided of COVID-19's symptoms and therapy options. Patients were detected with abnormal chest CT findings, and CT scan was strongly suggested for diagnosis of COVID-19. COVID-19's computed tomography (CT) components are widely discussed according to [8]. For this topic, they only scratched the surface [9]. This is a key weakness in these studies. Clinical characteristics, diagnosis, and therapy possibilities for COVID-19 are all examined in depth in [10,11]. The outbreak of COVID-19 has been thoroughly researched, but no final conclusion has been reached on its likely consequences and the extent of the investigation. There is a dearth of information on the potential influence of 5G cellular networks and AI in the fight against the COVID-19 outbreak. Identifying technical techniques to decrease the effects of COVID-19's outbreak will necessitate research into its clinical, preventive, diagnostic, and therapeutic aspects. This adds to the problem. Readers will benefit from this book's thorough examination of the COVID-19 epidemic, which was triggered by the pandemic. The lack of vaccination posed a significant threat as

hospital outbreaks ravaged various countries. The dedicated medical personnel, including diligent nurses and physicians, found themselves at the forefront of the battle, susceptible to the rampant viral transmission from the afflicted patients. The daunting task of contact tracing, cluster-level lockdowns, and efficient isolation of infected patients was exacerbated by the absence of cutting-edge technologies, further exacerbating the dire situation [9]. We can obtain a sense of how COVID-19 has affected technology by looking back at previous outbreaks. A combination of scientific research, clinical treatment, and technological advancements can help controlling the COVID-19 spread [12].

3. Epidemics of the Past

SARS-CoV and MERS-CoV, in particular, were to blame for these outbreaks, which have been troubled by an abundance of events and pandemics this century. AH1N1, AH2N2, and AH3N2 flu strains steered each of the past four pandemics. The Spanish flu and the swine flu were discovered during an H1N1 flu epidemic. There were two distinct strains of influenza that afflicted Asia and Hong Kong, both of which passed from person to person [9]. This section contains an overview of all previous pandemics. An epidemic is an outbreak that spreads quickly but is not anticipated, whereas a pandemic is an epidemic that has geographical spread of disease [13].

3.1. Flu Pandemic in Spain (1918–1919)

The Spanish flu was the worst and most destructive global pandemic in history. Around 50 million people died as a result of the 1918 Spanish flu pandemic, making it the deadliest pandemic in history. The pandemic was caused by the AH1N1 influenza virus. This sickness was spread by birds, according to popular belief. The Spanish flu had an unusually high mortality rate among the younger and healthier members of society. This resulted in the host's own cells fighting each other instead of attacking the virus, which ultimately led to the host's death [14]. Since they have higher immune systems than older people, younger people are at greater danger of contracting this deadly disease.

3.2. Flu Pandemic in Asia (1957–1958)

On 2 February 1957, Singapore became the first city to be hit by the Asian flu pandemic, which lasted for a total of six months. A total of 116,000 people in the United States died as a result of the Asian flu, while an estimated 1.1 million people died globally. This dreadful illness was caused by a genotype of influenza virus known as AH2N2 influenza virus. The A/H2N2 virus, as with the A/H1N1 virus, is believed to have originated in birds. Humans can no longer be infected by an influenza virus known as A H2N2 after an eleven-year outbreak.

3.3. Flu Pandemic in Hong Kong (1968–1969)

It began in Singapore in the second month of 1957, sparking the second major pandemic of the twentieth century after the Spanish flu outbreak of 1918. The Asian flu killed an estimated 1.1 million people worldwide, with 116,000 of the deaths happening in the United States. The AH2N2 influenza virus subtype was responsible for several devastating outbreaks. Believed to have been disseminated by birds, as with A/H1N1, the A/H2N2 virus is also thought to have been transmitted by birds. After an 11-year outbreak, the A H2N2 influenza virus changed into a type that no longer infects people.

3.4. Pandemic of Swine Flu (2009–2010)

In the spring of 2009, a new strain of A/H1N1 flu developed, and the swine flu pandemic began. Similar to the Spanish flu, the swine flu was initiated by a distinct virus strain. People younger than 65 years old were more susceptible to the severity of the pig flu. In the wake of the arrival of the AH1N1 flu virus, the more experienced open population has developed a higher level of resistance. It is estimated that more than 43 million people were infected, with a total of 195,086 people being hospitalized and 8868 of those being

killed by it, according to the US Centers for Disease Control and Prevention. The swine flu epidemic claimed the lives of more than 151,700 persons [15].

4. Preventive Measures

Many people from all corners of the globe have been affected since November's outbreak of COVID-19. Figure 2 shows that prevention is always better than cure. These easy actions will help you avoid becoming a victim of identity theft or leading someone else to become one. The COVID-19 curve could be reduced if people and groups follow these recommendations. As the curve flattens, the transmission of this lethal virus will slow down to the point where existing medical institutions will be able to diagnose its effects more accurately.

Figure 2. Preventive measures for the COVID-19 pandemic.

(1) When possible, use soap and water to thoroughly clean your hands; if that is not possible, an alcohol-based hand sanitizer can be used instead.
(2) Maintain a social distance of three feet (one meter) from other people.
(3) Unless absolutely required, stay in your house as much as possible. People over the age of 60, those with underlying medical concerns, and pregnant women are strongly recommended to stay away from social situations and gatherings at all costs.
(4) Hands must be well cleaned before contacting anyone's eyes, nose, or mouth.
(5) Wipe down and sanitize all the regularly touched items in your workspace on a regular basis.
(6) Cover your cough and sneeze with a towel, tissue paper, or handkerchief. Sneeze or cough in your own elbow pit if these are not readily available. It is important to dispose of the tissue or cloth appropriately after use.

(7) The wearing of a mask when among other people has been recommended by numerous healthcare groups. After using the mask, be sure to properly dispose of it [6].

Regular hygiene practices, including bathing, hand washing, and changing one's diet, are critical in the fight against the COVID-19's rapid and widespread spread. Even after a pandemic has ended, personal hygiene and a balanced diet are still critical.

5. Role of IoT and AI for Extenuating the Influence of the COVID-19 Pandemic

As the novel COVID-19 spreads around the globe, countries worldwide are experiencing both amazing economic growth and heartbreaking setbacks. Many people are at risk of the disease, and this is not expected to be altered soon. Despite this, a host of innovative approaches to dealing with pandemic crashes is currently under development. AI and cutting-edge media transmission systems, such as 5G, have undergone significant developments [7]. Modern technologies such as IOT and AI can play a significant role in the general public health response to COVID-19. The devastating outbreak of COVID-19 could have been prevented if previous developments had been implemented. This section describes the methods and analysis used for the current IoT, AI, and 5G use in different countries for the prevention and control of the COVID-19 pandemic. After the spread of COVID-19 from Wuhan, the Chinese government implemented strict contact tracing and lockdown to avoid the spread of the virus, and technologies such as IOT, 5G, and AI were used with machine learning to track the infected patients. Machine learning applications using laboratory data are used to diagnose different diseases [16]. Robots, telemedicine, and IoT are a few examples used in Wuhan. Despite the use of AI and 5G, there were a few challenges, such as public privacy and security and ethical issues for data collection. To manage these, a self-diagnostic solution with end-user mobile and consent, such as Google photo management in the cloud, is proposed by using a novel approach, as discussed in Section 6 of this paper. Further research and app development are required to achieve self-diagnostic approaches. The technology shifts from devices, sensors, robots, drones and thermal cameras, and hospital will move to self-management of COVID-19 with the use of mobiles only. There will be no security and privacy risk as users will manage and control their data as per future framework description for COVID, as shown in Figure 3.

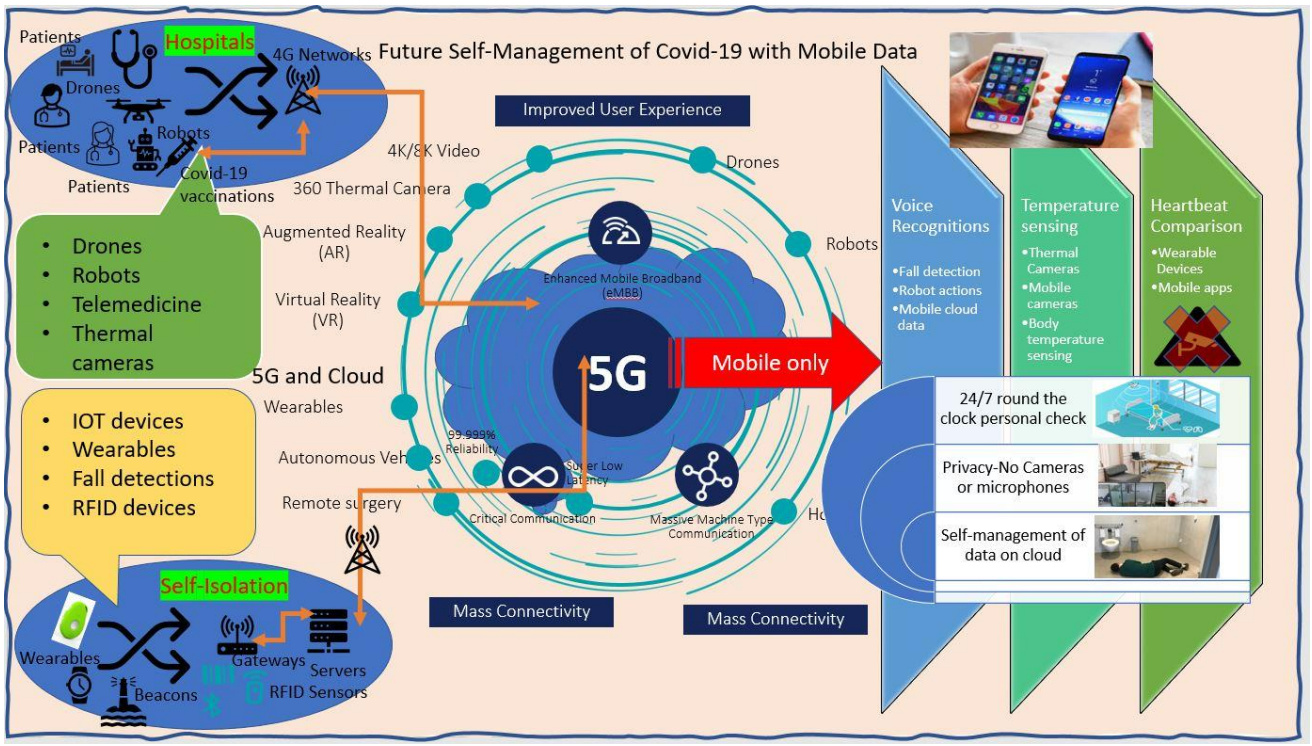

Figure 3. COVID-19 framework from current to mobile only solution.

5.1. AI

AI was heralded as a watershed moment in technological advancement when it was first produced. Anti-COVID-19 efforts could benefit from AI, which can be a powerful tool [17]. If AI is applied early enough, it can minimize the spread of the virus by 40%. Anti-COVID-19 efforts could benefit from AI's ability to monitor illness progression, anticipate risk factors, complete clinical diagnoses and screenings, and discover and apply lockdown procedures to protect the virus's host and prevent transmission to others. COVID-19 can only spread if AI is used. Subsequently, we will take a closer look at each of the applications that were previously mentioned.

Role of AI in Tracing Activities. All countries are working on AI applications to prevent the spread of infection.

- Several countries utilize population monitoring to track the occurrence of COVID-19 (for example, in Korea, algorithms use geolocation data, surveillance camera footage, and credit card records to trace coronavirus patients). Each person in China is assigned a color-coded risk level (red, yellow, or green) to signify their potential to spread a disease. As a complement to machine learning algorithms that analyze travel, financial, and communication data to predict future outbreaks, search engines and social media can be used to monitor disease activity in real time and reduce the spread of COVID-19 [18].
- Many countries, including Austria, China, Israel, Poland, Singapore, and Korea, have implemented contact tracing systems. When the Ebola virus spread in Israel, geolocation data were used to identify potential victims and send text messages warning them to flee.

Contact Tracing. It would be necessary to implement an extensive contact tracking and isolation plan to contain the COVID-19 pandemic, and digital contact tracking rather than manual tracking may be more effective in managing the epidemic according to models in published literature. Digital technologies such as contact tracing are heavily emphasized in this article because of Singapore's high population density.

Contact tracing is a critical component in reducing the number of new cases of the virus, but it is not 100% reliable [8]. In an effort to stop the spread of diseases that have no known cure, medical organizations worldwide have begun using contact tracing. Now that we have learned of this, we can stop the spread of the disease. Contact tracing is most commonly used to assist countries that have experienced a lockdown or disease outbreak in adjusting to the new normal. To avoid a second invasion, determine where the infection is spreading [18].

Contact tracing software is being developed as a part of the global effort to combat COVID-19, similar to CovidSafe in Australia, TraceTogether in Singapore, StopCoVid in France, and the Google/Apple API (application program interface (API). Health authorities in the central government are responsible for processing all these applications. This is an example of how public health experts use contact tracing to monitor this type of activity. Google and Apple have joined forces for the first time to develop contact tracing tools for specific locations. Users of the iOS and Android foundation apps who are COVID-19 positive will be able to utilize the app because it was developed in collaboration between Apple and Google [9].

Currently, there are 47 tools for tracking lost or stolen contacts that can be used anywhere in the world [11]. The COVI program, which aims to improve the administration of universal health systems, is being developed by Canadians using AI.

5.1.1. Monitoring of Ailments

Predicting and monitoring infections, particularly those with the potential to cause confusion, is essential. Nine days before the WHO was expected to receive a report on COVID-19, Blue Dot seized it on 19 December 2019, which is 9 days earlier. AI and natural language processing (NLP) devices are used by B-Dot to identify emerging disorders.

AI model B-Dot discovered COVID-19's proliferation much earlier than any human organization could. This does not mean that no human effort was required to obtain the same result. AI models are not only used by B-Dot to predict disease rates. A pandemic has been predicted by Metabiota's pandemic observation platform since its inception in 2008. These characteristics include the clinical signs of the disease, mortality rate, and therapeutic accessibility. Metabiota's epidemic tracker provides data and insights into more than 120 novel microorganisms [19]. These advances can be used to identify hazardous popular illnesses before they have a significant influence on human health, according to a group of scientists. One such example is the global virome project (GVP). The GVP combines monster families as a method of organizing a disease index that can infect people.

5.1.2. Risk Prediction

It is possible to forecast the danger of COVID-19 by using AI. Risk prediction can be divided into the following categories:

Infection risk prediction.

Predicting the likelihood of developing severe symptoms as a result of an infection.

How likely is it that a given treatment will harm the victim?

People's current health status, eating habits, and personal hygiene would all need to be factored into an AI model to determine how likely they are to develop a disease in the future. To describe this model, we cannot utilize the mathematical models of the above functions. An accurate and trustworthy risk assessment requires thorough examination of all AI-related tasks (AI). A list of weaknesses for those who are unable to defend themselves against COVID-19 can be compiled using ML. Infections can be treated with AI to shorten a patient's hospital stay and prevent recurrence. New AI frameworks are being developed by researchers at Stanford and the University of Chicago that can consistently identify COVID-19 infection patients who are at risk of worsening. Therefore, doctors know in advance who needs to be admitted to the intensive care unit (ICU).

Diagnosis and Screening of Patients. To prevent the spread of illness, governments need to identify COVID-19 sufferers as soon as possible. Testing kits to conduct a thorough diagnosis are limited globally. AI has been repurposed and new tools have been developed to address this problem. Specifically, 93% of Shanghai people were scanned using AI-based rapid scanning [20]. In this section, AI will be used to study coronary artery disease screening and diagnosis.

Devices that scan the face. Digital infrared thermometers have grown in popularity since the outbreak of this severe disease. However, this scanning process requires the participation of frontline workers. COVID-19 patients are protected from frontline staff by using cameras with AI-based scanning technologies at hospitals, medical centers, and public places, such as malls and airports. Even in heavily crowded locations, AI-based cameras can track body temperature and facial expressions, providing authorities with important information about human movement. The temperatures of all patients were monitored using an automated system at the hospital's main entrance.

X-rays and MRIs. Scanners using AI and deep learning (DL) were able to reduce the radiologist workload while accurately detecting patients with COVID-19. An Ontario-based AI start-up and the University of Waterloo teamed up to build a convolutional neural network for the detection of COVID-19 in X-rays (CNN). COVID-DesignerNet created an open-source computing framework to stimulate the creation of AI instruments based on their framework. This is the design. CAD-4-COVID is an AI model developed by the Delft University of Technology. Computer-aided design 4-COVID equipment was used in the AI tuberculosis diagnostic model. When it comes to assessing whether a patient has a heart infection, there is a lack of accurate information regarding the use of AI-based equipment.

5.1.3. Therapeutic Research

Without previous studies, diagnostic protocols, and treatment techniques for COVID-19, it is difficult to determine the symptoms of the disease. However, this is a significant

problem. The use of AI-based methods to identify and create new COVID-19 therapies and medications has increased in laboratories and organizations. AI-based approaches and a shorter time to market for new treatments could help research current pharmaceuticals that could be utilized to treat COVID-19.

5.1.4. Virus Modeling and Analysis

An in-depth understanding of the virus is necessary to develop effective diagnostic and treatment procedures. A virus needs a host cell to help it copy its own DNA in order to do so. Adhesion to the host is achieved using a lock and key mechanism. To prevent this, the majority of inhibitor-based mediators block the receptors of the targeted cells. A team of scientists are currently investigating this binding mechanism. ML appears to be the most powerful tool scientists have to create this type of binding mechanism model. Models trained on protein data have recently predicted interactions between P-PIs and human cells [21]. A variety of protein-folding mechanisms exploited by viruses can also be modeled using ML-based methods. Using DL methods, [20] can estimate a protein's structural composition using only its amino acid sequence. The three-dimensional structure of a protein is essential for understanding its function. Google's Alpha fold model predicted the sequence of proteins linked to COVID-19 at the time of the epidemic. A better understanding of the overall structure and organization of the virus can be obtained from these projections. The findings of this study could lead to the development of novel antiviral drugs.

5.1.5. Breaking Fake News

An increase in myths, conspiracy theories, and misguided ideas has occurred since the COVID-19 outbreak. Using social media, there has been much effective propaganda. The goal of Google, YouTube, Twitter, WhatsApp, and Facebook is to employ AI to stop the spread of misleading information and provide accurate information. These systems found no minor flaws in the tested contents. YouTube has implemented safeguards to prevent the spread of false information on its platforms [22].

5.1.6. Enforcing Lockdown Measures

AI is being used by several countries, including the United States, India, China, and the United Kingdom, to enforce social segregation and lockdown processes. Computer-powered infrared cameras are used to monitor public areas by China's leading AI company. Using facial recognition software, these cameras can also identify occupants who do not follow lockdown limits in the event of an emergency. Monitors were set up in Oxford, England to ensure that the foam adhered to open-access policies.

5.1.7. Challenges

During the COVID-19 pandemic, AI technologies are extremely beneficial. There is still a long way to go in the field of AI frameworks. Managing COVID-19 can be complicated by several AI-related issues, some of which are listed below:

(i) AI algorithms require AI data to ensure consistent and accurate outcomes. Many AI models do not work effectively because of access to historical information; despite that, this is a very unusual occurrence [6].
(ii) Although open information regarding AI models can be a nuisance, the information itself is bold and strange, casting doubt on the practicality of such advancements.
(iii) A weakness of an AI algorithm is that it assumes that all possible outcomes in some random events are equal to those that exist in the prepared dataset.
(iv) AI is viewed as a security breach by many.
(v) AI innovation is limited because of the need for human input. Controlling the use of AI in the fight against COVID-19 relies on human ingenuity [9].

The use of AI-based technologies is important in the fight against COVID-19, regardless of how challenging it is to implement them in the field. In recent years, AI has

made significant progress in NLP, ML, DL, and information retrieval, all of which have greatly benefited from these advancements. Advancements in AI have made it possible for COVID-19 to wreak havoc on broad structures.

It is important to keep in mind the ethical concerns that need to be addressed. Any AI policy should address these ethical issues. It appears that ethics were given high priority in this year's government AI readiness index.

Ethics must be considered when establishing AI policies, according to the World Economic Forum. Unless governments take ethics seriously, they are unlikely to be able to compete effectively in the global marketplace.

5.2. Fifth-Generation Cellular Technologies

The wireless cellular networks of the next generation are referred to as 5G cellular networks (or simply 5G). Indeed, 5G can support international mobile phone services. All aspects of this technology's performance have increased significantly in comparison with the previous iterations of this technology. Internet of medical things (IoMT), AI, and blockchain can change the healthcare industry owing to 5G networks and new technologies. It is changing China's approach to the COVID-19 outbreak due to the country's commercialization of technologies. Because 5G makes it easier to track patient connections and viruses, medical professionals and government agencies can make better use of it. Therefore, they could conduct screenings and analyze the data more effectively, and 5G technology can help countries affected by the COVID-19 outbreak by serving as a case study [22]. COVID-19 can be mitigated with the help of the IoT, big data, AI, and blockchain. Technology, including 5G, AI, and barcodes, was applied in a recently completed Wuhan hospital for COVID-19 therapy and contact tracing [11].

5G Telemedicine. Telemedicine refers to keeping track of patients who are distant from the source of their disease. Although drones, smartphone attachments, and mobile software can be employed to provide telemedicine phase capabilities, 5G network technology can still capture this potential. Mobile technologies, such as 4G, do not have the capacity, low latency, or data transfer speeds needed to maintain a high-quality video stream that is required for a consistent debate using remote coordination. As a result of 5G's VR/AR capabilities, telemedicine encounters can be observed, and healthcare providers can obtain a sneak peek into prospective treatment concerns and procedures. Further, 5G innovation was first commercially reported in China in early November of the previous year, and the telemedicine market has advanced to a new level. An emergency health center and Kunming Medical University have started an online demonstration stage and free COVID-19 therapy via 5G broadcast communications thanks to China Telecom's cooperation [23].

Owing to this conference platform, the hospital's health team in Beijing was able to collaborate with the Beijing healthcare workers [24].

Medical Imaging. Modern medical imaging processes, such as PACS, are becoming increasingly crucial in the diagnosis and treatment of medical conditions. As an alternative to RT-polymerase chain reaction (PCR), cloud computing and CT scans have been used for contract tracking. With cutting-edge portable systems that combine AI and big data analysis, PACS can provide information analysis and a board with less human work. The Wuhan Center, Leishenshan Hospital's 5G-enhanced clinical phases account for the continuous conclusion of COVID-19 patients [25]. Reverse PCR is currently used for testing; in the future, it can be performed using mobile apps and mobile data [26].

5.2.1. 5G Thermal Imaging

Heated envelope imaging is a beneficial tool in a wide range of industries, including healthcare. It is now possible to establish user systems with a variety of health protection and care systems because of the development of 5G networks, and thermal measurements can be performed with increased precision using the 5GC IR advanced checking framework. With 5G technologies, the data acquired by projects can be sent to the main test framework with little inactivity. COVID-19 may necessitate an open temperature check. Robots and

drones equipped with 5G warm-hopeful frameworks [25] have been used in some Chinese communities to reduce the spread of COVID-19.

5.2.2. 5GC Robots

COVID-19 has inspired worldwide efforts to develop and distribute robots that can assist first responders in emergencies. This chapter is dominated by the 5G technology. Only 5G technology can provide robots with low latency and high bandwidth, which need to be more productive [27]. By cleaning, temperature checking, meal delivery, and prescribing medication, robots can assist medical workers to avoid direct contact with infected patients [28].

(1) Thailand's deployed 5G robots

COVID-19 has inspired worldwide efforts to develop and distribute robots that can assist first responders in emergencies. This chapter is dominated by 5G technology. Only 5G technology can provide robots with low latency and high bandwidth, which need to be more productive [27]. Cleaning, temperature checking, meal delivery, and medication administration can all be performed by robots, avoiding direct contact with patients [27].

(2) Shanghai's China mobile's 5G robots

To ensure that COVID-19 is widely available, China's telecom authorities have provided the Shanghai Clinic with six 5G-certified robots. These robots can perform a wide range of tasks, including cleaning and delivering medications to patients. In addition to 5G cameras and health monitors, Shanghai's communication managers have increased the complexity of COVID-19 [29].

(3) WUHAN's Cloudminds 5G robots

A slight delay occurred in the opening of Wuhan's first 5G-enabled healthcare facility. The Beijing-based business Cloudminds delivers robots that can clean, disinfect, provide medication, and monitor patients' temperatures [30].

(4) Patrolling robots in several cities of China

As the demand for 5G over PCs increases, robots have been built using Advantech MIC-770s in Guangzhou, China. Currently, they are being produced. Using five infrared thermometers and high-resolution cameras linked together via a distributed computing network, these robots can monitor the heat levels of up to ten people simultaneously. A person's veil can be detected by these robots that use specialized sensors.

Challenges. Because of the extensive use of COVID-19, many mechanical configurations have been developed. AI, IoT, and drone technologies are among the most cutting-edge advancements in each field. Portable systems that outperform current breakthroughs in terms of transfer speed, idleness, and adaptability are required to properly appreciate the trailblazing potential of this innovation. Portable systems will have to take off if this is to happen in the near future; it is possible that a pandemic control system such as this may be used as one component of an incredible city concept [25]. The following are just a few of the current 5G network challenges:

i. This makes it difficult to engage the 5G network in the early phases as there is not much foundation.
ii. In and of itself, the use of 5G technology cannot improve people's lives. This can be observed in the case of the IoMT, AI, and distributed computing [30].
iii. In itself, the introduction of 5G technology will not have a positive impact on the lives of people. This can be demonstrated using IoMT, AI, and distributed computing technologies [31].

5G Internet of Things. The IoT will require massive deployment of connected devices and sensors, as projected by the GSM Association. Cloud solutions can access IoT sensor data over 5G networks, which are regarded as reliable. It is possible to stop the spread of COVID-19 by using IoT contact tracking and robotic interviewing, crowd temperature

monitoring with cameras, surveillance drones, and the IoMT. As displayed in Figure 4, the 5G technology will be heavily utilized in the regulation of COVID-19 [32].

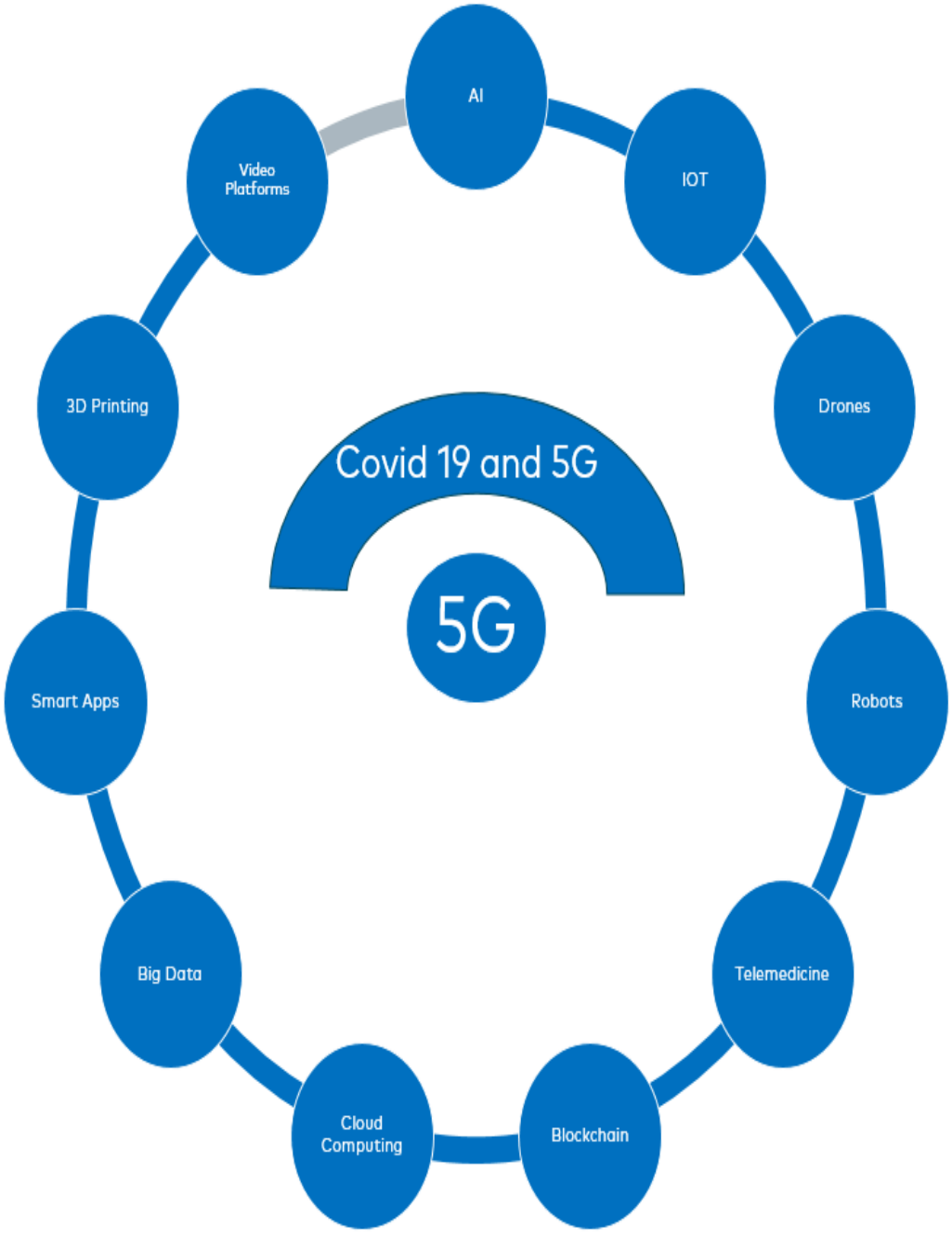

Figure 4. 5G technologies for controlling COVID-19.

6. Novel Approach and Discussion

A cell phone is required to detect COVID-19 in the future. End users can obtain their own assessment and tracking without visiting medical facilities or hospitals. Apple's fall detection scenarios were tested more than a decade ago under some circumstances. The COVID-19 virus can be diagnosed using phone and personal data in a few years. Even in industrialized countries, such as Australia and Singapore, end users have objected to COVID-19's current diagnosing approach and contract tracing due to privacy issues. As with Google and Facebook's photo features, there are no additional fees associated with the solution, which is discussed in a subsequent section. AI-based apps use speech-to-photo

matching to assist patients in tracking and detecting the symptoms of COVID-19; AI-based apps use speech-to-photo matching.

6.1. Image Processing with the Comparison of Selfies

Thermal imaging can be utilized in the same way as high-definition AI to watch crowds and detect those who are sick. Mobile users can self-diagnose and self-identify COVID-19. Google Drive allows users to compare selfies and generate results using an AI-based algorithm.

The health sector has benefited from a range of app development platforms [33]. Examples of how AI is being utilized to battle the present global epidemic of infectious diseases include research and development of antibiotics, vaccines, and public-policy-related information, such as quarantine and isolation of sick individuals.

Patients with COVID-19 can be identified and diagnosed using AI and DL using mobile data. An accurate and cost-effective diagnostic method with personal devices such as mobiles for COVID-19 detection is lacking. Despite the fact that the vast majority of patients infected with COVID-19 have only moderate symptoms, they should be separated, treated, and administered follow-up therapy. AI algorithms can be used to help individuals identify three possible COVID-19 patient groups: moderate (80%), severe (15%), and high risk (5%). New COVID-19 treatments can be developed using AI with mobile applications and data stored on a personal cloud. In recent years, DL patterns that are both light and precise have been produced.

Doctors' workloads can be reduced if AI-driven triage systems are implemented. Online chatbots can use mobile devices to help patients recognize early illnesses, teach people about basic hygiene, and show signals of better healthcare. Patients with mild influenza may benefit from telephonic monitoring of their medical data (e.g., daily temperature and symptoms) [34] For example, the latest pandemic can be transmitted using this method. Chinese hospitals work with blockchain companies and pharmacies to deliver medication to their patients. Pharmaceuticals can be delivered faster and more reliably using blockchain technology [35].

Mobile device data and AI systems have the potential to improve medical diagnoses in several ways. Currently, coronavirus-infected patients have limited screening options because they are too slow and unreliable. Two DL algorithms were used to identify COVID-19 from chest CT data. Both AI systems have COVID-related sickness detection and diagnostic algorithms. Many studies have demonstrated positive results when DL approaches are used for the analysis of medical images.

Chest CT may be useful in patients suspected of developing SARS-CoV-2 infections. Therapy and diagnostics are becoming increasingly dependent on COVID-19 imaging. Ground-glass opacity and pleural consolidation are two of the most obvious signs of infection on CT scans. Chest CT has been found to be substantially more sensitive than viral results in diagnosing COVID-19. When the healthcare system is already thin, CT can be used to quickly treat individuals at risk of developing COVID-19. Chest CT has a significant impact on the diagnosis of COVID-19 in individuals with severe and complex respiratory symptoms. This procedure can help doctors track the progress of a sick patient's illness, as well as the extent of damage to the patient's lungs.

It is becoming increasingly common for CT scans to detect COVID-19-induced lung abnormalities for various reasons. CT's ability of CT to detect COVID-19 has been greatly improved by applying an artificial neural network to many patients. To improve the ability of CT to detect COVID-19, many patients should be able to swiftly and precisely identify their symptoms using an artificial neural network.

Video safety cameras, facial recognition, credit card records, and a global positioning system (GPS) are some of the technologies that South Korea has developed to provide real-time data and accurate travel routes for individuals (GPS) using mobile data. Individuals infected with COVID-19 are required to self-isolate at testing centers, and those infected

with COVID-19 are notified through text messages. Early detection and quarantine have led to low fatality rates among the South Koreans.

Germany's software uses data from wearable sensors, such as pulse, temperature, and sleep patterns, to detect signs of viral infection. COVID-19 recurrence can be assessed using the application's map data, found in the United States. Because of the country's extensive use of broad-ranging diagnostics and digital health treatments, Germany has an extraordinarily low death rate per capita.

6.2. Voice Recognition and Comparison for Sneezing and Coughing

Preventive measures were taken to accurately identify pneumonia and asthma before the epidemic began. Therefore, we believe that we have nailed down each algorithm. There are many signs of Alzheimer's disease, including memory loss and neuromuscular deterioration, such as weaker vocal cords, which can be detected using AI. Machine learning system ResNet50 was designed to distinguish sounds with varying levels of vocal cord force. The sound "mmmm" is a good indicator of vocal cord strength and fragility. "Then" and "then" are frequently used in audiobooks; therefore, Subirana trained a neural network to select "The" from these phrases.

COVID-19 patients were interviewed in April by the researchers to obtain as many records of coughing as possible. The recordings of coughs were made using an internet-enabled phone or gadget and posted online. Individuals participating in the study will be asked to complete a questionnaire on their symptoms and the presence or absence of the COVID-19 gene. In addition, people can indicate their gender, location, and native language to better understand one another. According to reports, there are more than 70,000 records and 200,000 audio samples in Subirana's database of study coughs. COVID-19 individuals who were asymptomatic were included in the study's 2500 data points.

Regarding diseases such as flu or asthma, Subirana stressed that the AI model is not built to identify people with symptoms. Most importantly, the equipment can distinguish a symptomless cough from a healthy cough. The team is developing prescreening software based on an AI model provided by a corporation. To train and improve the model's accuracy, they collaborated with several hospitals around the world to obtain a wider and more diverse collection of tobacco records.

COVID-19 was first developed by Maghdid and others for Maghdid et al. Smartphones can be used to gather information about potential patients. Sensors can be used to monitor the fingertip temperature and speech of a patient. Data were sent to a cloud server powered by AI for disease identification and analysis (AI). Radiologists are unable to complete their investigations because it takes a long time to compare several CT scans. Radiologists benefit from this, as well as people who find themselves in a scenario where they are not sure what they should do.

6.3. Voice Recognition Using Recorded Calls from Cloud Sources

For a long time, this has been regarded as a threat to user privacy and security. However, now that everyone can upload their personal data to Google photos for free, it is becoming more common for customers to record their voice calls and save them for later use. Comparing previously recorded sneeze and cough recordings with newly uploaded recordings over time can help identify COVID-19 symptoms. In the future, mobile app users will be able to run reports and identify issues independently.

End-to-end networks and uplink connections strongly rely on 5G networks. They are also incredibly fast in communicating with one another and have a high level of mutual trust, and 5G is more secure and faster than Wi-Fi. Owing to its flexibility, coverage, and reduced latency, 5G may allow for more deployments in the lower-, mid-, and high-band ranges [36]. Figure 5 depicts IoT, edge computing, web apps used as the edge-to-cloud interface, and clouds for data processing that use coordinated profound knowledge. If you are not in the COVID-19 cohort, this information can be provided. Many IoT formats have been used for data collection. A web application can be used to link a cloud server to

specific hospitals and healthcare providers. Using secure online connections, hospitals and doctors may perform remote patient evaluations and plan for future situations as shown in Figure 5 [37].

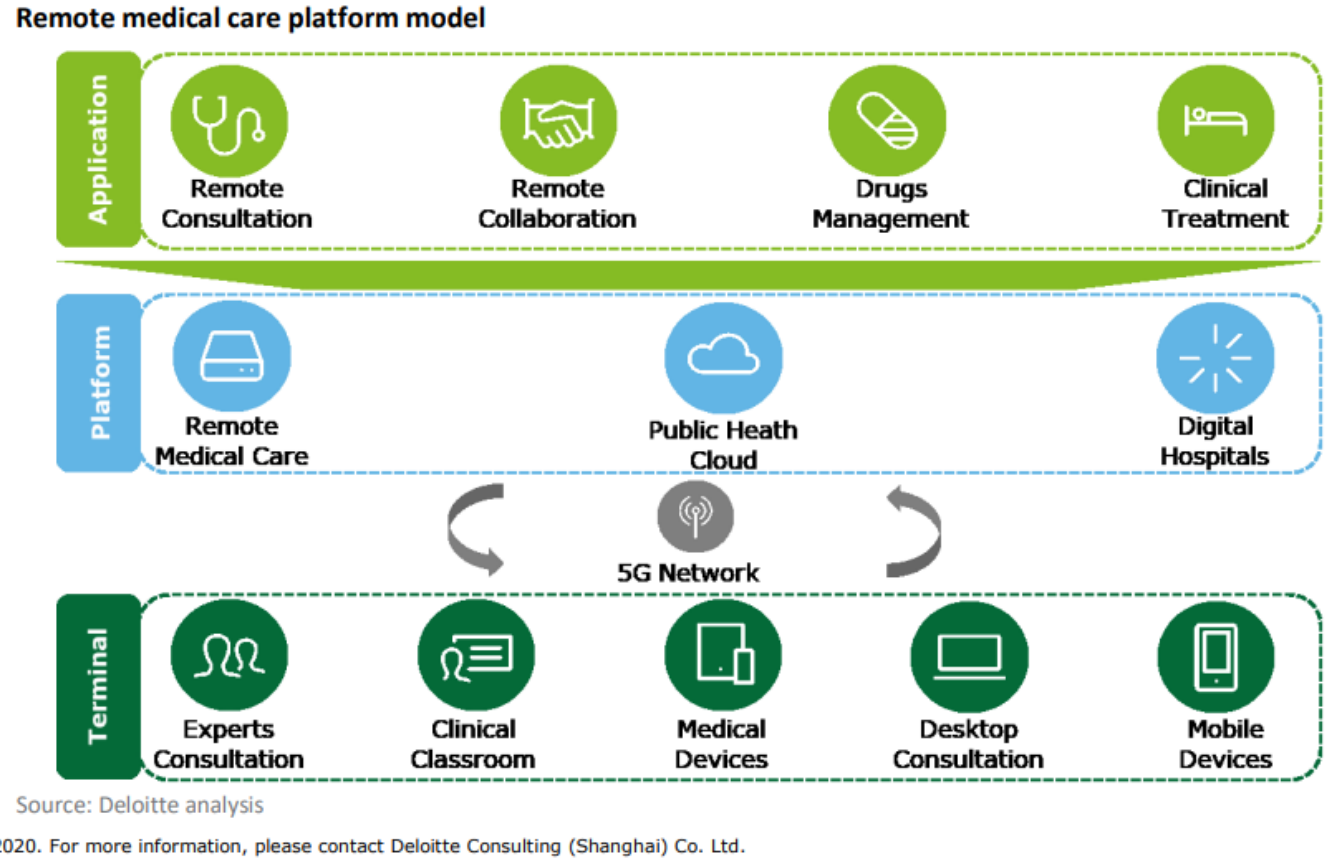

Figure 5. Depicts the many layers of data sources in remote medical care platform model.

Self-driving vehicles can be used to minimize human contact in healthcare. Images from many vehicle cameras can be retrieved in real time via control centers. Disinfectants can be dispensed by using automated or semi-autonomous robots. Detecting body temperature and operating touch points can be accomplished using platform recognition and facial recognition software in self-driving automobiles. Mobile apps and computer systems must adhere to established networking standards for automotive systems to operate swiftly and reliably.

Using 5G networks that connect vehicles to the cloud via the customer location and operator control and monitoring device, autonomous vehicles can be installed, enforced, and operated in accordance with end-user and public safety requirements. A wide range of 5G-related activities includes data centers, the internet, municipal rail systems, electric vehicle charging stations, and higher voltage power grids. In an effort to boost the economy and society, the government has targeted a number of enterprises and institutions. This is especially critical in developing countries, where trade and industry must continue.

ZTE's latest 5G technology in China allows the remote diagnosis of coronavirus pneumonia. In a cloud video environment, ZTE's smart video, AI, and temperature sensors avoid interruptions at all times [38]. The testing and commissioning of ZTE's 5G remote diagnosis and treatment system have reached a vital point in the process. In 5G networks, cutting-edge AI, robots, and other cutting-edge techniques have been employed to restrict the spread of infectious illnesses. As China's 5G network expands, many of the country's subway systems now offer video consultations. The low latency and enormous bandwidth of this technology have made early disease detection and treatment easier. To avoid privacy risks with videos, the voice recognition method can be used to detect infected people.

6.4. Temperature Sensing While on Call and Holding the Phones

In healthcare, self-driving cars can be used to reduce the requirement for human touch. Remote control centers can obtain real-time views from many onboard vehicle cameras. Automated or semiautomated robots can dispense disinfectants. Platform recognition and facial recognition software can be used in self-driving cars to detect body temperature and operating touchpoints. Networking requirements must be met by mobile apps and computer systems for automotive systems to operate quickly and reliably [39]. Phones can be used for temperature sensing and recording data in iOS and Android health apps. Data can be collected, especially when a user is not using headphones and holding the phone close to the face. Similar to wearable devices, phones can be used to detect and record temperatures that can be used with AI to investigate COVID-19 symptoms.

6.5. Temperature Sensing from Selfies and Photos

Mobile users will be able to employ thermal image processing to assess temperature variations and track and monitor the COVID-19 virus while photographs and other data will be stored in the cloud. In the COVID-19 crisis, cloud computing aided cooperation, communication, and crucial internet services. Because of the COVID-19 outbreak, many people have been compelled to work from home. As a result, we consider cloud computing as an essential part of the issue of working productively from home. During lockdown, cloud computing allows for the delivery of high-quality healthcare services, which is a comprehensive framework for digital transformation. The importance of cloud computing in today's environment has sparked protracted discussion. Researchers are still looking at COVID-19 pandemic cloud computing and have identified some of the most important COVID-19 cloud computing applications. Providing internet services helps to control the virus. To limit the spread of the virus, every country focuses on its efforts. This encourages healthcare workers to become more creative and productive. Newly infected patients can be identified and monitored by this method. This technology will be deployed in the future to save millions of people worldwide. Additionally, this method can be used to predict the impact of SARS-Co-2 in the future.

A Silicon Valley biosensor patch that monitors the electrical activity of the heart can detect COVID-19 at an early stage. The heart rate may be monitored using this biosensor, Patch-1AX, which is water-resistant and can be worn in your pocket. An IoT device or a smartphone app can be used for heart monitoring [20] and to view real-time data from a user's patch. If a patient with COVID-19 develops symptoms, it is possible to submit this patch's data to a cloud system to notify other COVID-19 patients while they are wearing it. Wearing patches for five days at a time prevents the illness from spreading outside the patch, according to the instructions. Biosensor patch 2A Patch 2B will also be released in June by LifeSignals. Critical signals from a clinically qualified patient (ICU) are stored and transmitted to COVID-19 patients in ICUs.

Infrared thermometers (NCITs) and thermal imaging systems use a variety of infrared technologies to measure temperatures. The non-contact infrared thermometer information page contains more information about the NCITs. The ability to accurately measure the skin surface temperature of persons without physically approaching them has been repeatedly proven by thermal imaging technology when used correctly. Methods requiring close proximity or touch to measure the temperature include non-contact thermometers and mouth thermometers (for example, non-contact infrared thermometers or oral thermometers). For example, temperature-based screening is insufficient to determine whether a person has COVID-19 permanently because COVID-19 may not be feverish; for instance, COVID-19 must be diagnosed with a diagnostic test.

6.6. Heartbeat Comparison with a Normal and Infected Person Situation

The blockchain-based platform MiPasa transmits the data. Blockchain and cloud technologies from IBM allow the exchange of medical and geographic data that can be verified. People and organizations from the medical and public health sectors were involved

in this effort. According to WHO guidelines (WHO), this software is safe and beneficial for doctors. COVID-19 hospitals may use this platform to better plan for the future and allocate resources to mitigate the impact of the pandemic.

Increasingly, Germans are using smartwatches, fitness trackers, and smartphone software (corona-Datenspende) to monitor their health and assess how many individuals are clinically unwell, a news-release state. As of this writing, more than 160,000 people have signed up for the program. Using the app's data, health professionals and the general public may better understand the prevalence and distribution of infections in the community via an online interactive visual system.

Wearable technology, such as wristwatches, can be used to predict flu outbreaks in the United States according to a study published in early 2020. Nearly the course of the two-year study, researchers examined the heart rates of over 47,000 Fitbit users across five states (California, Texas, New York, Illinois, and Pennsylvania). The 0.84–0.9 statistics from the CDC correlated well with these methods when mapping the prevalence of ILI. Wearable sensors and community health promotion during a pandemic are necessary to "flatten the curve" and reduce disease morbidity and mortality according to these studies.

Sharing short-range Bluetooth signals between nearby devices has been made possible by a Singaporean initiative. These meetings were recorded and saved on a mobile device for two weeks. A COVID-19 patient's contact information is available from the Singapore Ministry of Health. Per capita mortality from COVID-19 is lowest in Singapore and South Korea. With the help of mobile and heartbeat data, AI-based apps can be used to detect COVID-19 symptoms, and this method will have fewer implications from the privacy side of personal data use.

6.7. Social Distancing Alarms with Mobiles and Keeping Track of Full-Day Reports Using Wi-Fi and Cellular Technologies for Connecting to Nearby Devices

People can be counted, their whereabouts tracked, their geographic movements tracked, and even taken abroad using big data from telecom providers [40]. However, law enforcement and the management of privacy security have an impact on this. With users' individual cloud data, there will be no issues regarding privacy and data security as users can decide to keep or delete data from the cloud.

Free internet and cloud-based solutions can be used in China to identify the most relevant materials for an individual's needs. A Taiwanese airport deployed infrared thermal cameras to promptly detect individuals suffering from fevers. Businesses, schools, and public transit in Singapore were surveyed to collect temperature data. Temperature data were collected to identify the illness clusters and hotspots.

The position of an asymptomatic person is thoroughly analyzed in Iceland, as in other countries. To better understand pathological illnesses and viral proliferation, Iceland gathered patient-reported symptom data as well as clinical and genomic sequencing. Using digital thermometers and wristwatch apps, a commercial firm in the United States monitors fever clusters and COVID-19 epidemics in California. There is no place in politics or practice for commercial or intellectual business.

6.8. Quarantine and Self-Isolation

Random infection control lockdowns have resulted in considerable financial loss in several countries. Quarantine for persons who have been exposed to or infected with the virus is made easier using digital technologies. It is now possible for health officials in China to keep track of patients' movements and temperature readings while completing symptom surveys because of the QR technology. Health and travel certificates for COVID-19 can be issued by using QR codes. Both the green and red codes were permitted to travel simultaneously. Drones and digital recorders are used in China to monitor and regulate public gatherings.

In Wuhan, passengers from the Australian mainland were arrested, whereas those from other countries were quarantined at their hotels. As a result of the new regulations, anyone

breaking quarantine would have to wear tracking devices and face fines. A quarantine break can lead to personal messages and fines in Taiwan, where those quarantined can electronically monitor their government-issued mobile cell phones. Downloading an app on your smartphone will allow officials to notify you if you leave the exclusive South Korean community. Self-isolators in Hong Kong are obliged to wear cloud-based wristbands to notify authorities if the quarantine is breached. A mobile phone system for COVID-19 soldiers was built in Iceland.

With contact tracking apps, sunshine and rainbows are not available. Quarantine is not required for all exposures, including those involving personal protective equipment or thin barriers that can be penetrated by mobile signals. People can miss a great deal of exposure if they do not have or carry a cell phone. According to UK experts, more than 60% of a country's population must apply an effective mitigation strategy.

People may avoid using mobile phone solutions for quarantine enforcement if they leave the quarantine region without phones. To use self-reported data (such as the QR code system) effectively, participants must be unwell enough to describe their symptoms accurately. Even if these technological breakthroughs are employed alone, they can be advantageous in combination with other methods. Self-isolation and apps for detecting close contacts will reduce the risk of privacy and government enforcement for the use of contact tracing apps [41].

6.9. Clinical Management

In China, AI CT services can be used to identify patients with COVID-19 pneumonia. COVID-19 may be distinguished from other lung diseases using our method, which significantly accelerates diagnosis. Thoracic radiograms can be easily searched using COVID-Net, a deep open-source coevolutionary system for clusters worldwide. Machine learning algorithms were created by the Chinese to predict the likelihood that those infected with Ebola will suffer severe respiratory distress and potentially life-threatening illnesses. Using these modeling frameworks, it is possible to improve clinical decision making and resource allocation and uncover key care resources, medical supply sites, and institutions. Videoconferencing and digital monitoring in virtual care systems worldwide can limit exposure to SARS-CoV-2 in healthcare facilities. Between February 2020 and May 2020, the number of Canadians seeing a doctor increased significantly.

A Swiss company has developed an AI-powered patient flow management system. It is a cutting-edge learning platform that compiles data from various municipal hospitals [38]. Using this information, it is possible to predict and forecast the demand for hospital beds and other treatment facilities. This technology can be used by hospitals to deliver DL for future patients. Image classification with DL is already effective, and ML and AI can be implemented for COVID-19 detection [42]. A growing number of hospitals, tourism attractions, and sporting events have contributed data to AI solutions that employ these models to improve their algorithms. In research on hospital availability, important hospital availability and AI solution performance are updated every 7 days. As shown in Figure 6, with regular data from different sources coming in, its platform and AI can help prevent hospital turmoil and keep patient flow in the hospital running smoothly, according to this assertion [43].

The curse of COVID-19 has been broken owing to AI in robots. The development of AI-based robotics has curbed the rise of COVID-19. The Vici and Tug robot serves as a good example of how robotics can be applied. By using high-tech equipment, Vici and Tug Robot can confine the virus. Healthcare workers were exposed to SARS during 2003 [44]. Therefore, they were less likely to receive high-quality treatment. Vici, a medical robot, facilitates patient–doctor interactions through visual cues on a screen. Infected patients might utilize a wheeled electronic tablet to connect with healthcare staff. It can be used as a diagnostic tool to measure body temperature. Until a healthy immune system can be developed, doctors, airport employees, and hotel staff can make considerable use of high-tech technology to reduce human contact and the risk of infection. Because support

people are not present, the deployment of Vici and Tug robots can significantly minimize the spread of the virus, as displayed in Figure 7 [45].

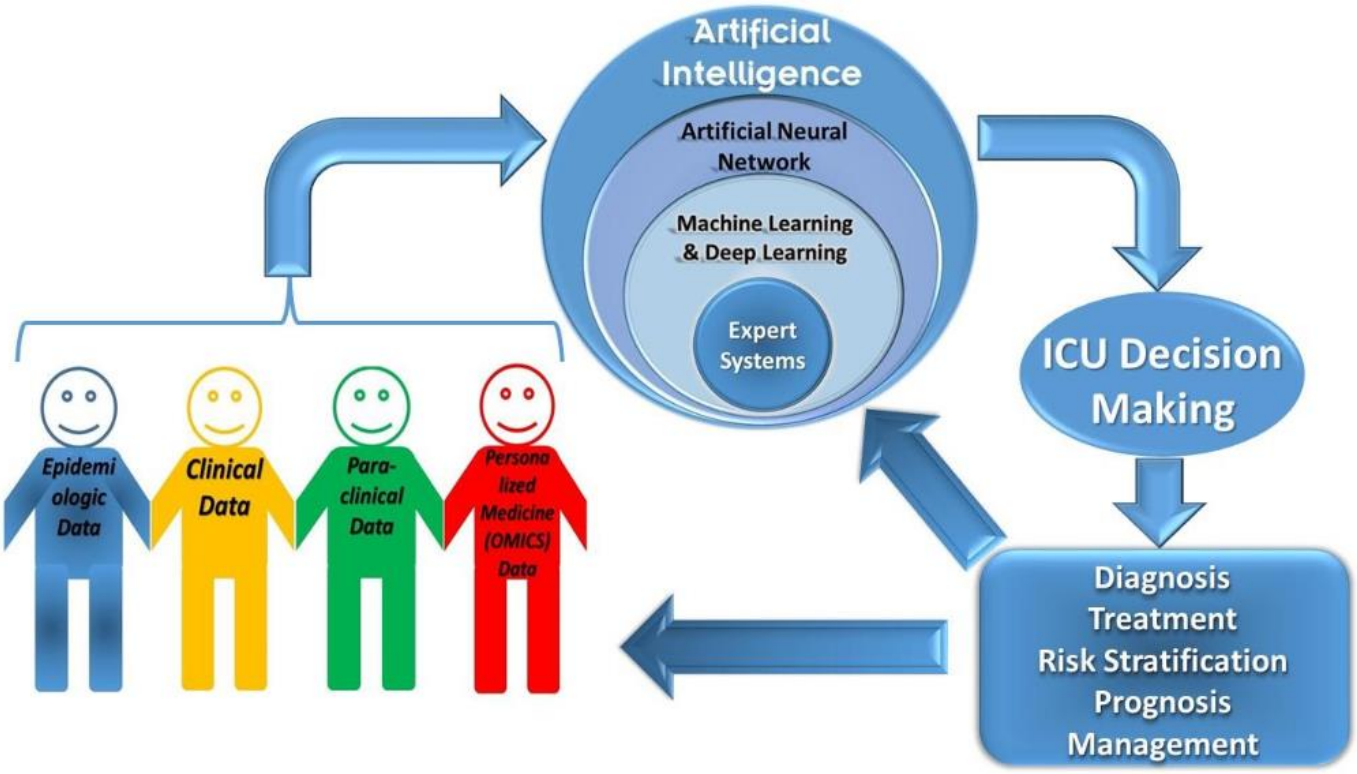

Figure 6. Role of AI in ICU.

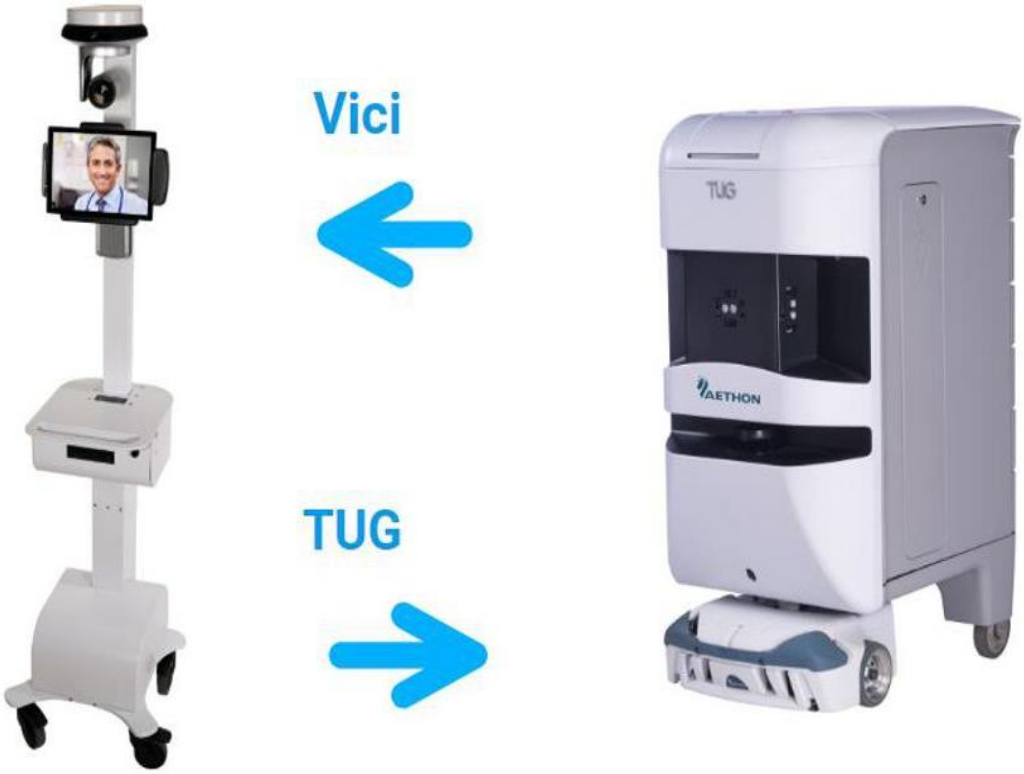

Figure 7. Vici and Tug.

The "Little Peanut Robot," which has been released in cities across China, has been added to the list. These robots may provide food, medical supplies, and other requirements for persons in quarantine or those suspected of harboring the virus. Medical supplies and patient belongings were saved from a filthy area by similar robots at a hospital in southern China. To stop the spread of this new coronavirus, many robots may be deployed in hotel rooms around the world. Traveling by air was needed during this tough period for many people, both domestic and foreign. Aircraft disinfection is regulated to ensure that passengers are appropriately screened and monitored. This was proven by the "GermFalcon robot" [46], which was created specifically for this purpose. This robot can destroy bacteria, viruses, and superbugs by degrading the UVC light. UVC lights installed in a plane's cabin are intended to shine on all the cabin's high-touch surfaces. As soon as an airplane becomes infected with the virus, passengers who are unaware of the danger must be protected immediately. With IoT and mobile devices, there is no need to use cameras to reduce security and privacy risks. Movement detection at home for quarantined people can be used with mobile applications, and sensors and robots can take action based on the symptoms. A fall in a locked room for a heart patient can be detected with motion sensors, and the robot can act accordingly to provide critical medicine within a few minutes of an accident. Further research on robots, IoT sensors, and mobile apps is required for self-management at home for COVID-19-infected persons.

7. Role of Internet of Intelligence System and Emerging Technologies in Monitoring of Pandemics

Emerging technologies play a pivotal role in monitoring, controlling, and mitigating the spread of pandemics. The latest robotics, sensors, video analytics, drones, and artificial intelligence can be effectively leveraged using low-latency, high-bandwidth 5G networks, cloud computing, and edge computing. These highly advanced devices can seamlessly communicate with each other and with centralized platforms and user-friendly mobile applications to take swift and necessary action [45].

For instance, an internet of intelligence system could deploy state-of-the-art thermal imaging cameras to detect the temperature of infected individuals in densely populated areas. These cameras can promptly send the data to a centralized platform, which leverages cutting-edge facial recognition technology and individuals' identities. Based on this information, highly efficient and responsive robots or drones can be instantly activated to alert the crowd about the risk of infection through a highly intuitive mobile app. This seamlessly integrated system can be implemented through an ultra-efficient centralized platform, user-friendly mobile application, and the latest internet of intelligence technology.

In the United States and China, robots were used for temperature sensing, food delivery, medicine delivery, cleaning, and disinfection of hospitals [46]. Shanghai police used robots and drone dogs for patrolling and surveillance during COVID-19 [28]. Robots are being used for infection prevention, and their use is expected to grow in the future [47]. Further, 5G was used to enable IoT sensors, high-definition video analytics, and thermal imaging for the prevention of COVID-19 [48].

The future is no more about connected things and will be more about connected intelligence to monitor and control COVID-19-type pandemics; in the last decade, we have moved from human-to-human interactions to human-to-machine interactions. Now, it is all about machine-to-machine interactions; however, with 6G, it will be intelligence as a service, and a major paradigm shift will revolutionize the connected intelligence. Super smart cities and e-health will have intrinsic 6G features, such as massive machine type communication supporting distributed intelligence (MMTCXDI), globally enhanced mobile broadband (GeMBB), and ultra-reliable, low-latency computation, communication, and control (URLLCCC) [49].

8. Conclusions

Many cutting-edge technologies, such as AI and 5G, are being deployed to ease the consequences of the COVID-19 pandemic on the global population. The core of our effort was to provide the most up to date COVID-19 pandemic strategies. COVID-19′s clinical features and transmission system are explored in the first phase of this study. The unique therapy attempts to stop the pandemic and preventive measures that can be taken until the pandemic is stopped are also discussed. Post-conversation discussions described several of COVID-19′s innovative treatments. This paper covers the currently employed technologies in different countries for the control of COVID-19's spread. The first-world countries were using these technologies while waiting for vaccination as technologies are easy to deploy, whereas vaccine production and certification takes months to years. The middle sections focus on current solutions with AI and 5G technologies and use cases from different countries. Users decide which data they can upload to the cloud and other applications for self-diagnosis. Similar to thermal cameras for temperature monitoring, mobile devices have the capability to test and monitor temperature from selfies and photos. The data are automatically stored in the cloud in the same manner as Google photos; that is, users can upload their photos to Google photos and can access these photos when needed. Fall detection with mobile applications was a dream, and now IOS has this capability. Voice recognition, coughing and sneezing analysis, heartbeat monitoring, and temperature monitoring are critical for the diagnosis of COVID-19. These novel approaches will produce mature products in the future, and there will be no need for clinical testing in hospitals. Our primary goal was to minimize the impact of the COVID-19 outbreak by employing cutting-edge technologies, such as AI and 5G. This new technology is exclusively responsible for controlling and limiting the consequences of this disease until treatment is established.

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