Leveraging Emerging Technology to Combat COVID-19 Pandemic emphasize on AI

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Abstract

The epidemic of coronavirus disease which is called COVID-19 is dispersing all over the world. The pandemic has taken the world as a surprise, and the government of maximum countries suffering from this pandemic failed to predict the magnitude of the situation as well as prepare themselves on time. Heavy demand for medical care facilities has broken down the top health care models in the world and failed in protecting their public. This is a matter of discussion on why top models health care sectors not able to handle the situation created by this infectious disease. This scenario gives a message to adopt the resources of emerging technologies at the global level to make a healthy nation in place of a powerful nation. This pandemic prompted a record demand for critical health resources and forced to adopt all the emerging technologies based applications to help for fighting with this situation. These technologies help for mass screening, patients surveillance, tracking virus, effective quarantine, implement social distancing as well as lockdown effectively, supply medical essentials, and many more. The world was not prepared to handle this situation that's why emerging technologies are adopted in the battle of this coronavirus like AI, cloud computing, IoT, Deep Learning, Drones, Robotics, etc. are some emerging technologies used to fight with the epidemic of COVID-19. These techniques help decision making authorities to make policies and take decisions after analyzing the data and prediction done. This chapter explains the role of some emerging technologies like Artificial Intelligence (AI), Cloud Computing, Internet of Things(IoT), Robotics, Drones, 5G Network, and Blockchain in COVID-19 pandemic time. These techniques are playing a vital role in the battle of COVID-19 and also highlight how these technologies are used to handle this situation.

Keywords

COVID-19, Artificial intelligence (AI), Drones, Robotics, Internet of Things (IoT), Cloud Computing, 5G Network, Blockchain

I.   Introduction

In the whole world, many countries have been infected with COVID-19, and the infection transfer through human to human contact (Shi et al., 2020). The infected people's count is being increased day by day by this virus. Up to 14th August 2020, **20 439 814** cases of COVID-19 have been reported in the world and resulting in approximately **744 385** deaths (WHO, 2020). COVID-19 has affected the day to day life of the human being and also slows down the growth of activities in the world. This virus is speedily spread from person to person so the identification

of this virus at an early stage is very important to control the spread of the virus(Haleem et al., 2020). Some characteristics of this virus are listed as(Shaw et al., 2020):

- **High spread rate:** In a few months, this virus spread globally and become pandemic globally. The virus spread so fast due to the mobility of people globally by crossing international borders. The coronavirus spread at a very high rate from human to human contact.

- **Specific Target:** Elderly people are the main target because of their low immunity and other respiratory problems. People having other medical issues like diabetes, heart problem, blood pressure is also the target of this virus.

- **Recovery Rate:** The recovery rate of coronavirus infected patients are low globally and differs from country to country. China, Korea, and Japan have a high recovery rate as compared to Iran, the United States, and Europe.

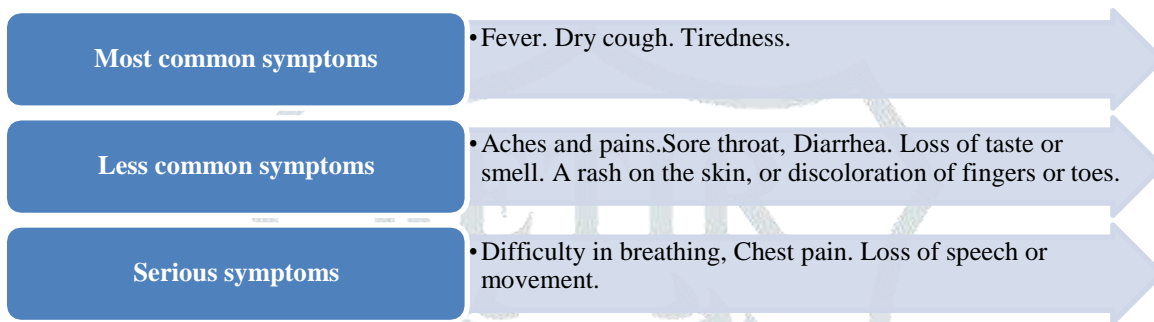| Most common symptoms	• Fever. Dry cough. Tiredness.
Less common symptoms	• Aches and pains.Sore throat, Diarrhea. Loss of taste or smell. A rash on the skin, or discoloration of fingers or toes.
Serious symptoms	• Difficulty in breathing, Chest pain. Loss of speech or movement.

Figure 1: Symptoms categorization of COVID-19

The clinical symptoms of COVID-19 ranging from mild symptoms to severe infection. Some patients show symptoms like sore throat, headache, and problems in breath while some show nausea, nasal congestion, and diarrhea. After the infection, the symptoms may arise within two weeks in the patient and some time may become visible in 27 days. Survival of the virus can be 6 to 41 days which also depends on the medical history and age of patients. Sneezing, cough droplets, and contact with the infected person are the main source of transmission of this virus. The main entry point of this virus into the body is the mouth, nose, and eyes. If a healthy person comes within the radius of a 6ft distance of an infected person then he or she may be infected with this virus. The survival time of the virus is 2 hours to a few days in cough and sneezing droplets fall on the surface or ground. The main concern to control the COVID-19 is only prevention(Ali & Alharbi, 2020). Figure 1 shows the summary up of the most common symptoms of COVID-19(Chamola et al., 2020).
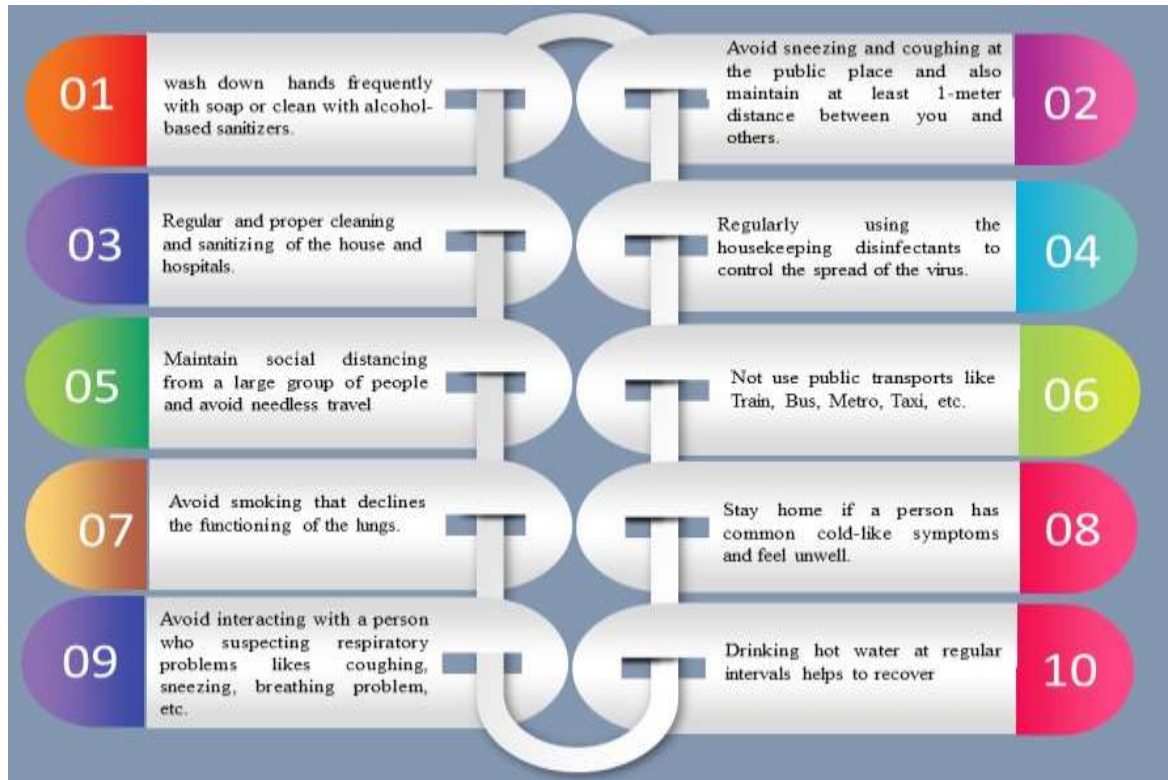
Figure 2: Precautions are taken to prevent the infection and slow down the spread of COVID-19

As shown in figure 2, it is recommended and request to the people who have symptoms of COVID-19 should take the precautions and quarantine themselves without any divergence otherwise results would not be good and the situation will deteriorate. The antidote of coronavirus is hidden with CORONA itself like:

C: Clean hands with soap or alcohol-based sanitizer O: Off
from the social gathering
R: Raise Immunity
O: Only stick to wear a mask N: No
handshake
A: Avoid rumors

II.   Learning key points from the COVID-19 pandemic

The coronavirus starts in December 2019 from Wuhan city, China, and spread around the world in a few days. For the future outbreak, several learning points should be taken from the COVID- 19.

Table 1: Learning key points from the COVID-19 pandemic (Sohrabi et al., 2020).

Issues with the current response	Event	Consequence Key	Learning Points
Lack of transparency	Share initially identification information of COVID-19.	Delayreleasing the information regarding the COVID-19 cases.	Set up the clear policies of global health emergencies.
Travel restriction delay	After the COVID-19 epidemic, aviation services are running for over a month with minimum health screening at airports, especially for international flights.	People who travel from high-risk areas were able to freely move through international airports without any health screening.	Safety measures like screening of persons who come from high-risk areas should be earlier put into practice.
Public misinformation	Initially, the information regarding COVID-19 was hiding from the citizens and due to this ambiguity rumors and half-truth spread among the public of the countries.	Discrimination and erroneous public precautions	Transparency and open access to information is required to stop and avoid the spread of misinformation.
Emergency announcement delay	WHO declared this situation as a Public Health Emergency after around one month following the initial outbreak	The strictness of the epidemic was not broadly broadcasted or acknowledged which may cause the delay in containment measures.	To escalate a threat status earlier, the framework should be developed for the fast-spreading disease.
Quarantine Delay	The quarantine process was implemented nearly one month later of the first case reported of COVID-19.	Allowed a healthy person to infect with COVID-19 to broaden the infection both nationally and internationally.	The quarantine process should be implemented as soon as possible on the high-risk area as a health threat is identified.
Research and development	Sufficient funds are not available for the COVID-19 vaccine research and development.	Due to COVID-19 over Lakhs of patients have died worldwide and the death toll still increases.	The effective treatment and development of vaccine required investment to contain a future epidemic of communicable disease.

III. Emerging technologies for mitigating the COVID-19 pandemic impact

The pandemic of COVID-19 has changed the world and the majority of governments of countries are not prepared to handle this situation. Thus this situation deploys the latest technologies and adopted all the emerging technologies to help to battle with this pandemic by a number of applications. Table 2 listed some applications of emerging technologies that play a vital role during the COVID-19.

Table 2:Applications based on Emerging Technologies during COVID-19 Pandemic(Vaishya, Haleem, et al., 2020)

S No	Emerging Technology	Applications in the COVID-19 pandemic
1	Artificial intelligence (AI)	• Help in the detection of the virus. • Suspected symptoms of COVID-19 with the thermal image and cloud computing. • As a result advice for the treatment.
2	Robotics	• In the quarantine zone, help to execute the repetitive task with accuracy and reliability. • Help to provide the medicines and food to COVID-19 patients and stop the spread to coronavirus.
3	Drones Technology	• Unmanned vehicles which control by remote are used to provide medicines and other goods from one place to another place. • Also used for disinfecting remote locations and areas.
4	Blockchain	• Single interconnected network to facilitate the secure share of data from anywhere. • To keep track of virus activity, new cases, tracking, and management of patients on a digital platform. • Help to streamline the supply-chains of various types of medical equipment like face masks, PPE kits, sanitizer, etc.
5	5G Network Technology	• With the high-speed network, the sharing of data is very fast in the form of video and audio. • Providing high speed of data, lower latency, increased availability, and more reliability. • Provide better assistance to frontline staff and help them to track the movement of the virus, patient monitoring, data collection, and analysis.
6	Internet of things (IoT)	• In hospitals, all devices are interconnected with the help of the internet. • Provide updated information and requirements during the treatment process to health workers.
7	Cloud computing	• Cloud act as the storage area of all necessary information. • Enable to increase the computing power with the usage of the internet. • Support for a real-time decision.

IV. Role of Technologies during COVID-19 Artificial

Intelligence

In this pandemic time, health-related industries searching for a new technology which used to observe and also help to stop the spread of coronavirus from one place to another. This problem is solved by artificial intelligence (AI) technology because this technology easily tracks the spread of this virus, recognizes the high-risk patients, and is also used to control the infection of this virus in real-time. This technology also predicts mortality by analyzing the previous data of the patients. This technology act as the evidence-based medical tool to modify the planning, treatment, and reported outcomes of COVID-19 patients (Vaishya, Javaid, et al., 2020).
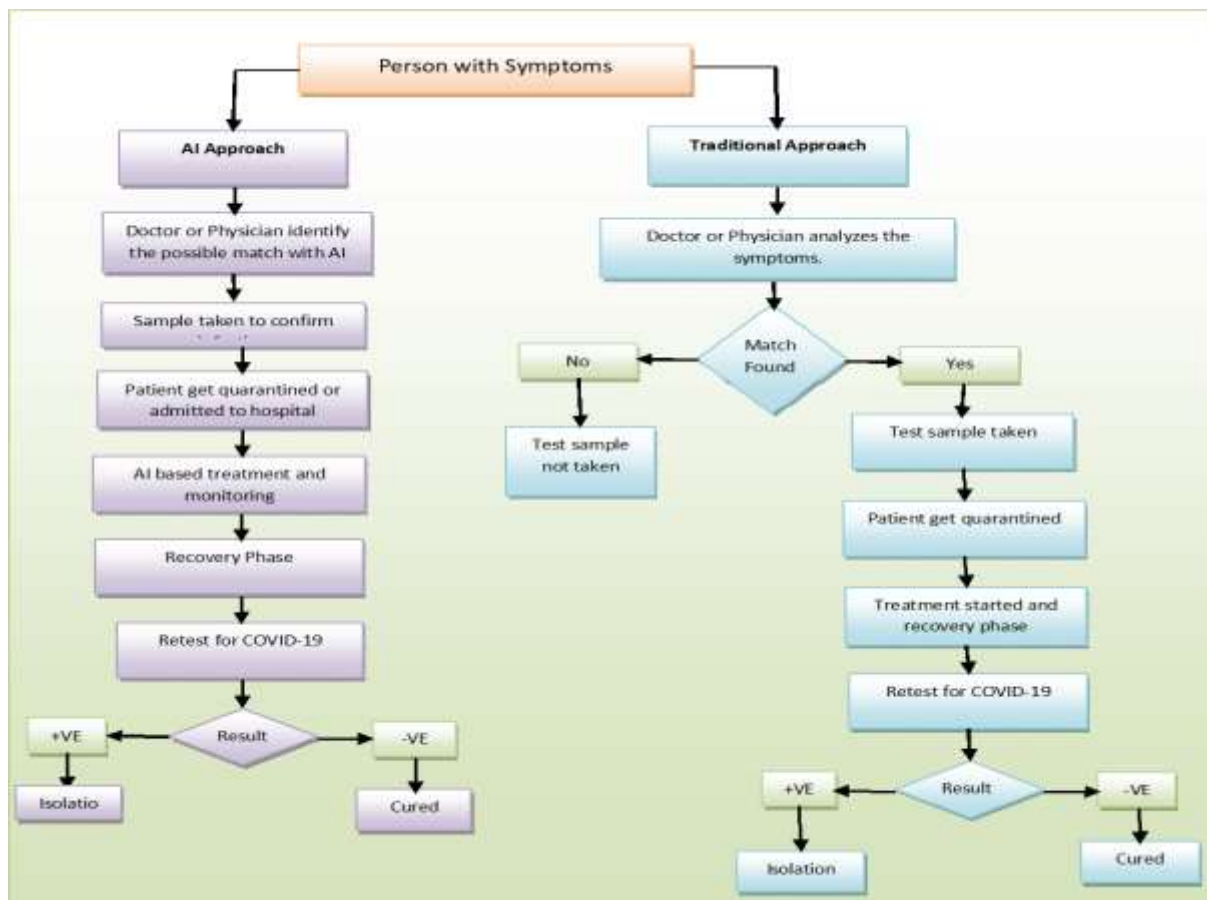

Figure 3: Comparative method for identification of COVID-19 patients with AI approach and the traditional approach based on common symptoms(Vaishya, Javaid, et al., 2020)

With the help of AI method, a sample of the patient is matched with the database and provides the confirmation of positive or negative on the basis of data availability. But in the traditional approach doctors or physicians analyze the sample on their experience. In both cases, if the report is positive then the patient should be quarantined for 14 days and after that retest the sample again. This comparison to identify COVID-19 patients with AI technology and the traditional approach based on common symptoms has been shown in above figure 3. As compared to the traditional method this AI-based procedure will save time as well as will also give accurate results.

In today's scenario, AI technologies play an essential role to stop the spread of coronavirus from one place to another and it has been improving day by day by using AI-based applications. Since its initiation, AI has been proved to be a technological advancement landmark. During this pandemic, AI is playing a significant role in fighting the pandemic carried on by covid19. This technology is being used with resources and

innovations to quickly find out the patterns and gain inside. Struggles are still underway to speed up the identify, treatment, and understand of the spread of COVID 19. Several prediction models are on the way to predict the spread of COVID- 19 by incorporating AI (Staff, 2020). AI helps for understanding the virus that helps medical frontline warriors to diagnosis and treatment of the infected person. Some of the probable and actual ways with which AI can guide the authorities in efficiently fighting with COVID 19.
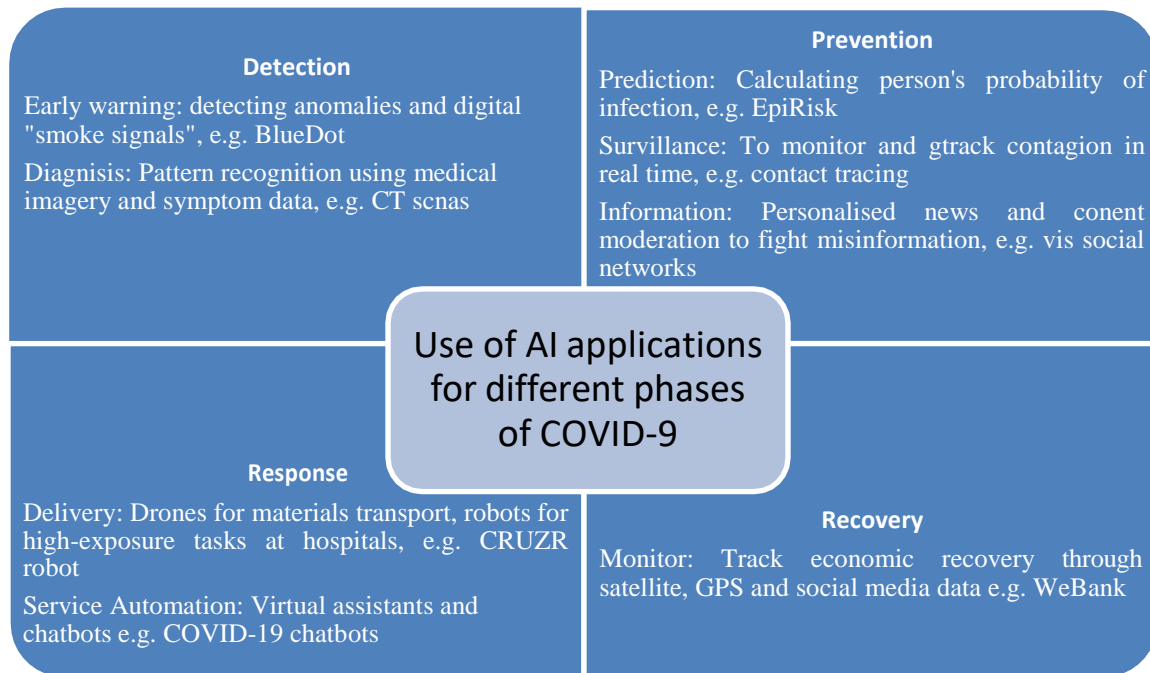
Detection

Early warning: detecting anomalies and digital "smoke signals", e.g. BlueDot

Diagnisis: Pattern recognition using medical imagery and symptom data, e.g. CT scnas

Prevention

Prediction: Calculating person's probability of infection, e.g. EpiRisk

Survillance: To monitor and gtrack contagion in real time, e.g. contact tracing

Information: Personalised news and conent moderation to fight misinformation, e.g. vis social networks

Use of AI applications for different phases of COVID-9

Response

Delivery: Drones for materials transport, robots for high-exposure tasks at hospitals, e.g. CRUZR robot

Service Automation: Virtual assistants and chatbots e.g. COVID-19 chatbots

Recovery

Monitor: Track economic recovery through satellite, GPS and social media data e.g. WeBank

Figure 4: Examples of AI applications at different stages of COVID-19 crisis(OECD, 2020)

- **Disease Investigation**: Keeping track of such an infectious disease like COVID 19 is very crucial. The migration of humans through the world is responsible for the spread of the virus around the world. Hyderabad based start-up launched an IT-based system called TTS (Traveler Tracking System) help to collect all the relevant information regarding travel history, symptoms, any positive case contacts, home address and all the related data geotag it to the passenger. This data shared with the officials and police to trace the passenger at home quarantine if no symptoms were found. This system was also installed at Secunderabad railway station to screen passenger's symptoms and their travel history.

An AI-based solution is also introduced called iMASQ(Intelligent Monitoring Analysis Services Quarantine) for COVID surveillance in containment zone after then iMSAQ Hybrid Healthcare service on Wheels used in Telangana to deal with COVID 19 quarantine services. It offers remote consultation and monitoring services in the quarantine area (Bureau, 2020).

- **Virtual Healthcare Assistants (CHATBOTS):** When COVID 19 hits, hospitals get overwhelmed with a number of inquiries from patients and this requires a way to handle the solution without human intervention. Conversational Technology(CHATBOTS) has been used in the COVID-19 pandemic for the last few months. Chatbots help to diminish the workload of healthcare management by responding answers to common questions that come from the public related to COVID 19. Bots take extreme conversational demand in a time when there is a shortage of human teams, especially during this pandemic. Millions of people used CHATBOTS to sought guidance for coronavirus symptoms overnight(Underwood, 2020) CHATBOTS must be simple in use and able to deliver information so that everyone was easily accessing information from it. Stanford psychologist and AI experts designed the woebot, a chatbot which uses the daily conversation of chats, wars games, videos and also tracks the mood of a user to manage the mental health. It is based on CBT (Cognitive Behavioral Therapy) using structured exercise to encourage a person to question and change their habit of thoughts. Woebot can help patients to improve mental health by changing their negative thoughts to positive by using Natural Language Processing(NLP), medical advice, and talk with them to create a healing experience for the user(Preetipadma, 2020).

- **Therapeutic Research:** The major problems with coronavirus is a deficiency of research and treatment etiquette of the virus. However, by studying the existing research and current cases of different diseases, AI can prove to be a valuable technology to accelerate the process of drug and vaccine development. One startup company funded by Indians Innoplexus AG headquartered in Germany claimed that the AI platform for drug discovery is giving a direction to treat the CORONA 19 cases more efficiently with the combination of existing drugs. A combination of Chloroquine with Pegasys drugs which is used in the treatment of Hepatitis is to work more effectively works (Das, 2020). Many organizations trying to forecast the associated protein structure with the coronavirus by using the models of deep learning. This helps pharmaceutical companies to recognize new and existing compounds that can help in the possible use of coronavirus therapy as well as to develop a prototype vaccine. Researchers are using AI technologies with in- silico modeling to filter down the research of chemical compounds which are expected to give better results in clinical trials on humans. It increases the research work for finding the drugs and vaccines of coronavirus(Kelley, 2020). Professor and students of IIT Roorkee with support of the medical scientist team in Kyoto have developed an AI-based software to detect coronavirus and predict the same in asymptotic patients by using X- Ray producing results with high accuracy of 99.69%(Nandini, 2020).

Suggestion for encouraging the use of AI technology to fight with COVID-19(OECD, 2020)

During this pandemic time, governments and other stakeholders of the world are encouraged to use the AI technology to fight with COVID-19. To implement this some suggestions are listed as:

- Data should be exchange nationally and internationally by the stakeholders in between the AI community, medical society, developers, and also with policymakers to understand the problem. With this step, relevant data is identified and tools and training models are shares.
- AI systems are based on machine learning which works on data patterns and to identify these patterns, a large amount of data is required. The output of any AI systems is based on the training data sets.

- AI systems are designed for specific requirements. Some times, in AI systems personal data is reused and sometimes breaks the privacy and other rights.
- AI implemented monitoring tools are designed that perform the research work without sacrificing privacy.
- Take a lesson from this pandemic and prepare for the same situation in the future. To commit the research on AI technology that uses limited data and performs the accurate function.

Challenges Face during Implementation of AI

AI plays an essential role in this COVID-19 pandemic time. At present, AI systems are in the development stage. Some of the challenges faced during the implementation of AI in COVID-19 are listed as:

- AI models required a large amount of training data to produce reliable and accurate results. Due to the unique nature of this pandemic, resulting in a shortage of data that affects the efficient functioning of the AI model.
- Too much noisy and outlier data has affected the performance of AI models and the result is not accurate.
- The working of the AI model completely depends on human knowledge. Expert human is required to implement AI techniques against COVID-19 pandemic.
- With the implementation of AI, the privacy of human beings is reduced because data is continued to monitor even after the pandemic is over by the governments.
- AI models are particularly machine learning models, these models perform the same task depends on the dataset that has been trained on.

Robotics: COVID 19 is contagiousness so it is safer if minimum human to human will contact. Robots are protective of infection spread and help to provide the medical supplies to healthcare workers and also deliver the essential items to the quarantined people in hospitals. Shenzhen- based startup Pudu technology implements home delivery of drugs and meals via robots to keep social distance and help reducing infection. According to a survey conducted among 109 companies by the American Chamber of Commerce, Shanghai found that nearly half of the companies would face a bigger challenge to have enough staff to run the full production in the factories. This reality will enforce the robotic automation that ensures the continuity of work as well as productivity and even help to reduce costs if the country will face any such lockdown or shutdowns in the future(Marr, 2020). Robots are not susceptible to viruses, so they are being used for many tasks like sterilizing, cleaning, and supply medicines to patients. In some places, robots are being used to disinfecting items and public areas in the fight against coronavirus. Robots can target the objects that need to be disinfected and able to move in public places. Disinfection robots are installed in airports for the safety of passengers and staff. Robots regularly move through the terminal to disinfect high-risk touchpoints at airports like toilets, escalators, trolleys, and lifts also check the temperature of passengers by using ultraviolet light to kill coronavirus and also stop the spread of the virus(Lewington, 2020).

Drones Technology: An important responsibility of authorities right now is to reduce the spread of COVID-19 globally. Drones are used to observe the activities to minimize human to human contact and social gathering to ensure social distancing. In such a scenario, drones are helpful for authorities and local police to monitor people's movements and break up social gatherings that could force a risk to society. At this time of crisis introduction to drones reducing the risk of getting infected to staff and police officials since it enables them to reach tough places without any physical contact. Although the use of drones for tracking people's movement also raises a debate on the individual right for their privacy on social media as well as mainstream media platforms(M. Sharma, 2020). In addition to public surveillance, drones are also used by authorities to broadcast health-related information and lockdown related messages, especially in rural areas. Many countries are using drones for public announcements through loudspeakers to keep people indoors, for aware

then to taking precautions, for wearing masks, and to follow measures of social distancing. Health authorities are using drones to disinfect public places and stop the spread of coronavirus. These drones used for spraying disinfect more rapidly as a comparison to traditional methods and also cover a large area. With the help of the services of these drone health and sanitization, workers can protect themselves from the exposure of the virus. These drones are inexpensive, easy to operate, and portable.

Blockchain: In recent times blockchain technology has been under a widespread topic of debate among industrialists and researchers especially during this COID-19 situation. This technology is spreading its use among all domains including the healthcare sector. During this current health crisis, brought by the COVID-19, the use of this technology is the need of the hour. Fight with COVID-19 is very difficult or almost impossible without the use of such emerging technologies because the nature of this pandemic is distributed itself in nature. To deal with this situation DLT(Distributed Ledger Technologies), such as Blockchain can be highly advantageous. Blockchain technology allows individuals or organizations to connect with a single interconnected network from any corner of the world to facilitate the secure share of data. Blockchain technology-based applications enable government agencies to keep track of virus activity, suspected new cases, tracking and management of patients digitally, and relieve some burden from healthcare staff (Chamola et al., 2020). This technology help early detection of symptoms before they spread and develop treatment quickly by rapid processing of data results in more efficient as well as accurate reporting. Some of the significant points contribute by blockchain technology to fight with COVID-19 (T. K. Sharma, 2020):

- Increased testing and reporting
- Tracking infectious disease outbreak by keeping a record of COVID-19 patients
- Help to manage the crisis by instantly alerting the public about the virus and also give recommendations to the government on how to contain the virus.
- Blockchain technology help to streamline the supply-chains of various types of medical equipment like face masks, PPE kits, sanitizer, etc.
- Blockchain technology is used in disaster relief and insurance industry by simplifying the process of approval after removing intermediaries' third-party which accelerates the process.
- With the help of Blockchain technology, the general public who give donations can understand the flow of their donations and its progress.

5G Network Technology: All over the world every nation struggles to manage efficiently the challenges of COVID-19 by protecting their people from this pandemic. This devastating pandemic is forcing people towards the use of digital services provided by the government, banks, healthcare, and academics to quickly respond and keep social distancing. The switch of people from physical to virtual happened almost overnight. This situation will impact for longer terms so these digital services must be planned according to the current scenario. Currently, there are 3.5 billion mobile users to date, and a live webinar of standard definition quality for one hour requires 30-100 MB data transfer. In the future users and usage of data are only going to rise as the world transforming into a remote workforce (Ghosal, 2020). 5G technology can handle this situation by providing a high speed of data, lower latency, increased availability, and more reliability. 5G technology providing frontline staff better assistance and help them to track the movement of the virus, patient monitoring, data collection, and analysis. Together with other technology like AI and IoT, 5G technology has the potential to revolutionize the health sector, especially during the pandemic time. 5G thermal imaging supports monitoring of infection by spotting the temperature of moving object temperature in real-time without contact and alarm for abnormal temperature issues.

Internet of Things: This is a network created by the interconnecting of devices like sensors, home appliances, health monitoring devices, and many more. With this connectivity, devices can sense, collect

data, process the data, and communicate with each other, and also automatically interact with people (Swayamsiddha & Mohanty, 2020). During this pandemic time, IoT technology plays a vital role. IoT is the new emerging technology which is used to ensure that all infected patients with coronavirus are quarantine. During quarantine, IoT helps in the monitoring and tracked all high-risk patients. This technology is used for the biometric measurement of the patient like blood pressure, heartbeat, etc. With the implementation of IoT technology, the chances of error to come are reduced because it works automatically. IoT devices collect the data from the sensors and then store that data in the cloud. After processing this collected data, IoT devices will execute their task without the involvement of human beings and enhanced the diagnosis process. The successful implementation of IoT improves the efficiency of health workers by reducing their workload.

With the help of IoT, the real-time update in COVID-19 cases are collect globally including the number of crude patients, Deaths, and number of active users in different locations. The health worker remotely takes the X-ray from the control room with live streaming of the video images processed by AI-enabled visual sensors. So consuming the less time for the diagnosis and confirmation of the cases. IoT enables contactless and early detection of the virus. IoT is useful to maintain quality supervision with real-time data. It also predicts the upcoming situation of COVID-19 with the help of a statistically based method(Singh et al., 2020).

Cloud Computing: COVID-19 is the biggest pandemic of the 21st century. Till now no vaccine is discovered, the only precaution is the single solution for that. To stop the speed of the spread of viruses, social distancing and lockdown are implemented across the globe. Due to this, businesses are motivated to use the technologies in every part of operations and for business continuity of businesses are required to go remotely. For the remote performance, the accessibility of data and services mostly depends on the data centers means the server, but in remote working conditions, the task of accessibility becomes tough to manage the data and services. To solve this problem, cloud computing technology can be used by the business owner to boost productivity and improve the functioning of the business. After the implementation of lockdown, many organizations have decided to continue their task remotely. With the usage of cloud computing, employees get the flexibility to work from anywhere and at any time. This technology helps to improve the productivity and efficiency of the employees(Inspirisys, 2020).

With cloud computing, business and governments rapidly implement the solution to the present crisis and also maintain continuity. Cloud computing technology deploying life-saving solutions quickly. Every day, a user using the App number of times on a smartphone, in the back end site the power of App is cloud and it becomes the new invisible power that provides the platform to IT systems and Apps for execution (ITU, 2020). In the absence of cloud solutions, boredom and inconvenience become part of many people. In business, it stops the commercial activities because all the functions of business are executing remotely. In the education sector number of Apps like ZOOM, Webex, GoogleMeet, and many more are used to provide virtual classes. These Apps also used to perform the virtual meetings of the MNCs. The cloud provides the stability and flexibility to a web-based platform to work continue without any congestion by the unexpected number of users going online(Bourne, 2020).

V.   Leverage of Emerging Technology in the Post-Pandemic of COVID-19

Before the COVID-19 pandemic time, the adoption of emerging technologies like AI and Robotics was considered an investment in an organization. During this pandemic time, only social distancing is the only solution and organizations are implementing the emerging technologies to enable the return of workers with safety protocols. Organizations are leveraging a range of computer vision tools, thermal imaging cameras, sensors robots, etc. to battle with COVID-19. Proxxi recently introduced a smart social distance bracelet that works on Ultra- wideband locating technology that vibrates to notify the user that another bracelet user is

within 6 feet. Robots are used to doing the work in organizations without the involvement of human beings. These emerging technologies ensure that the users are best prepared to operate these technologies devices effectively(Pierce & Perkins, 2020).

VI. Conclusion

It is advised to follow the guidelines given by the government for prevention and keep social distancing to stop the spread of the virus. In this situation, no need to panic and proper prevention and management are the essential weapons to fight this disease. This chapter may be beneficial to aware the people about the disease, how to prevent and how emerging technologies like AI, Cloud Computing, IoT, Blockchain, 5G Network, Robotics, and Drones are used to identify early infection due to coronavirus and also help in monitoring. These technologies have played a vital role in diagnosis, tracing of the virus, social distancing, workplace safety, and many more. They also significantly improve the consistency of treatment and power of decision making by the implementation of useful algorithms. They also help to facilitate the research on this coronavirus by using the existing data. With the help of these technologies, many health workers can serve the nation without getting infected and can decide and guide the treatment by virtually diagnose the patients. But still, these technologies have received little more research attention for the rapid usage of emerging applications in the real world. It is expected that these technologies will help success in the health field and also used for humanity in this COVID situation as well as for future pandemic.

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