



ROLE OF INFORMATION TECHNOLOGY IN THE PROGNOSIS AND DIAGNOSIS OF COVID-19: A REVIEW

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Abstract: Our world has been changed completely by the Novel Coronavirus Disease 2019 (COVID-19). More than 4 million deaths till date, 200 million positive cases and the numbers are still rising. Innumerable families are devastated and the economy has crumbled in many countries. Although several countries are already on the verge of fighting this deadly disease, and vaccinations are now being provided, but the efficacy of vaccinations is still debatable. What can be surely said is that the pandemic has a continued impact on individuals, governments, economy and nations for a long time. The scholars around the world are collaborating in a “war” against an invisible enemy. Being a computer science engineer, it becomes an utmost important to find out how does information systems contribute to this global effort? This paper summarizes the role of information technology in the preventing the rapid spread of disease and developing the medicine for of Covid-19. Initially, we have discussed how the crisis management is done with the help of information technology. Later, the whole emphasis is on the studied literature, through which we can see how the healthcare information technology has converged to effectively cope with Covid-19. It can be seen that there’s operative integration of Big Data, Artificial Intelligence, Blockchain Technology, Cloud Technology, Internet of Things and Smart Wearable Devices. A brief summary of all of these aspects are provided along with their actual working examples from all around the world.

Index Terms – Covid-19, Big Data, Artificial Intelligence, Blockchain Technology, Cloud Technology, Internet of Things and Smart Wearable Devices, Information Technology, Crisis Management Systems

I. INTRODUCTION

The COVID-19 Pandemic have accelerated the use of technologies which includes online shopping, digital payments, telehealth, AI, Remote work, Distance education and online internet. To save people from COVID-19 government is taking help of digital epidemiological surveillance tools to gather data such as symptoms of patients and past health history, survey, tests etc. as well as taking major steps like quarantine people to stop COVID from spreading. There are plenty of preventive measures taken by people and government like quarantine and self-isolation, perform timely tests and provide treatments as soon as possible. After treatment, a patient’s recovery is also confirmed.

This paper mainly focuses on how computer technology is helping to tackle with Covid-19 virus. In this paper, we have the critical analysis of existing literature which is relevant to information technology and the mechanisms associated with Covid-19. Though, the literature consists of a lot many research contributions, but here we have critically analyzed and summarized twelve significant research works and projects addressing this issue. It is found that the information technology plays a vital role in crisis situations and acts as a backbone for overcoming this pandemic. Through our critical research we have observed that the countries with stronger IT outreach has managed to connect every citizen and make sure that they comply with the government norms. Countries like New Zealand has successfully managed to hit zero active corona cases thanks to their active crisis management and proper implementation of their information technology.

II. ROLE OF INFORMATION TECHNOLOGY IN CRISIS MANAGEMENT

The government and information technology work hand in hand with the management of citizen's lives. This is not only routinely applicable in every day's life but has to be extensively utilized in the crisis situations. Many new technologies are being gradually incorporated [1]. In the wake of a pandemic, the utilization of information technology becomes multifold. And hence, in a crisis management situation the following becomes the imminent role of the information technology:

- (a) to connect people
- (b) deliver about life saving information
- (c) reach out to the people affected by the disaster
- (d) to restore connectivity to the affected area
- (e) to help people find their loved ones
- (f) to coordinate rescue missions
- (g) work efficiently in the containment zone;
- (h) to help with business recovery
- (i) to analyze the pandemic affected areas
- (j) to help develop better solutions and prepare to save more lives

It is, hence, not a wrong thing to say that the advancement of computing and telecommunications technology has progressively changed the crisis management [2].

Respondents who are involved with crisis management are surely combining the new technology utilities in order to help those affected by the pandemic. The advent of information technology has given rise to a more concrete decision making in dealing with the crisis management. It can be easily observed that the role of information technology in crisis management is broadly divided into

1. Provision of infrastructure (smart phones, internet, satellites, PCs, LAN and WAN, digital cameras, GPS/GPRS, GIS, weather stations, etc.)
2. Managing information flow throughout the crisis management process (mitigation, preparedness, response & recovery), This can be illustrated with the help of the following framework shown in Fig. 1. used for crisis management.

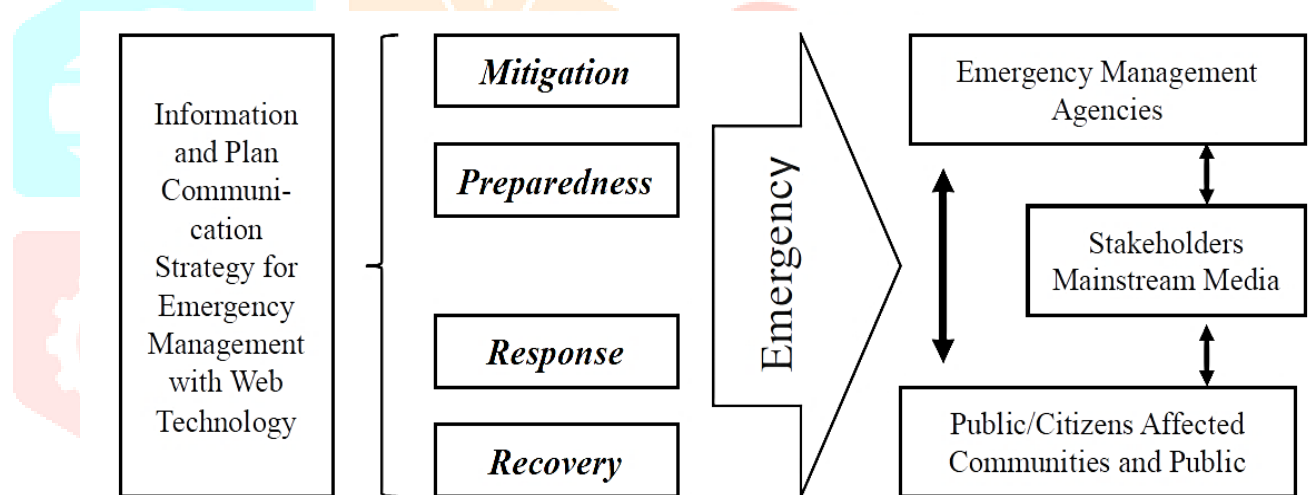


Fig. 1. Information and Planned Communication Strategy for Crisis Management

III. RELATED WORK

Although there are many researches works on crisis management systems, here we have critically analyzed and summarized twelve research works and projects which are more relevant and pertinent. It is observed that most the recent works addresses the issue of Covid-19 and use of information technology.

In 2020, a review was conducted [1] indicating that various IT-based systems have different outbreak management applications. It was shown that without applying IT, the control and management of the crisis could be difficult on a large scale. In this paper the authors mentioned that Information technology was applied in several aspects and especially in response phases. The authors have tried to present an overview of the IT application and the existing gaps in the emergency management of the COVID-19 outbreak. It was later concluded that the smart city features could help in early screening and diagnosis of infected cases.

In 2020, the role of information technology was examined in response of COVID-19 pandemic [2]. In this paper, the authors have identified the latest information technology trends, namely video conferencing, instant messaging, drones, AI, blockchain, Big Data and robots. These technologies were found to have used optimally in handling pandemics both for mitigation purposes, as a tool when dealing with pandemics and for treatment and recovery efforts.

In 2020, the authours proposed an AI based cloud/ fog assisted IoT framework [3]. In this paper, the aim is to prevent and protect people from COVID-19. The work provides real-time processing of users' health data. The symptoms are observed and an emergency alert is generated. The system collects information from the hospitals/ quarantine shelters through the patient IoT devices for taking necessary actions/decisions. Also, an alert message is sent to the government health agencies for timely actions.

In 2020, a survey was designed [4] as a response to the COVID-19 pandemic. The aim is to find the effects of the pandemic on social interactions. Also, the extent to which digital technology is being utilized by citizens is to be determined. Psychological well-being is targeted. The analysis of the data collected will show that use of digital technologies are associated with psychological well-being and how it is affecting individual social and emotional connections.

In 2020, a review [5] was done on digital technology use during the COVID-19 pandemic. The review addresses the four things viz; digital technologies that were used, the people who have used these digital technologies, response of people using these digital technologies, and the effects of using these digital technologies. Through this rapid review, the authors sketched an expansive, multilevel model of how people are using digital technology during the COVID-19 pandemic.

In 2021, the application of FOSS was studied [6] and summarize which includes projects that were available through reliable web-based materials. The results show that a high percentage of FOSS projects against COVID-19 were related to visual dashboards. The open dataset and analytical methods made a significant contribution to this context. Previously learned lessons from FOSS have shown that the explained projects would play important roles in future pandemics by forking and joining in new projects.

In 2020, emerging technologies were examined [7] that are used to mitigate the threats of COVID-19. This paper also addresses the challenges related to technology design, development, and use. This paper also emphasizes on how the information technology scholars can help fight the COVID-19 pandemic. The need for technology development is mentioned so as to produce better solutions for tackling the COVID-19 pandemic.

In 2020, the various aspects of modern technology [8] is discussed to fight Covid-19. This includes medical image processing, disease tracking, prediction outcomes, computational biology and medicines. An insight is provided on the technology advances used to decrease and mitigate the impact of the pandemic. It was observed that there are still many areas to improve the applications and contributions of technology especially in AI.

In 2020, a review on digital solutions [9] to mitigate the impact of COVID-19 is provided. A scoring rubric was created by cross-classifying the patient needs with the type of technology. They classified each technology according to health care system target, grade of innovation, and scalability. The use of AI-powered tools for the diagnosis was suggested. The authors have identified that in the field of diagnosis, AI-based diagnostic algorithms appear to be promising. For surveillance, digital apps have already proven their effectiveness. For other patient needs, telemedicine or telehealth tools are proposed. Digital solutions are being proposed to implement best practices.

In 2020, a review of digital innovations [10] for the public-health response to COVID-19 was conducted. The limitations of these digital innovations were also discussed. There are many barriers for the implementation of these digital technologies which includes, legal, ethical, privacy, organizational and workforce barriers. It was later mentioned that as the future of public health is digital, and the need for the proper strategies for the use of digital technologies is needed internationally.

In 2020, a review aiming to investigate the recent digital technologies [11] that were applied to fight the COVID-19 pandemic. In this paper, the authors have identified that there are two major categories of technology combating COVID-19. First is on the diagnosis side where the potential to support the process including non-contact thermometers, AI, drones, and virus genome sequencing. In the next category, the digital technologies addressed the logistic applications such as pharmaceutical tech, robots, telemedicine, GIS, IoT, and big data and blockchain. It can be concluded that technologies with the ability to reduce human contacts through teleservices as well as those that quickly enable decision-making via in-depth analysis received more attention among the health authorities and organizations.

IV. ROLE OF INFORMATION TECHNOLOGY IN PROGNOSIS AND DIAGNOSIS OF COVID-19

The COVID-19 pandemic has created tremendous disrupt resulting in loss of human lives, serious health issues, social, political and economic degradation worldwide. The overall failure has made the healthcare organizations to strive to come up with various effective approaches to stop this pandemic. The situation has been completely unprecedented and unpredictable and hence it has been very difficult to find an effective solution. With a view to help solving this worldwide crisis, we hereby summarize how the information technology in the field of healthcare has worked and converged.

After studying a vast literature, we can say that there are two essential resolutions in the context of information technology: preventing the rapid spread of the deadly virus (① in Fig. 2) and developing an effective medicine for it (② in Fig. 2). Now to address these issues, we need an integration of cloud technology, smart wearable devices, big data, blockchain technology, internet of things (IoT), and artificial intelligence (AI).

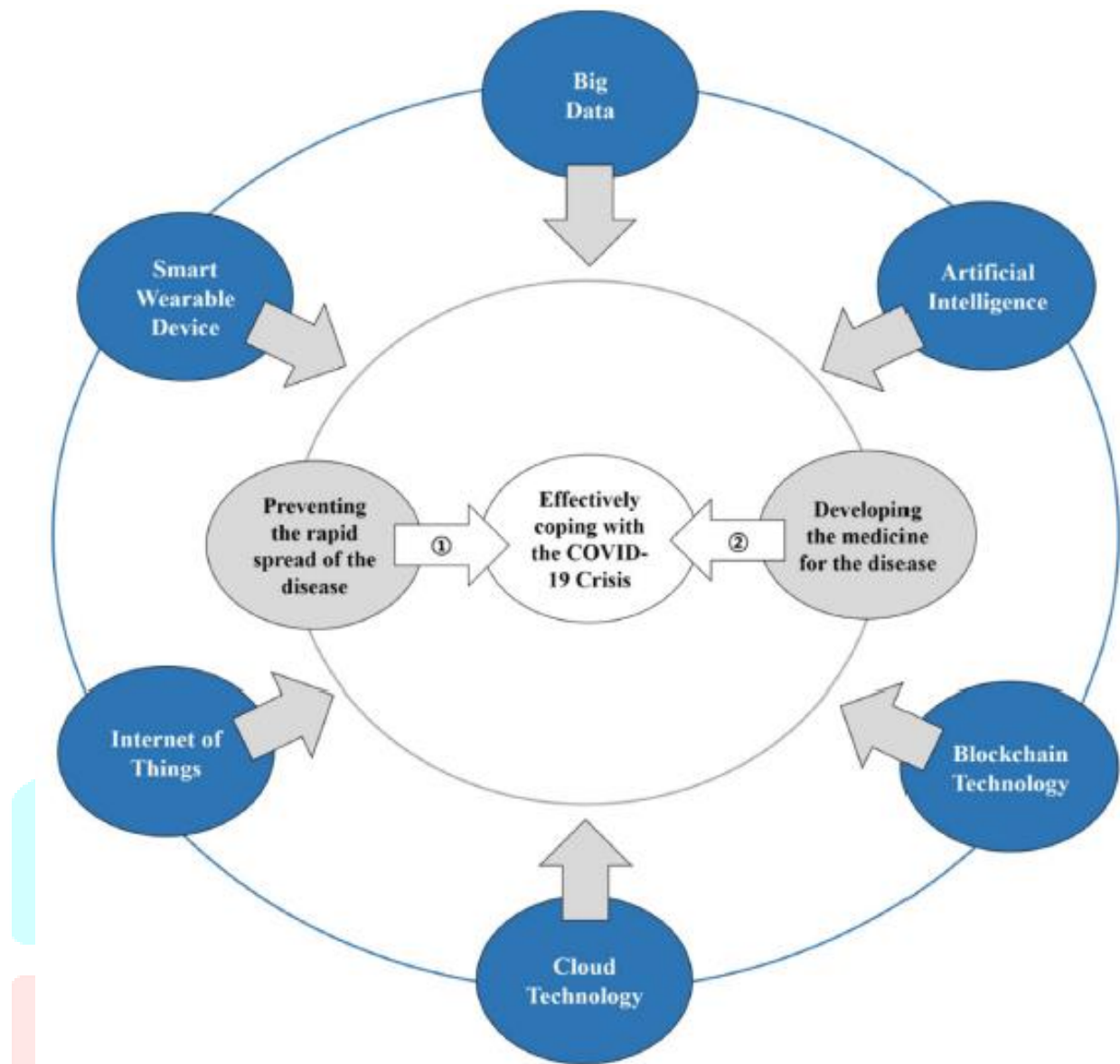


Fig. 2. Healthcare IT convergence to effectively cope with the COVID-19 crisis.

1. Artificial Intelligence

It is possible that an early warning can be given. The trigger action to appropriate reaction time can be decided. Artificial Intelligence (AI) can play one such role as a part of the IT devices. We know that AI is the field of computer science that tends to create the machine intelligent so that they can act and react like humans. An incident displaying the use of AI has already been reported when the first warning outside of China was carried out by the HealthMap system [3]. It is mentioned that this HealthMap AI technology found in a social media upload that discusses Wuhan's health authorities regarding unexplained pneumonia. The warning detected from this AI system was issued 1 week before the information of the COVID-19 pandemic was announced by international organizations.

This shows one of the roles of AI technology in helping to provide early warning and information that is useful for the decision-making process. The use of technology to monitor the condition of suspects and patients was found in which utilizes neural network technology and machine learning for disease tracking by trying to recognize abnormal breathing patterns [4]. This AI technology is also used to recognize Baricitinib's ability (a type of drug), which is predicted to reduce the ability of the virus to infect lung cells and more broadly to find drugs that match the symptoms and symptoms that are recognized.

2. Block Chain

One of the prominent technologies that played a vital role in handling the Covid pandemic, along with the AI technology, is the Block chain technology. It is actually a distributed digital record data system which is connected using the concept of cryptography. Block chain technology in the field of medicine has served, and is still serving as a means to increase efficiency and diagnostic accuracy of treatment. Along with it there are many more applications of it such as to track the supply chain of medicines and other medical supplies, management of medical data and recognizing patterns of different disease symptoms [5]. For the real time handling of large amounts of incoming data, like in the case of Covid 19, Block chain reduces uncertainty, offers computational trust, and serves as an automated platform for record and exchange of factual information consistent with various parties.

During tough times like now, when our Covid warriors i.e the doctors, scientists as well as the common people are fighting the pandemic, data consistency plays an important role and Block chain is useful for providing reliable data to the public. For instance, in the U.S, data and metadata regarding Covid is received from big organizations like WHO, CDC(Central Disease Control), clinicaltrials.gov and then this data is matched with the source of the information [6]. The data received is further confirmed and 'timestamped' by the block chain technology or the general ledger technology at the time of receive, and is safely stored for review by others. Block chain has been considered as a trusted platform for such real time handling of data among stakeholders.

3. Big Data and Smart Management System

Implementation of Big Data technology was inspired by South Korea's plan of battling COVID-19. Basically, a Smart Management System (SMS) derived from Big Data technology was deployed by South Korea to track infected individuals and also to track people these people might have had contact with during the period of infection. A network of 28 organizations such as the National Police Agency, Credit Finance Association, three smartphone companies, and 22 credit card companies are used by the South Korea Disease Control and Prevention Center (KCDC) to track the movements of individuals infected with COVID -19, using a tracking system [7]. The nearest health care centers in the vicinity of the identified people are informed by the KCDC, who in turn notify the KCDC back. Then a Covid 19 test is performed on these individuals. If it turns out to be positive, they are sent to a dedicated Covid 19 hospital. On the other hand, if it turns out to be negative, these people are advised to remain in isolation for 2 weeks.

After the unfortunate MERS outbreak of 2015, South Korea has prepared a legal grant for accessing personal information pertaining to all residents. South Korea know the importance of contact tracing for curbing the impact of Covid 19 [8]. However, for privacy and security reasons, there's a condition that only KCDC epidemic investigators can access the location information, and care has been taken that once the pandemic is dealt with, the information would be immediately deleted.

4. Robotics and IoT

In the lockdown we have seen that people have to adhere to social distancing norms and stay at home during This limitation of human contact has given rise to the Robot technology. COVID-19 pandemic has accelerated the overall acceptance of the use of robotics so that they can replace human work upto some extent [9]. We have already seen that in some advanced medical facilities, robots were used as an intermediary for medical personnel wherever there was a high level of risk for contracting COVID-19.

In Wuhan, a medical facility was inaugurated where all medical and staff services were carried out by robots and Internet of Things (IoT) devices. Patients were asked to wear smart bracelets and rings that are synchronized with the AI CloudMinds platform so as to monitor their temperature, heart rate and blood oxygen levels [10]. To recognize the early signs of infections, the doctors and nurses also wear devices. The service including food, drinks, and medicines were provided to patients by the robots. Moreover, the robots also performed certain tasks like spraying disinfectants and cleaning the floor.

In yet another example of Robotics and IoT, germ killing robots named GermFalcon was used in US Airports to clean the aircraft. Robots were also used for shipping services. It is clear that the use of robots proved beneficial during the pandemic and many lives were saved as a result.

5. Smart wearable devices

With the proper use of resources, the information technology can effectively facilitate the prevention and cure. One challenge is that the coronavirus is rapidly transforming itself and new mutants are found every now and then [11]. So, in order to develop a cure, there should be an increase in the need for various medical information about the mutations of the virus, advanced global research, and real time collaboration between various healthcare organizations.

Smart wearable devices, integrated with cloud technology and IoT, can constantly nourish the medical big data necessary for analyzing the transformations of COVID-19. The government of Singapore has launched an application, named as TraceTogether, which uses the Bluetooth technology to identify infected people near its users [12]. Another example of smart wearable devices was used by the Hong Kong government where they issue smart wristband for citizens so that the government can monitor whether the user is in the designated area or not.

V. DISCUSSION AND FUTURE WORK

Put together, the healthcare IT – big data, AI, blockchain technology, cloud technology, IoT, and smart wearable devices – can make a substantial and positive synergic effect on effectively counterattacking the COVID-19. Therefore, we hope that the healthcare IT convergence will be deployed to facilitate the prevention of the rapid spread of the COVID-19 and the development of an overall effective medicine as soon as possible.

In the future, we will utilize one of the key parameters of information technology to contribute in a “war” against the invisible enemy.

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