

The impact of Artificial Intelligence, Blockchain, Big Data and evolving technologies in Coronavirus Disease - 2019 (COVID-19) curtailment

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Abstract— The pandemic of Coronavirus Disease 2019 (COVID-19) is proliferating across the globe obnoxiously and it is the most heard buzzword in recent times. Every person ranging from older people, persons with disabilities, youth, indigenous people have become a part of this chain and are most likely to suffer in the upcoming chronology. Social distancing is likely to become a new norm where “Work from Home”, Online Lectures” and “Meetings” ensue on social media applications. Technology has always lent a helping hand for mankind’s problems. The idea focuses on highlighting the advancements in technology in the midst of a bizarre situation. Deep Learning applications to detect the symptoms of COVID-19, AI based robots to maintain social distancing, Blockchain technology to maintain patient records, Mathematical modeling to predict and assess the situation and Big Data to trace the spread of the virus and other technologies. These technologies have immensely contributed to curtailing this pandemic. Strong will power, patience and optimistic guidelines catered by the respective government are some of the altercations to COVID-19.

Keywords— COVID-19, coronavirus, Society, Social Distancing, Technology, Guidelines, Precautions, Diseases, Machine Learning, Deep Learning, Blockchain, Artificial Intelligence, Robotics, Big Data.

I. INTRODUCTION

The COVID-19 pandemic has manipulated the perspective of people towards their existence. It has manifested that the pre-planned things can be shattered by a nano-particle almost naked to the human eye. Large scale businesses have come to a cessation, no transportation facilities, closed cafeterias - all these have surely led to low economy and less trade, the fact that the farmers and the small scale vegetable vendors who have been in benefit due to the pandemic. People have started to purchase merchandise from small grocery shops instead of virtual shopping or tele-ordering. Although online services have started, its effect has drastically reduced, thus giving an influence on small scale vendors and our contribution to such workers will be of great help as they earn on daily wages.

The ‘lockdown’ situation due to COVID-19 is a grueling problem when it comes to houses where only old or elderly people live. It is also an onerous time for people who were already on medication and one in need of medical supplies.

Regular check-ups for dialysis have stopped which has endangered human lives. However, people have become more considerate than before due to the pandemic. The social life of people has enhanced due to the rise of phone calls, messages during the lockdown period which surely has given a boom to the telecommunication Industry. On the contrary, it is also disadvantageous to mankind which may have a negative impact on the mental health of the employees & the officials that are either working from their residencies or working from remote areas. As mentioned by many of the Health Ministers and doctors all around the globe, ‘Social Distancing is likely to become a new norm’ as it means the physical distance between two respective people should be more than 1 meter respectively. It is assumed that the post-COVID-19 phase would not be as same as it used to happen before the existence of the global pandemic as things are going to take some time to get back to its normal nature.

The coronavirus disease is creating chaos across the globe and the ending of COVID-19 is indistinct and our society has already started witnessing economic & non-economic disturbances which lead towards an absolute turmoil and an uneasy, undesired lifestyle. The time spent with our families has increased to a great extent due to which the problems, misunderstandings created among the family members might have reduced due to quality time spent together. On the other hand, there have been registered court cases against domestic violence, increased burden of family, immense growth in the rate of increased divorce cases. As considering the facts and demonstrating certitude in the most optimistic approach, this surely must be a good world to come, with better people to stay in.



Fig. 1. Social Distancing - One of the effective measures to control the impact of COVID-19 on society

II. CURRENT POSSIE & ITS CONSEQUENCES

The world has seen many manifolds because of COVID-19 and the routine has been disturbed on a larger scale and the World Health Organization (WHO) declared coronavirus as a global pandemic at the start of 2020. There is no reliable data to tell us when the pandemic will end. The very new norm of social distancing, masks, gloves and washing of hands is here to stay. Even if all restrictions are lifted, until a vaccine is found, the virus will still be among us. There is no guarantee that the vaccine will be developed for coronavirus. There is a worst-case possibility that the vaccine will never be developed. At such a possibility, it is always needed that societies advance by conceding to the virus and hence develop the habit of living with it. Hotspots would gradually unfasten the restrictions, consequently allowing people to move out of their homes. However, they must be on a short leash in order to follow the experts' recommendations. Accordingly, testing and physical tracing will continue to become part of our everyday lives. On the contrary, some countries may abruptly instruct to self-isolate under any circumstances. Treatments may continue to develop, but a chance of ebullition of the disease is prevalent, leading to the escalating death rate.

The initial growth of coronavirus started from the metro cities of China, followed by the United States of America (USA) accompanied by some of the European countries like Italy & Spain and it gradually started to show its symptoms in Asian countries. As of May 2020, the entire world has become an absolute turmoil because of the pandemic caused. Though there is no existence of a vaccine for coronavirus, leading countries have been taking cogent measures to break the chain of COVID-19. As China been talked about, they built two new 1300-1500 bed hospitals to fight against the coronavirus, one in fifteen days and the other one in just six days, as well as they, converted a lot of training centers from their IT firms into quarantine centers. As the United States, United Kingdom, and the European countries been talked about, proper screening at the International airports and banning the international flights from coming at their respective destinations have severely helped them shutting out the spread of the dangerous coronavirus. On the other side, India has taken sagacious steps for the same as they put the biggest lockdown in the history of this planet - putting 1.3 billion people into lockdown, quarantine centers have been improved quality wise as well as quantity wise. According to a report, it is suspected that the first ever coronavirus vaccine may be developed at 'The serum Institute of India' located at Pune, India and the development cost of the vaccine would be as cheap as 0.5 cents per ampoule. Countries like Taiwan and Korea are looked at, they have successfully survived the virus outbreaks, which are held out as quintessential examples. However, both the countries were not only efficient in implementing measures but also owned great assurance from their respective populations. But in the case of China, they were undoubtedly strong but lacked the trust required to address a crisis of this magnitude. The world is still in the headway to make this world a quintessential place to survive, and it has been believed that the vaccine of coronavirus might be got by the end of the year 2020.

At this obscure situation, World Health Organization (WHO) received enormous support from the tech companies to overcome COVID-19 pandemic. This has lead to remarkable demand for solutions to various problems like population screening, infection tracking, prioritizing the need and allocation of resources, and designing predictive models by diverse digital health technology companies. Effective guidelines prescribed by the WHO tell mankind to follow the respective guidelines.



Fig.2. Vaccine for COVID-19 is assumed to be developed as soon as possible as prescribed by the World Health Organization (WHO)

What should I do to prevent catching and spreading the virus?



Fig.3. Guidelines prescribed by World Health Organization (WHO) to fight against COVID-19

III. TECHNOLOGIES USED IN GRAPPLING THE MINACIOUS CORONAVIRUS

Technologies have always been a life saving factor for the prevention of the stuff that mankind could not do in centuries. At such scenarios, positioning technologies play a vital role in unraveling similar crisis and disasters. In order to accurately judge the situation, locate the high-risk areas and accomplish relief and rehabilitation efforts, government agencies and first responders need error-free positions. Elaborating more onto

technology, as discussed by the Government of India, the Aarogya Setu” mobile application which is an Indian COVID-19 tracking mobile application developed by the National Informatics Centre and that comes under the government of Ministry of Electronics and Information Technology and also is one of such measures taken by the Indian government to spread awareness about the dangerous virus.

A. The Chest X-Ray Mobile & Desktop Application using Deep Learning.

The traditional methods of medical imaging, namely, radiography and computed tomography (CMT) undoubtedly assist in fighting against COVID-19. However, new technologies using Artificial Intelligence (AI) additionally enhance the potentiality of imaging tools and aid professionals in medical care.

Coronavirus strains 229E and OC43 are associated with a variety of respiratory conditions, ranging from common self-resolving colds to severe pneumonia [2]. Along with chronic symptoms of acute respiratory virus infections, which are major determinants of COVID-19 virus, few data pertaining to coronavirus-related pneumonia in patients with an impaired immune system are also available. So, as the practical implementation of a particular platform is being talked about, if symptoms of pneumonia and symptoms of the various lung such similar diseases are being detected at the proper time, COVID-19 can be prevented on a very large scale. As shown in the block diagram, the complete flowchart of medical imaging and analysis techniques associated with COVID-19 which comprises an image capturing, segmentation, training and testing of a model, fine-tuning of the model, selecting and evaluating the best model for identification and follow up is distinctly demonstrated. Therefore, Machine learning and Deep Learning fundamentals are being used to design this application.

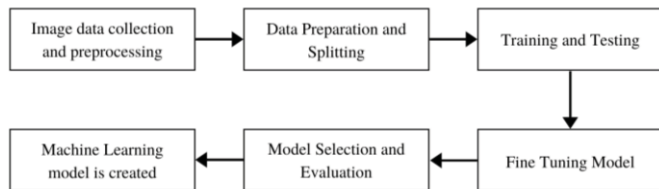
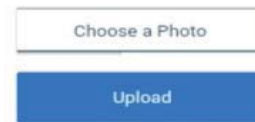


Fig.4a. Steps involved in creating a Machine Learning model

There are 14 different diseases which can be detected with the use of this app ranging from Pneumonia, Pneumothorax, Edema, Cardiomegaly, Infiltration, Mass, Nodule, Effusion, Hernia, Mean, Fibrosis, Pleural Thickening, Emphysema & Atelectasis, respectively. The dataset of the X-rays is the NIH Chest X-ray dataset which is a large public dataset for chest radiograph interpretation, consisting of 112,120 chest radiographs of over 30,000 patients. This is the National Institutes of Health's collection of chest x-rays from October 2002 to July 2017 and the associated radiology report. The training, Testing and Validation being done in the ratio of 7:3:1 and the model which have been used for it is Densenet121 respectively, which is a predefined model

available on Kaggle. The presented model takes an X-Ray image for the processing which then classifies the possibility of 14 distinct chest conditions. This model can be simply deployed on the smartphone as well as on the desktop.

Chest X-ray Classifier



Chest X-ray Classifier

Disease	Probability
Pneumonia	97.80%
Fibrosis	97.40%
Infiltration	92.20%
Consolidation	91.50%
Pleural Thickening	87.80%
Edema	86.40%
Effusion	80.70%
Emphysema	69.50%
Nodule	68.70%
Pneumothorax	58.00%

Fig.4b. Mobile/Desktop Application to detect the diseases [3]

Therefore, in the case of immunocompromised patients, detection of lung disease, and most importantly pneumonia and pneumothorax, is necessary, as coronavirus is a potential causative organism of pneumonia. Hence, it is undoubtedly the best diagnostic method which governs and dominates the biomedical industry and clinical practice. The output of the model can further be improved if a dataset is obtained which gives the information of X-Rays which are of the patients who were tested positive for COVID-19 before. Training and testing the model using such a dataset will eventually increase the efficiency of the model as well as accuracy will be obtained on a greater scale. The fact being that the idea provides a huge help in detecting diseases like Pneumonia, which shows almost the same symptoms as that of the Coronavirus family's COVID-19 disease. On successful implementation of this idea on social platforms, it can significantly help to ascertain and avert the rapidly rising spread of similar viruses. Accordingly, effective measures can

be taken to control its spread and consequently benefitting the society.

B. Artificial Intelligence

Artificial intelligence is a branch of science which is a natural intelligence demonstrated by humans and machines. This concept of Artificial Intelligence is used on machines to simulate human intelligence assuming that the later can be explicitly described to be imitated on machines. Artificial Intelligence is arguably the most happening & invigorating field of the robotics industry and recently it has shown its enormous development in healthcare. The respective domain has been providing innumerable platforms for developing applications that turned out to be serviceable in the healthcare industry. In the background of a global epidemic, AI is notably used in obtaining results in the major three domains namely, in virus research and evolution of drugs and vaccines, in the allocation of services and resources at healthcare centers, and in the processing of facts pertaining to public policy decisions including patient isolation and quarantine [16].

1) *Calyps*: a Swiss based startup created an AI-driven solution to manage the patient flow in hospitals. It is a deep learning platform which gets the information from the various sources provided by various hospitals in the locality. With the help of this information, it is possible to anticipate and predict the presence of beds in the hospitals as well as other clinical facilities. Also, the platform helps in determining how many beds a hospital must provide for the upcoming patients using Deep Learning. Furthermore, in order to increase the efficiency of the respective AI-driven solution, more data is being used by the model and the sources of these data are various hospitals, tourist places, event gatherings as well as from various other clinical centers. Due to this, more data is added due to which the performance of the AI-driven solution gets better and the provision of the beds in hospitals for the infected patients along with the other clinical facilities for the next seven days from the day of searching the respective availability in the hospitals. The organization has also claimed that if global data is provided to their platform on a regular basis, the platform will provide proper outputs and the idea can be imitated globally to avoid chaos in the hospitals and ensure the proper flow of patients in the hospital.

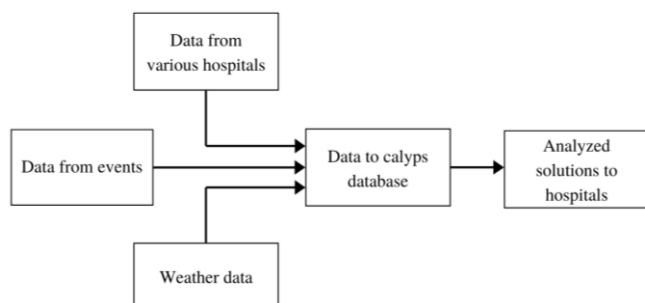


Fig.5. Calyps - Functional Block Diagram

2) *AI in Robotics*: Artificial Intelligence in the field of robotics has helped to fight against the curse of COVID-19, thus enabling its wide-reach. The ideology of creating AI-based robots has helped to shut out the escalation of COVID-19. One of such additions to the field is the Vici & Tug robot [6]. The idea of Vici & Tug robot talks about how high-tech machines are used to control the containment of the coronavirus. The main motivation behind developing such types of robots is to highly minimize the duties of healthcare workers in the areas and hospitals where the probability of getting infected is very high. During the 2003 outbreak of SARS, large numbers of healthcare workers were affected. It reduced their chances of receiving quality treatment. The Vici robot allows for doctor-patient interaction via the screen, but not directly. It comprises an electronic device similar to a tablet on wheels which is used by healthcare workers to communicate with the infected patients. It also permits to carry out some elementary diagnosis like measurement of body temperature. Such high-tech devices are widely used by doctors, airport workers and hotel staff to decrease the human interaction and thereby lowering the risk of getting infected by the virus until a justifying vaccine is developed or commendable immunity is built up. Thus, Vici & Tug robots can be used when support staff is not necessary to be physically present at the infected areas and hence, controlling the spread of the virus to a wide extent.



Fig.6. Vici and Tug Robot

Another addition to the list is the introduction of the ‘Little Peanut robot’ which was introduced in some metro cities of China. These robots can deliver food, medical and similar supplies to people living in the infected areas either quarantined or suspected of having the virus. Similar bots were used at a hospital in southern China to dispatch medicines and collect bedroom accessories from the infected area. Multiple such robots can be employed on each floor of every hotel around the globe to reduce human contact and prevent the spread of the novel coronavirus. During this tough phase, people got the urge to travel to their home cities and countries via International and domestic airlines. So there arose an absolute need to regularize the disinfection of the airplanes so that the passengers would travel under proper supervision and vigilance. To fulfill this desideratum, another such measure was initiated and the ‘GermFalcon robot’ is being taken into picture. This robot works on the property of ultraviolet-C (UVC) light to destroy viruses, bacteria and superbugs found on the surfaces of materials and in the

surrounding air which greatly improves airplane hygiene to a certain extent. It is designed in such a way that it can be used to direct an airplane cabin, with UVC lamps placed, that can uncover all high-touch surfaces to the UVC light. Immediate action must be taken pertaining to the naive passengers on an airplane, so that they do not get infected by the virus.



Fig.7. GermFalcon and Little Peanut Robot

Along with the practical implementations mentioned above, there have been several other technologies which have been implemented by the respective governments across the globe. Drones, Autonomous vehicles are being used to avoid chaos at public places and the places where courier services, post offices, telephone exchanges are present. Many health sensors and applications, as well as Robotics, are being taken into the picture to make this world a better place and an absolute altercation to fight against the COVID-19 virus.

C. Blockchain Technology

Blockchain technology uses the blocks which store the prescribed data publicly and in chronological order. It is an append-only data structure which stores an incessantly growing list of transactions. Blockchain has two important features: immutability and non-reputability. The immutability is obtained because it is not possible computationally to modify and manipulate any executed transaction in the blockchain. The transactions in a blockchain are non-repudiable since they are replicated by a large number of entities [5].

1) *Blockchain HIE*: On the background of COVID - 19, healthcare is becoming an increasingly important field. Currently, the entire world's attention is focused on finding a cure for the vivacious coronavirus. Therefore, the ideology of the Healthcare Information Exchange (HIE) gets an appreciable involvement in order to provide ways to fight for the cure of the pandemic. Healthcare Information Exchange (HIE) becomes useful in diagnosis, treatment and management of the disease. As the world seeks to find the cure for COVID-19, it is important to track the patients suffering from the pandemic worldwide and analyze their symptoms or reactions to the disease. Hence, the Healthcare Information Exchange (HIE) is turning out to be efficient since the outbreak of the novel coronavirus. For many years, HIEs have used cloud services for data storage [13], but cloud platforms suffer from reliability and confidentiality issues in addition to data sharing issues. Blockchain provides a great alternative to this by supporting privacy, immutability, and security.

There are few HIE systems proposed based on blockchain. The proposed blockchain-based HIE system in this paper supports Electronic Medical Records (EMR) and personal Healthcare Data (PHD). Electronic Medical Record is the data generated by Medical institutions like patient reports and statistical records. Personal Healthcare Data is the data generated by an individual from his personal device or some smart health monitoring system. The proposed system divides these two types of data into two different loosely coupled Blockchains because of the different requirements of each of the types. EMR blockchain provides more privacy and security over the PHD blockchain due to the criticality of data. Also, EMR blockchain uses off-chain storage and on-chain verification methodology due to the large size of records. Original records are stored in the hospital's database. Another copy of these records with only hash values and doctor's and patient's signature proving the consent of both the entities to upload data in the blockchain is present in the block. This saves the data size and improves the efficiency of the system.

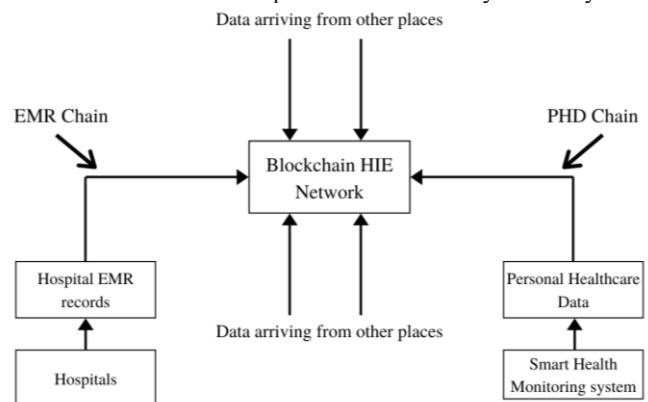


Fig.8. BlockHIE block diagram

2) *MiPasa*: Another application where the Blockchain technology has flown to its flying colors is the recent addition of 'MiPasa' platform. The World Health Organization (WHO) in association with the other tech giants has introduced MiPasa, a platform which is based on the blockchain technology which helps in conveying data about the ongoing COVID-19 pandemic. MiPasa is built on Hyper-ledger Fabric in partnership with renowned organizations-IBM, Computers-Oracle. It claims to be "totally private" and to share information between organizations that need to know, such as state and health authorities. Described by the author as an "information highway," MiPasa creates cross-referenced data on health information locations to protect patient privacy and identify local and global trends such as viruses that are currently involved in the world's confusion.

It is believed that blockchain technology, being a beneficial platform in many COVID-19 affected nations, especially in the fields of healthcare and also in the supply chain. Due to the pandemic, investments have almost stopped and due to the prioritization of high-priority expenses, blockchain will be forced into an interim fall-off. Though Blockchain is beneficial in terms of the supply chain, tracking of goods and services, lucidity across multifold use cases, the

investments in blockchain are anticipated to recover once the spread of coronavirus reduces on a large scale. With the presence of multitudinous tech giants and organizations across the globe, usage in the field of blockchain will be a big boost-up in the post COVID-19 phase [14].

D. Mathematical Modeling

Mathematical modeling is a method of describing a system or a problem by using mathematical functions as it has been witnessed that beyond Artificial Intelligence, Mathematical Modeling could be a better beneficial tool as far as the ongoing pandemic is concerned. Mathematical models have long been generating quantitative information in epidemiology and providing useful guidelines for outbreak management and policy development [9]. In particular, a number of modeling studies have been performed for COVID-19. For example, Wu *et al.* [10] introduced a SEIR model to describe the transmission dynamics of COVID-19 in China and forecasted the national and global spread of the disease, based on reported data from December 31, 2019, to January 28, 2020. Read *et al.* [11] reported a value of 3.1 for the basic reproductive number of the early outbreak using an assumption of Poisson-distributed daily time increments in their data fitting. Normally when a pandemic outbreak happens, every focus is given to find the cure and contain the disease. But while finding the solutions some of the factors get ignored. An outbreak can happen in one place but the questions like how it will spread, how it will affect the other parameters, or the measures are taken to control the disease will be sufficient or not remains unanswered. Therefore, mathematical modeling is required. This, in turn, can help medical workers, policymakers, and the general public to implement measures for both control and treatment.

Mathematical modeling involves running the models on specialized software and simulating different scenarios by considering different values of variables. Mathematical modeling has been proven useful in assessing COVID - 19 situations also. Many research institutions have used modeling to predict the patterns of a possible future outbreak. Researchers from the London School of hygiene and tropical medicine developed a mathematical model to assess the effectiveness of controlling COVID - 19 through isolation and contact tracing. For this, they used different variables like 'reproduction number' which essentially is the number of people that can be infected by someone who is already suffering from the virus and another variable like 'time' to show the symptoms and number of people who can get affected by one infected person. This was useful to give the estimates of how effective isolation can be and how long should it be kept. Researchers from the Shanghai Open University School of Medicine also created a similar model to predict the possible number of future cases of COVID - 19 in Wuhan city after the implementation of lockdown. They used variables like reproduction number that is the number of people that can get affected by one infected person and effective reproduction number which is the actual number of cases generated by one infected person.

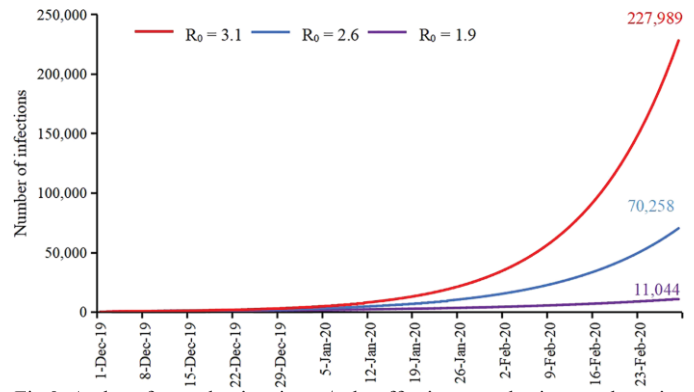


Fig.9. A plot of reproduction time v/s the effective reproduction number using Mathematical modeling

E. The QR Code system based on AI & Big Data

As the entire world tries to combat the situation of COVID - 19, there is no proper cure found for coronavirus yet. The only solution as prescribed by the respective government body is Social Distancing and maintains distance from people who are suspected of the virus. The World Health Organization has advocated for the employment of color coded growth charts in detecting malnutrition and grading the same in under-five year children [7]. As different countries have different policies to deal with the pandemic, technology is now playing a crucial role in such circumstances. Therefore, as relied on mobile technologies and big data, the Chinese government has used a color-based 'Health Code' system to control movements of people and curb the spread of coronavirus. The automatically generated 'Quick Response' codes, commonly abbreviated as QR codes, are assigned to the citizens as an indicator of their health status. It is hosted on Chinese tech giant Alibaba's mobile payment app 'Alipay' and Tencent's messaging app 'WeChat' as these Smartphone applications are very commonly used by millions of Chinese citizens. To use this system, one must sign up for it by giving his/her respective personal details, travel history, and details of any contact with COVID-19 patients. Users have to also mention if they are facing any of the symptoms listed in the application. After signing up with all the respective details, the data is verified by the authorities and the user is assigned a QR code. This QR code automatically turns green, amber, or red when scanned based on the data provided for coronavirus related information. If the QR code is green then the user is considered safe, if it turns red then the user has to go under self - quarantine for 14 days and if the code turns amber then the user has to go under 7 days of self - quarantine. This application is being used by many organizations, apartments, residences, offices and public places in the metro cities of China. At any public places people visit, they have to display their QR code in front of the QR code scanners at those places, and if the QR code turns green then only the user is allowed inside the premises. People having colors other than green on their QR codes are not allowed to visit any of the public places or public gatherings. Though this application has its drawbacks as there are many grievances from the users getting the unexpected QR code assigned to them as this is mostly because of a lack of data at the local level to properly analyze

the situation and hence people having sort of similar symptoms like common flu or cold & cough are also assigned red QR codes. And hence the government is trying to sort this situation by sharing more and more data. Also, many people and agencies are raising privacy concerns over this application as the data from this mass data pooling tool can be used in other sectors also. Currently, this application is used by innumerable people in China and other countries are also imitating a similar platform in their provinces. The application based on QR has gained immense popularity in a shorter period and the platform has the potential to become an important and mandatory health tracker Smartphone application, especially in China. In Beijing, the QR code is also used to analyze the threats of coronavirus as drones with the QR codes hover above the cars. Passengers can scan this QR code to log into their journeys. This data is provided to the traffic control center which analyzes the traffic to check the places from where the threats are coming and due to this; it helps in mapping the coronavirus database and understanding the risks in a better way.



Fig.10. Green QR indicated entry of a person at public places; Amber & Red QR codes indicate prescribed specific periods of quarantine

F. Big data in Healthcare

Big data analytics provides a lot of benefits in the healthcare sector to detect critical diseases at the initial stage and deliver better healthcare services to the right patient at the right time so that it improves the quality of life care. Big data analytics in Healthcare (BDAH) is used to store electronic medical records, pharmaceutical researches, and many other types of medical data. BDAH involving proper analysis of huge amounts of patient data in conjunction with the knowledge of treatments must be carried out in hospitals [8]. By using the data of patients from around the world, big data analysis is required for the deep learning models which are being generated by various organizations and authorities in order to cut back the spread of COVID-19. Machine learning models predict COVID-19 impact in smaller cities can help reduce the effect of pandemic even in smaller cities if a kosher dataset is being prepared from certain data of people suffering from coronavirus. Using the same principle, a 'Forecast Hub' for fighting against COVID-19 can be developed as it will give the general public, as well as policy makers and scientists at the centers for disease control and prevention by estimating the type and the nature of models to understand the dealings with the pandemics in the upcoming future. In China, thermal scanners are being provided and installed at train stations. If an individual is scanned with these thermal scanners and is found to have a high temperature which is considered to be a potential sign of infection, the individual is quickly instructed to undergo the coronavirus test as prescribed by the

authorities. If the test turns out to be positive, authorities warn co-passengers who may have come in contact with the fellow individual who is now positive, are quarantined and notifications are activated by national transport regulations that require all passengers to travel. Public transportation uses real names and IDs issued by the government [4]. There is a platform developed by the Chinese government to warn users who are infected with COVID-19 to stay away from healthy users. In Europe and USA, there have been several platforms developed with the help of big data analysis that provides high-end data for initiating coronavirus control and prevention strategies as it has been witnessed that majority of the coronavirus transmissions occur when an individual starts showing basic symptoms, therefore it is the need of an hour to escalate and enlarge the pace and effectiveness to create awareness and to alert people that their knowledge regarding the same can be paramount during a pandemic such as COVID-19. In the US, the government has consulted with technology giants such as Facebook and Google to determine what is possible and ethical by tracking and understanding movements using US smartphone location data. Some patterns that help avoid the very large new cases of coronavirus [4]. The huge round of applause and immense rate of success in controlling COVID-19 could be seen in Taiwan, a country who shares its borders with China. It was presumed that they are going to be the most affected country due to COVID-19 after China. They initiated numerous strategies ranging from integration of the various databases which also includes National Health Insurance Database with data being available from its customs database and immigration and by the centralization of data, the success of achieving real-time alerts regarding the individuals who might be infected based on travel history or based on the prescribed symptoms [15]. At the same time, QR code scans and online reports of health and travel symptoms which help to categorize the infection risk of travelers and introduction of the respective helpline numbers for people to report mistrustful symptoms. Therefore, AI in combination with big data as well as big data analytics required at various sources helped to brawl against the doom COVID-19.

G. Other technologies

1) *BioSticker*: BioSticker is a wearable device on the left side of the lungs, a device created by BioIntelliSense, a Silicon Valley firm and the company is also releasing its Data-as-a-Service platform. BioSticker not only monitors heart rate, respiration rate, skin temperature, posture, sleep status, activity level, but also provides high resolution gait analysis, fall detection, and even detects certain symptom events that need to be reported. All the activities prescribed can be recorded for the next 30 days, thereby achieving a proper list of the vital signs so that it could be easy to find out that the person using this device is infected from the coronavirus or not, thereby proving a serviceable mini device that can control the dominance of COVID-19 on the large scale.

2) *ZTE launches 5G diagnosis and treatment system*: ZTE Technology of China telecommunication industry has

realized China's first 5G remote diagnosis of new coronavirus pneumonia bore witness to the latest 5G technology. ZTE provides an intelligent solution to prevent and control the outbreak of a video cloud with temperature measurement equipment that integrates intelligent video, AI, and thermal imaging. ZTE has completed the rapid construction, optimization, speed testing, and commissioning of its 5G indoor power distribution system at another central point in its remote diagnostic and therapeutic system. The 5G network combines AI, Robotics as well as the other technologies to support the indoor distribution of infectious disease rooms and reduce the risk of infection. After the 5G network was commissioned, innumerable health care centers in the metro cities of China conducted the remote video consultation. The upcoming and trending 5G technology with its important features such as high bandwidth and low latency, the 5G technology has been proved beneficial to make an early diagnosis and treatment more efficient and expedient [12].

IV. CONCLUSION

COVID-19 is a disease that has spread all over the world and it is not only affecting the medical situations of countries but also financial and social situations. In order to curb the various problems faced, the discussed technologies have been used at its best. The chest X-ray application using Deep Learning has helped in detecting symptoms at an early stage so that the patients can be quarantined thus inhibiting further spread. AI based solution like Calyps and robots like Vici & Tug, Little Peanut and GermFalcon are widely used by healthcare, airplane and hospitality industry to maintain social distancing. Blockchain HIE and MiPasa are applications using Blockchain technology to maintain patient records securely and effectively, along with Big Data Analytics, help pharmaceuticals companies develop a vaccine. Various mathematical models are being followed in order to productively analyse the current fluctuating situation. Usage of QR codes to judge the health of citizens thereby controlling their movement acts as an effective means for social distancing. A wearable device like BioSticker helps in continuous monitoring of the citizens' health to ensure a robust environment. To enable remote video consultation, the introduction of 5G technology is also discussed in the paper, which helps doctors and healthcare workers to interact with coronavirus affected patients remotely. The vaccine for coronavirus is on its way to the rescue as most of the government organizations, private pharmaceutical labs and many private companies are in the race of developing it but currently, the vision of developing a successful vaccine has not been witnessed by the world. Technology has been proven an asset during the outbreak of such pandemics that can help prevent the spread, apprise, educate and empower those on the ground to be conscious of the situation and noticeably lessen

the impact to keep society running by providing digital connectivity and also helps in diagnosis of patients.

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