

Potential of ICT in India to Cater Pandemics in Healthcare Sector with Special Reference to Covid-19

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Abstract - Corona virus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome Corona virus 2 (SARS-CoV-2). The disease was first identified in December 2019 in Wuhan, the capital of China's Hubei province, and has since spread globally, resulting in the ongoing 2019–20 corona virus pandemic. As of 9 June 2020, more than 7.12 million cases have been reported across 187 countries and territories, resulting in more than 406,000 deaths. More than 3.29 million people have recovered. The virus is primarily spread between people during close contact, often via small droplets produced by coughing, sneezing, or talking. The disease has been given official name as COVID-19[1]. Since its outbreak in china, infrared thermometers were used to check the body temperature in order to identify the infected people. Countries like China and Korea started the use of different technologies to detect, track and prevent the spread of this deadly virus. Among the major technologies used are Internet of Things (IoT), Artificial Intelligence (AI) and deep learning. With the invent of 5G technologies, we are able to transfer and process huge amounts of data on a real time basis. Health experts have argued that a key tool at governments' disposal to contain the COVID-19 outbreak, and which was not around during the 1918 Spanish Flu, is the ability to harness digital technologies to track the spread. At the same time, deployment of contact tracing apps by governments or public health authorities has added to the debate on online privacy and personal data protection. In this research paper, we discuss the potential application of different information and communication technologies (ICT) like IoT, AI and 5G that can help in (i) Monitoring (ii) surveillance (iii) detection and prevention of COVID-19 and enhancing the healthcare to make it future-ready for any such diseases like COVID-19.

Keywords: Covid-19, Origin, Transmission, Symptoms, AI, NLP, 5G, IOT

I. INTRODUCTION

A pandemic is an epidemic of disease that has spread across a large region, for instance, multiple continents or worldwide, affecting a substantial number of people. A widespread endemic disease with a stable number of infected people is not a pandemic. Widespread endemic diseases with a stable number of infected people such as recurrences of seasonal influenza are generally excluded as they occur simultaneously in large regions of the globe rather than being spread worldwide; the world has seen pandemic diseases like Smallpox, Tb, etc. Currently, we are facing a Pandemic in the form of COVID_19 /Corona virus.

With a population of 7.8 billion worldwide, it is impossible to stop a pandemic like Covid_19, without causing a massive damage at a mass scale, which vitalizes the role of ICT tools and technology in activities like prediction of hot spots of the disease, spreading awareness regarding disease, locating persons with a history of contact with affected or symptomatic persons, locating nearby Covid_19 affected persons, identifying potential drugs and possible solutions etc. Pandemics have been a part since the inception of human civilization. To contain the pandemic the development and implementation of technology is rapidly taking place around the whole world. Corona virus (covid-19) was recognized as part of the corona virus group, which involves SARS and other known symptoms of flue. It is an infectious disease and infected person may experience mild to moderate respiratory illness. Although 80% of the infected people recover without requiring any special treatment. In the remaining 20% only around 5% of the infected persons may need some critical medical care. Although the motility rate is around 2-3% but the disease has already created panic among the people. At the current time, there is no specific vaccine or medicine available for treatment of COVID-19. However, worldwide there are many ongoing clinical trials evaluating potential treatments. On the directions given by WHO, many countries around the world are performing lockdown as a strategy to minimize the spread of the corona virus disease.

On March 24, 2020 the Government of India ordered a nation-wide lockdown for 21 days. However on 14th of April, 2020 the nation-wide lockdown was extended until May 3rd [2]. India with a population of 1.35 Billion [3] which constitutes 17.7% of the total population of the world, it is impossible to stop a pandemic like COVID-19 without causing a damage at mass scale. At this junction of time technology has to play a vital role in activities like prediction of hot sports of the disease, spreading awareness regarding disease, locating persons with history of contact with affected or symptomatic persons, locating nearby COVID-19 affected persons, identifying potential drugs and possible solutions.

In this paper we investigate a number of technologies to discuss how Information and Communication Technology

can help governments and people in combating the novel corona virus with special reference to India.

II. ROLE OF AI CAN PLAY TO COMBAT A PANDEMIC

The first and foremost technology that can be employed at a massive level is AI. Artificial intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and animals. Leading AI textbooks define the field as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals [4]. AI can be beneficial in combating disease in multi ways, some of them are discussed below point-wise:

As the COVID-19 infection is spreading at an alarming rate, and as such leads to a burden on health care system due to shortage of medical staff, in such scenario AI can prove highly beneficial, for example in Italy, at the peak of that country's crisis, doctors faced terrible decisions about who should receive help and resources.

Artificial intelligence can come to rescue in such cases. AI systems trained via machine learning can offer clinical decision support hence may play an important role in the COVID-19 crisis, helping to keep hospitals functional and patients alive. For example In the United States repurposing of existing AI systems at some medical centers is done that were initially designed to predict the course of patients' illnesses, modifying them to predict specific COVID-19 outcomes such as intubation. Researchers are checking to see if existing tools can be customized to be used to fight COVID_19. As per one of the physician Mr. Dana Edwlaon working at the University of Chicago medical Centre , is working on an upgrade to an AI system called eCART, which the hospital launched in 2015. eCART is currently being used to predict patients with likelihood of cardiac arrest requiring immediate transfer to ICU and expected to die within next eight hours. eCART bases its results on data available from patients' e-medical records such as vital signs, lab results, and demographic information to calculate and provide real-time risk scores for patients. It uses 30 variables in it's calculations while as upgraded 100 variables are used , wherein the patients respiratory rate is the most important predictive feature, in upgraded version the amount of supplementary oxygen requirement for a the most important feature to signify that the condition of patient is deteriorating. Edelson says that increasing oxygen requirement is an indication of Covid_19 disease whose lungs are failing. Although the upgraded version will still predict those outcomes, and it will also "predict more specifically the need for intubation and the need for IV medications that increase blood pressure, both of which require the patient to be in the ICU," Edelson says. The team is also working with other institutions in order to validate the new eCART version, so that, it accurately predicts COVID specific-outcomes. What can doctors do

with eight hours' warning that a patient will need to be incubated or transferred to the ICU? While they probably can't prevent those patients' conditions from deteriorating, Edelson says, they can try different treatments immediately, like affixing nasal cannulas that deliver supplemental oxygen through the nose [5].

AI has the potential to act as an Early Warning System to locate the outbreak and to predict how outbreak in the form of disease might spread from region to region and perhaps even from one demographic cohort to others, for example vendor BlueDot uses an AI-based solution to monitor outbreaks of infectious diseases around the world. BlueDot had alerted an unusual spike in pneumonia a week apriority to WHO'S officially declaration of COVID-19 outbreak. Furthermore AI has the potential to identify the path how the virus spreads within a community, although theoretical but still an Unsupervised Algorithm can be used based to simulate all possible evolution paths and determine how vaccines perform in different scenarios. Although for current pandemic it may seem to be less beneficial due to need for rapid advances in science, modeling and computing capabilities to stop the pandemic, that has wretched havoc all around the world. Moreover availability of reliable data becomes a prerequisite. AI can act as an early diagnostic tool, for predicting the novel infection that might have occurred in humans, for e. g., AI-supported services for a lung CT scan: the AI is premeditated to quickly detect lesions of likely corona virus pneumonia; to measure its volume, shape and density; and to compare changes of multiple lung lesions from the image. This provides a quantitative report to assist doctors in making fast judgments and thus helps expedite the health evaluation of patients.

With the help of data analytics and predictive models, medical professionals are able to understand more about a lot of diseases. Baidu, the Chinese Internet giant, has made its Lineatrfold algorithm available to teams that are fighting the outbreak, according to the MIT Technology Review. Unlike Ebola, HIV and Influenza, COVID-19 has only a single strand RNA, so it is able to rapidly mutate. The algorithm is a lot faster than other algorithms that help predict the structure of a virus. AI-powered infrared system can detect change in a person's body temperature. It was being used in Beijing's Qinghe Railway Station to identify passengers who were potentially infected. The system can examine up to 200 people in one minute without disrupting passenger flow. Alibaba has developed a Cloud-based Corona virus diagnosis tool that the company claims is more than 96% accurate and takes less than 20 seconds to work. The tool uses AI to detect traces of the virus. Alibaba says that it has been used on more than 5,000 patients throughout China.

AI can act as a research tool, and has the potential to accelerate access to a vast, constantly changing corpus of research literature, data, and analytical tools pertaining to outbreaks, their spread, and effective treatments.

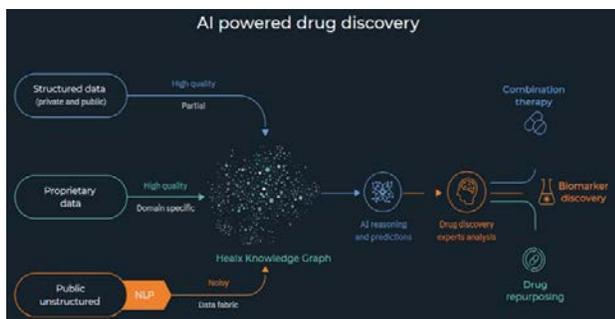


Fig.1 AI powered drug discovery (Photo courtesy of Healx)

MIT Technology Review Article discusses, a new open database known as CORID_19 (COVID-19 Open Research Dataset) which contains over 29,000 corona virus research papers. Researchers from several organizations released the Covid-19 Open Research Dataset, which includes papers from peer-reviewed journals as well as preprints from websites such as bioRxiv and medRxiv. The research covers SARS-CoV-2 (the scientific name for the corona virus), Covid-19 (the scientific name for the disease), and the corona virus group. It was compiled under the request of the White House Office of Science and Technology Policy (OSTP).

The database, now available on AI2's Semantic Scholar website, leverages AI to speed searches through academic literature. It incorporates natural-language processing models such as ELMo and BERT to map out the similarities between papers and create personalized feeds based on researchers' interests. The OSTP also launched an open call for AI researchers to develop new techniques for text and data mining that will help the medical community comb through the mass of information faster. Though no one can dispute the value of this database or the need for more powerful AI tools to search it, it's clear that most insights that researchers might gain from them over the next 4-8 weeks will apply more to the next pandemic—which could be decades in the future—but probably won't come in time to be much use in combating the current outbreak. And most research studies included in the database now are probably derived from studying previous outbreaks, limiting their usefulness in devising strategies for dealing with today's unfolding emergency [6].

Deep learning one of the sub-branch of AI can be used to learn patterns and predict the outcome based on training data, this requires access to larger data sets, for example, sufficient amounts of behavioral, social, clinical, airline, and other data sources of sufficient quality are required to build and train accurate enough machine-learning models of an outbreak's likely evolution path. In such a situation NLP can be handy to look for relevant reports coming from news outlets and official health care channels in different languages around the world. AI with Big data can make a radical shift in how we have approached to treat Pandemics in past.



Fig. 2 AI-tool-predicts-which-covid-19-patients-can-develop-severe-respiratory-disease

A. Role of AI W.R.T Health Sector in India

Since early 90s India's success in software and IT-enabled services (ITeS) exports, has made it a significant services exporter with its share in world services exports rising from 0.6 per cent in 1990 to 3.3 per cent in 2013.

The IT and ITeS services sector in India has been of tremendous importance to its economy eventually growing to account for 7.7% of India's GDP in 2016. In an attempt to capitalize on this foundation, the current Indian administration announced in February 2018 that the government think-tank, National Institution for Transforming India (NITI) Aayog (Hindi for Policy Commission), will spearhead a national program on AI focusing on research. This development comes on the heels of the launch of a Task Force on Artificial Intelligence for India's Economic Transformation by the Commerce and Industry Department of the Government of India in 2017. AI can play an important role in health sector to cater pandemics, the need for which is further necessitated in India as India being the second largest country with respect to population and fastest evolving economy. In budget speech of 2018-19, Hon'ble finance minister mandated the need for National Program on AI. In India we are blessed to have abundance of IT professionals, and in addition to this availability of cheap Internet access thanks to companies like Reliance JIO and initiatives like Digital-India etc. which adds further to the scope of AI for social development; the primary amongst which is healthcare. As healthcare is expected to grow USD 280 billion at a CAGR of upwards of 16%, from the current ~USD 100 billion. Yet, it faces major challenges of quality, accessibility and affordability for a large section of the population:

1. Shortage of qualified healthcare professionals and services like qualified doctors, nurses, technicians and infrastructure: as evidenced in 0.76 doctors and 2.09 nurses per 1,000 population (as compared to WHO recommendations of 1 doctor and 2.5 nurses per 1,000 population respectively) and 1.3 hospital beds per 1,000 population as compared to WHO recommended 3.5 hospital beds per 1,000 population 10.

2. Non-uniform accessibility to healthcare across the country with physical access continuing to be the major barrier to both preventive and curative health services, and glaring disparity between rural and urban India. At many places to get basic facilities people have to travel a large distance, the problem is further accentuated by quality of proper healthcare.
3. Affordability remains a problem with private expenditure accounting for 70% of healthcare expenses, of which 62% is out-of-pocket expenditure, probably one of the highest in the world. Significant portion of hospital costs in both rural (47%) and urban India (31%) are financed by loans and sale of assets. Poor and marginalized are hit the most, and as per the Government estimates, a sizeable part of the population (63 million) are faced with poverty every year because of their healthcare expenditure [1].
4. Reactive approach to essential healthcare largely due to lack of awareness, access to services and behavioral factors implies that majority of patients approach a hospital / physician only when a disease has reached an advanced stage, thus increasing the cost of care and reducing the chances of recovery.

The Government of India has been making a series of large scale interventions to address healthcare challenges in India, viz. transformation of 1.5 Lakh Health and Wellness Centers, developing district hospitals to cater to long-term care for non-communicable diseases, Ayushman Bharat Mission, promoting e-Health etc. Despite such obvious economic potential in healthcare, it is the most significant and pragmatic field for intervention by AI driven solutions as is obvious by massive participation and involvement by startups and corporate.

Adoption of AI for healthcare applications is expected to see an exponential increase in next few years. The healthcare market globally driven by AI is expected to register an explosive CAGR of 40% through 2021, and what was a USD600 million market in 2014 is expected to reach USD6.6 billion by 2021.

The increased advances in technology, and interest and activity from innovators, provides opportunity for India to solve some of its long existing challenges in providing appropriate healthcare to a large section of its population.

AI combined with robotics and Internet of Medical Things (IoMT) could potentially be the new nervous system for healthcare, presenting solutions to address healthcare problems and helping the government in meeting the above objectives [7].

With a population of 135.26 crores, AI can be substituted for scarce healthcare personnel, lab facilities, accessibility problems by way of early detection, diagnosis, decision

making and treatment to a larger part of the country, for example in India every year, 1 million new cancer cases arise and in such cases early detection and management can be crucial for optimum cancer treatment. AI based healthcare can make a radical shift of Indian healthcare from a sick care to true healthcare system, with emphasis on preventive techniques.

Emerging an AI Research and Advisory company has carried out a detailed survey; to find the current status and scope of AI in India. Although this research is particularly focused on finding out actual position AI and its future in India.

In their survey they spoke with experts from GOI, Indian AI startups, AI academic researchers in India and data science executives at some of the largest companies operating in INDIA, including Reliance, ADA, AMAZON, AIG, Equifax, Infosys, NVIDIA and many more. To summarize their detailed research we could draw following conclusions:

1. The industry experts agreed on the fact that AI has certainly caught the attention of the Indian Govt. and tech community in recent year, with Healthcare and Agriculture deemed to be the most important sectors of focus in order to improve the living conditions for Indian Citizens.
2. In healthcare sector in India as there is a dearth of Radiologists and Pathologists in number relative to the population (especially in rural areas) thus enhancing the importance of AI applications in healthcare sector. e.g., NITI Aayog is working on early diagnosis and detection of Diabetic Retinopathy and Cardiac Risk based on the AI models. Such initiatives would in the long run help patients on proactive medication in early stages rather than reactive healthcare in advanced stages – bringing down healthcare costs and better chances of recovery. These initiatives with modifications can also be used to control pandemics.
3. Although AI attention is considerably smaller in India than in China or the USA, the increased AI interest has manifested itself in many ways as highlighted by following important facts:
 - i. Industries are training their manpower to empower them with the skills so that they can compete with global powers.
 - ii. Educational institutions have included courses on machine learning and other relevant areas. Similarly individuals and professionals are also upgrading their own skills.
4. The potential of AI in India is further enhanced by the availability of cheap skilled labor.

Although we don't have an AI strategy like China like China or USA, but still we have started to work at grassroots. The bigger advantage lies in the fact that GOI is encouraging startups to take a lead in AI, with a primary focus on sectors like Agriculture and Health-care. e.g. It is predicted that the applications of artificial intelligence in the healthcare space will be worth INR 431.97 Bn by 2021, expanding at a rate of 40%. Based on this growth of AI applications in healthcare, the doctor-patient ratio in India is expected to reach 6.9:1,000 by 2023, from its 2017 ratio of 4.8:1000. India in 2020, will be the youngest country in the world, with a median age of 29 years, compared with a median age of 37 years in China at this point. In such a case India needs to put to work its growing number of young scientists in the coming decade. Enacting a sound AI policy requires to be the foundation of this young workforce. India already fills the role of the world's outsourcing destination and many of the firms have large teams in the India for the purpose of data cleaning and tagging, with work executed on low costs. Data cleaning and tagging are not only a huge opportunity for near term business but also highly beneficial for containing pandemics like Covid-19 [8]. The adoption of artificial intelligence (AI) is reshaping the Indian healthcare market significantly. AI-enabled healthcare services like automated analysis of medical tests, predictive healthcare diagnosis, automation of healthcare diagnosis with the help of monitoring equipment, and wearable sensor-based medical devices, are expected to revolutionize medical treatment processes in the country [9]. To end, we can hope in view of above mentioned facts pertaining to our AI industry, we can utilize most out of it, to improve the quality of our Healthcare system, by incorporating AI apps which have the ability of early predictions and diagnosis of pandemics. Further as India being a multilingual country, the scope of NLP is much more necessitated, for integration of data collected from various parts of the country, with people speaking different languages.

III. ROLE OF 5G NETWORK

COVID-19 or coronavirus has put tremendous pressure on healthcare and epidemic response system across the world. In India due to its highly dense population screening for the infected individuals has become very complicated. The frontline medical and administrative staff needs effective communication mechanism to exchange vast amounts of data in real time basis for controlling the outbreak. Fifth

Generation (5G) can play a critical role during these types of situations. 5G has the ability to virtually connect machines, objects and devices together. 5G wireless technology is meant to provide very fast download speeds, ultra-low latency and more reliability massive network capacity. During this corona virus outbreak telecommunication operators can collaborate and setup specific 5G networks dedicated to COVID-19 hospitals. With the use of 5G, hospitals can maintain effective communication and enable sharing of data between hospitals and scientific research institutions. 5G networks can provide the bandwidth and speed to transmit large amounts of data sets in real time. High Definition (HD) based remote diagnosis; monitoring and treatment of infected people can be achieved. Remote monitoring and treatment can help to avoid doctors and other medical staff being infected while treating suspected or confirmed patients. Use of thermal imaging cameras can help to detect infected or suspected persons in a large gathering. These 5G-enabled cameras provide high resolution images and detect the changes in temperature within human body. This will enable co conduct massive screening which would be impossible in country like India where the population is very dense [10]. 5G thermal imaging supports contagion monitoring and it can accurately spot a moving object's temperatures in real-time without contact and issue abnormal temperature alerts [11]. These body temperature sensing hybrid thermal cameras with the use of Artificial Intelligence can sense people with a fever from up to 3 meters away without direct contact. 5G-powered robots can add a new dimension in monitoring the spread of corona virus. 5G-powered robots can be deployed at public places like airports or markets to monitor social distancing and mask-wearing. These robots are equipped with high-resolution cameras and infrared thermometers; they can detect the absence of a mask or high body temperature and can alert a centralized control center for response and decisions-making. These robots can be controlled remotely and hence preventing cross-infection. These 5G-powered robots can be installed in Quarantine centers to help in treating the patients and gather the information related to infection symptoms [12]. Natural disaster response can be equipped with 5G and Internet of Things (IoT) networks, thus, enabling deep analysis of supply chains and providing real time information on front-line supply consumption, resource inventory levels, production capability, supply capability and logistics support decisions to balance supply and demand [13].



Fig.3 Body temperature sensing thermal camera

IV. ROLE OF INTERNET OF THINGS

Internet of Things (IoT) is a network of interconnected smart devices, sensors and objects through which data can be collected in its raw form and transmitted through the internet to be analyzed for patterns or trends. Each of these devices are uniquely identified over a network. IoT allows these things/devices to communicate and exchange data (control and information) while executing meaningful applications towards a common user or machine goal without requiring human-to-human or human-to-computer interaction. Applications on IoT networks extract and create information from data by filtering, processing, categorizing, condensing and contextualizing the data. The information thus obtained is then used to infer knowledge about the system and take decisions as per the need. The connected devices in IoT can transfer or receive data or control from a local network server or can be connected to a cloud service and hence can be monitored and controlled virtually.

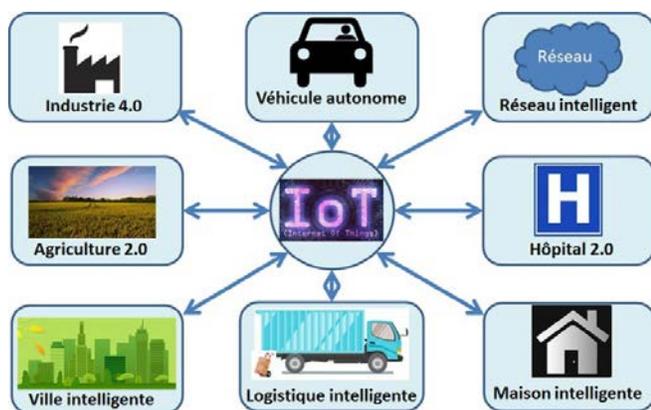


Fig.4 Applications of IoT

A. IoT in Medical Field

IoT has numerous applications in various domains, mainly: Wearable, Smart Home Applications, Health Care, Smart Cities, Agriculture and Industrial Automation. IoT is gaining global attention and becoming increasingly available for predicting, preventing and monitoring emerging infectious diseases [14]. The Internet Of Medical Things (IoMT) is an application of IoT that is used for health related purposes. The new wave of digitizing medical records has caused a paradigm shift in the healthcare industry. The industry is witnessing an increase in the sheer volume of data in terms of complexity and diversity [15]. IoMT is used for collection and analysis of the data for monitoring and research purposes. IoT enabled devices can be related to the purpose of both remote health monitoring and emergency notification systems. Various wearable devices can be used to monitor heart rate and blood pressure. For senior citizens, equipments with specialized sensors can monitor the health conditions and can send an alert notification in case of any emergency. Digitization of medical records has brought a new regime in health industry. Hospitals now have a huge volumes of data related

to patients. This data is accessible in real time hence helping the medical staff to take decisions in a short amount of time mostly in case of emergencies.



Fig.5 Wearable smart device to check blood pressure

B. IoT in Remote Medical Assistance

All around the world most of the primary medical services came to halt as virus spread. Healthcare systems can use the digital technology to maintain the core critical clinical services. Virtual clinics could be set up through the use of tele-medicine consultations with imaging data (e.g., chest X-ray and/or CT of the thorax) uploaded from peripheral sites and interpreted remotely. These virtual clinics would make sure that the basic medical services are running and also will reduce physical crowding of patients at hospitals. Some phone-based software can also detect and record patient's data (e.g., body temperature and symptoms) and can share that data with the concerned doctors [16]. So in occasion of emergency, the concerned doctors will be pre-empted and doctors can instantly examine the illness and proper treatment can be carried out.

C. IoT in Surveillance

India has 35.0% urban population and the median age is 28.4 years [17]. Hence the majority of the population is young generation who loves to use technology. To curb the spread of COVID-19 like pandemic use of smart phone technology is very essential. The first step in infectious disease control is detection. Though India is doing tests at a rapid rate but with such a huge population and being an under-developed country it would be technically impossible to conduct test for the whole population. A global network of sensors can be installed in the major cities across the country for the detection and control of disease. Wide-area IoT solutions like video surveillance can be implemented. This network with virus-detection or symptom-detection sensors can trace and monitor people that may have contracted the virus. An added layer in this network would be tracking every individual that came in contact with the infected patient. These types of networks can be implemented in places like railway stations, airports, religious places, factories etc. People can get regular information related to the spread of the disease and the areas

that are most affected. Use of mobile applications to track the movements of citizens can provide a better information and quick response mechanism to trace the contacts of the infected persons. Technologies like Bluetooth and Wi-Fi are used to track the contacts of a person.

Once the potentially infected people have been identified, they need to be isolated from the people in order to minimize the probability of infecting others. Since there is no practical way of monitoring these thousands of patients who have been quarantined. IoT will ensure that the quarantine rules are being followed by the local government and the patients as well. In case of any security breach by the potential patients, IoT will help in tacking them down. Moreover the healthcare workers going door-to-door surveillance is a slow process and also dangerous for the workers. Contract to this method IoT application like drones carrying an infrared thermometer can be used by health workers will not only speed up the process but is also safe.

D. IoT in Contact Tracing

Apple and Google announced a partnership to provide tools that will help track the spread of corona virus. The collaboration will open their mobile operating systems (Android and iOS) to allow for creation of advanced 'contract-tracing' applications [18]. These applications would use Bluetooth technology to help governments and health agencies to reduce spread of virus. Bluetooth will be used to retrieve location to let people know when they have come into contact with someone who has been diagnosed with corona virus, a process called contract tracing.

These applications can also be used by healthcare agencies to provide real-time updates and clarify uncertainties with the public. These statements and warnings will help people to take decisions like which places to which and which routes to avoid. The government agencies can use this information to locate the areas which need to be locked down in order to reduce the rate of spread of virus.

V. CONCLUSION

India is emerging as potential power so far as Information Technology is concerned. Also the concept of smart cities taken up by the Government is bringing new hopes in the ICT field to enhance different capabilities in medical and security systems of the country. In India although various

steps have been taken to spread digital literacy which is a primary requisite for use of ICT, but we have still miles to go to develop proper infrastructure before the full potential of ICT can be harnessed. The role of ICT in current era is quintessential in containing spread of pandemics. The ICT in its primary form can be used to spread information regarding the transmission measures, preventive measures, location of hotspots for a pandemic. Technologies AI, ML, IOT, BIG-DATA, NLP which have brought a fundamental shift in ICT as these technologies dramatically enhance performance of communications, interfaces and applications. The need of the hour is to develop and use low-cost ICT tools and software solutions that will enhance the healthcare sector to deal with any kind of pandemic or medical emergencies. These tools and technologies will revolutionize the medical sector without much expenditure as exiting infrastructure can play a role of backbone for the new technologies.

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