Artificial Intelligence and Drones to Combat COVID - 19

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Abstract:- Globally, an approximate of 380,000 patients succumbed to death due to the pandemic COVID-19 which also infected more than six million people since December 2019. Not sparing anyone, COVID-19 infections are widely reported among healthcare professionals, sanitation workers and researchers too while global leaders and various governments are providing their best in defending their citizens against this airborne and contact spread virus. In order to contain the virus and protect millions of lives from this deadly coronavirus, there is a need to have a combination of advanced engineering technology and medical facilities. Application of applied science, engineering and technology diffuse almost every aspect of contemporary living. Grasping the fundamentals to determine humanity's most imperative and forthcoming challenges is essential. Artificial Intelligence, the technology that learns, adapts and reciprocates the actions according to the situations, finds optimum position in the fight against corona virus and acts as a powerful tool against this pandemic. In this research article, the authors discusses how Artificial Intelligence (AI) can be leveraged to fight the deadly virus. The research paper further discusses the efficient utilization of AI across the globe to help in testing, treating and serving the population in these hard times. This manuscript focuses on the potential impact of the process in which AI can be implemented to prevent, test and treat.

Keywords: COVID-19; pandemic; Artificial Intelligence; prevention; testing; treatment

1. INTRODUCTION

SARS-CoV-2 virus causes the deadly disease COVID-19 and it was first identified in the month of December, 2019 in China [1]. The World Health Organization (WHO) declared the disease as a pandemic on 11th March 2020 [2]. At present, the global researchers and pharmaceutical industry pioneers are putting tremendous efforts in finding an effective vaccine and develop a standard treatment protocol in order to contain the virus. These actions should be supported by technological advancements also and not merely health sciences [3]. In these hardships, Artificial Intelligence (AI), an 80-year old technology, comes in handy since it has the capability to make the machines learn, function and react like human beings. In spite of the fact that human beings are superior to technology, AI plays a major role in today's world that makes human beings depend on it for various day-to-day applications [4] as shown in the Figure 1.

Figure 2 showcases that AI is predominantly used in the context of medical applications. This potential characteristic of AI can be leveraged to increase the fight against COVID-19 pandemic [5]. There are three potential areas that could possibly be contributed by AI in containing this pandemic such as preventive measures, testing and treating [6]. This research article that discusses on the role played by COVID-19, details about the three processes involved in containment of the virus and the potential impact on the growth of AI.

2. ROLE OF AI IN COVID19

COVID-19 is a global pandemic that was first identified in Wuhan city, China and started spreading to different countries of the world. The medical community roughly defines COVID-19 [8] infections as an illness that is caused by novel coronavirus termed as severe acute respiratory syndrome coronavirus. The primary transmission of COVID-19 occurs through droplets of saliva or discharge from nose when an infected person coughs or sneezes.
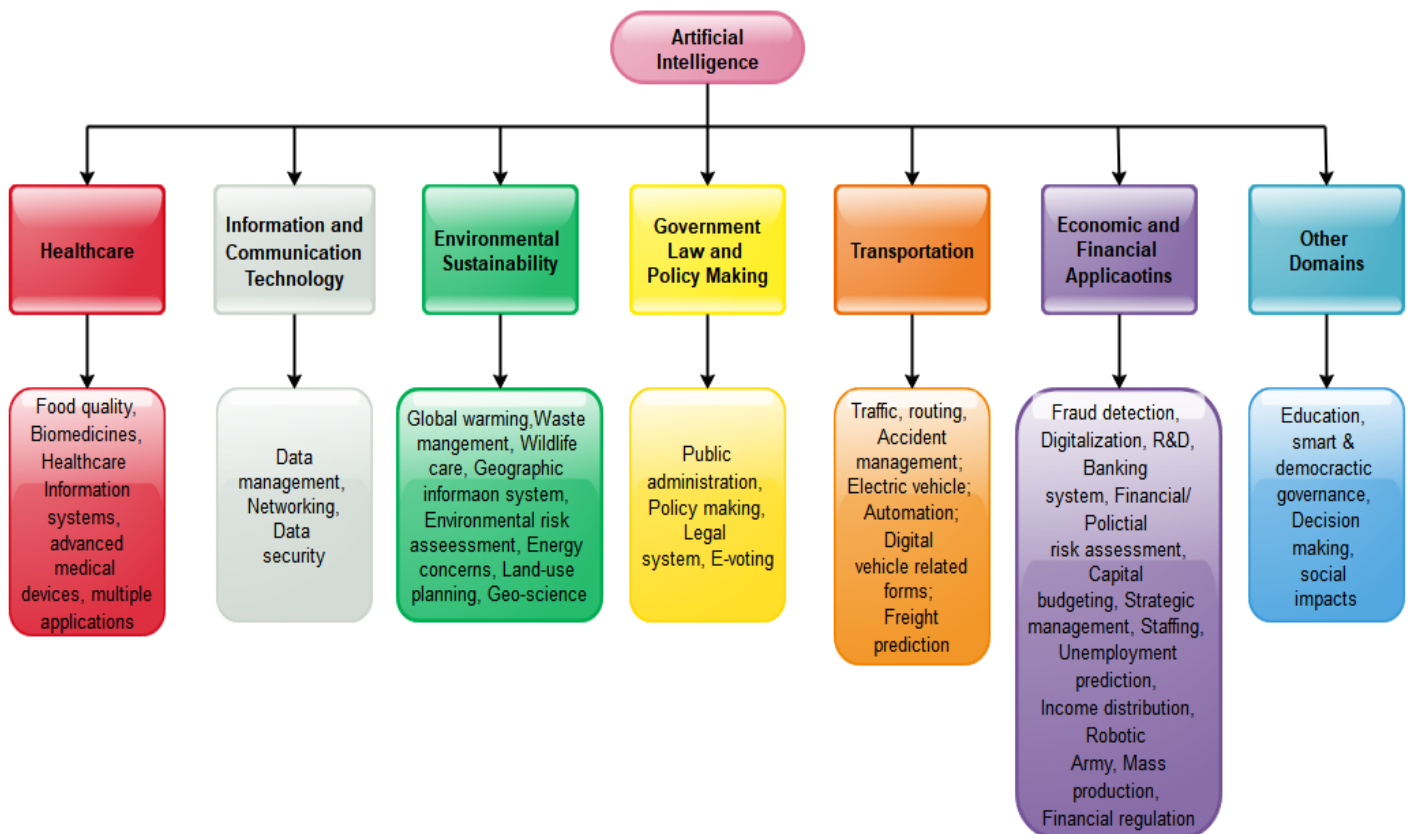
Figure.1. Application of AI in various fields [4]

Figure 2. Contribution of AI in the field of Medical Science [7]

In this life-threatening scenario, the Artificial Intelligence technology has been successfully applied to manage the situation. It is an established fact that the healthcare professionals such as doctors, nurses, sanitary workers, lab technicians and other healthcare workers are the forerunners in this fight against COVID-19. So, these frontline warriors must be protected from virus contraction using proper Personal Protective Equipment (PPE) whereas the interest to use AI has gained immense popularity to reduce the person-to-person contact. In line with this, there is a steep increase observed in the usage of telemedicine that allows doctors and nurses to communicate with the patients without being exposed to infections [9-10].

The evolution in technology is tremendous and rapid which results in the development of disruptive technologies [11]. Figure 3 illustrates a total of 12 disruptive technologies that are being used in various facets of life such as

Artificial Intelligence, Advanced Robotics, Internet of Thing (IoT), Cloud Computing, Automation of Knowledge work, Global Internet Penetration, Autonomous and Near Autonomous Vehicle, Next Generation Genomics, Renewable Energy, 3-D printing, Advanced Oil and Virtual/Augmented Reality. These disruptive technologies can be leveraged to put up a great fight against the pandemic through different ways.
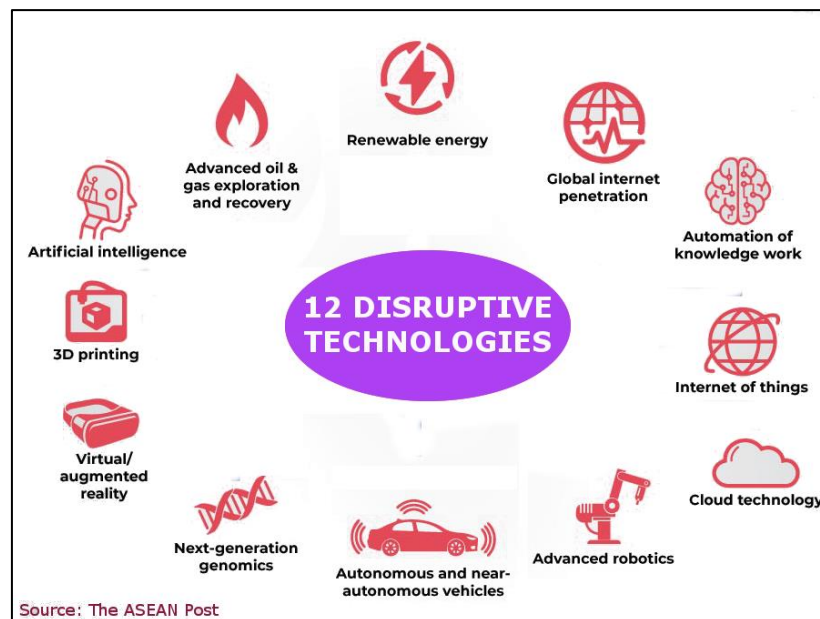

Figure 3. Collective Image of 12 Disruptive Technologies [11]

3. Process Involved

The three basic processes [4] which are involved in the containment of this pandemic using AI are (a) Preventive Measures and contact tracing (b) Testing advances and (c) Treatment process. All the three processes are described in detail below.

3.1 Preventive Measures and contact tracing

The health sector saw rapid diagnostics with high precision in the recent times, especially in finding the novel corona virus (COVID-19) due to technological progress in this sector. Utilizing AI-driven algorithms for earlier detection of coronavirus is at its final stage and it could potentially pave the way for better preparedness. The outbreak of corona virus (COVID-19) in china was predicted by few AI-modelling driven companies such as BlueDot and Metabiota, way before it reached the global countries. They made it possible by scouting its impact and its spread. In order to ensure the occurrence of enhanced data sharing, there needs to be efficient data protocols in place so that the data is shared among various resources, networks and systems while at the same time, not compromising privacy and prevention of oversight, specifically in case of medical data [9].
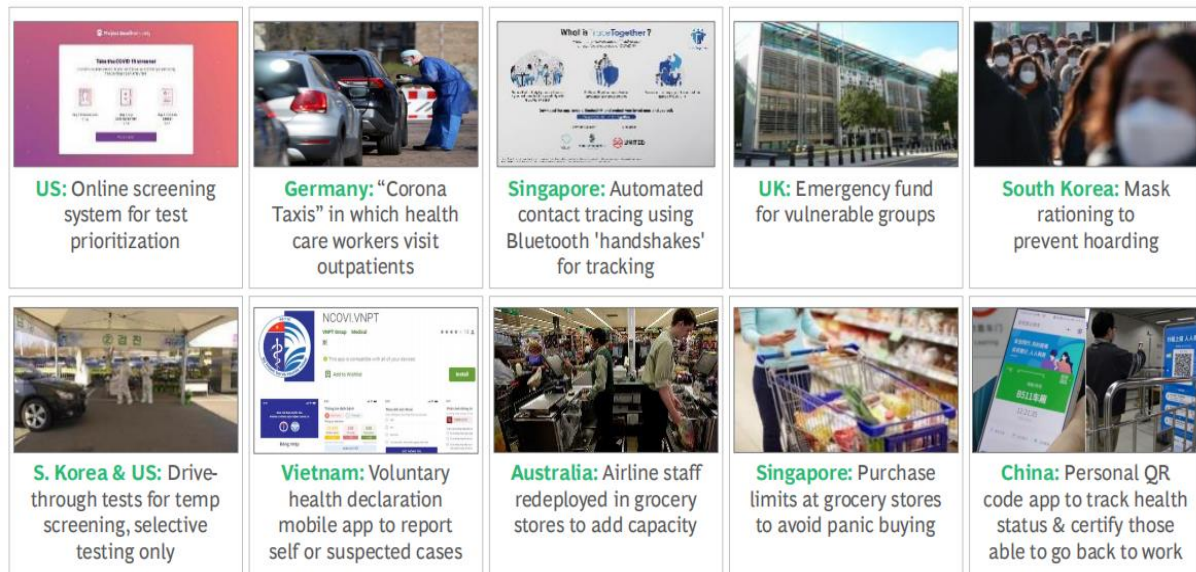
Source: BCG Analysis

Figure 4. Implementation of AI at various levels in different countries [12].

AI is used by various countries, in addition to China, such as US, UK, Germany, Singapore, South Korea, Vietnam etc. in different fashions to prevent, track and contain the coronavirus [12]. Figure 4 is a collage that shows how AI is utilized in these countries.

In the report published by Andrew Ilachinski upon Department of Defence (DoD), US, the author detailed about how unmanned and autonomous weapon systems were used at the time of war between 2012 and 2016. This report was developed on the basis of reports, memos and directives published by DoD and Defense Science Board (DSB). Figure 5 summarizes the reports published so far, which detailed about various technologies that are involved in this period. The centre position is occupied by eight commonly-cited technologies [13]
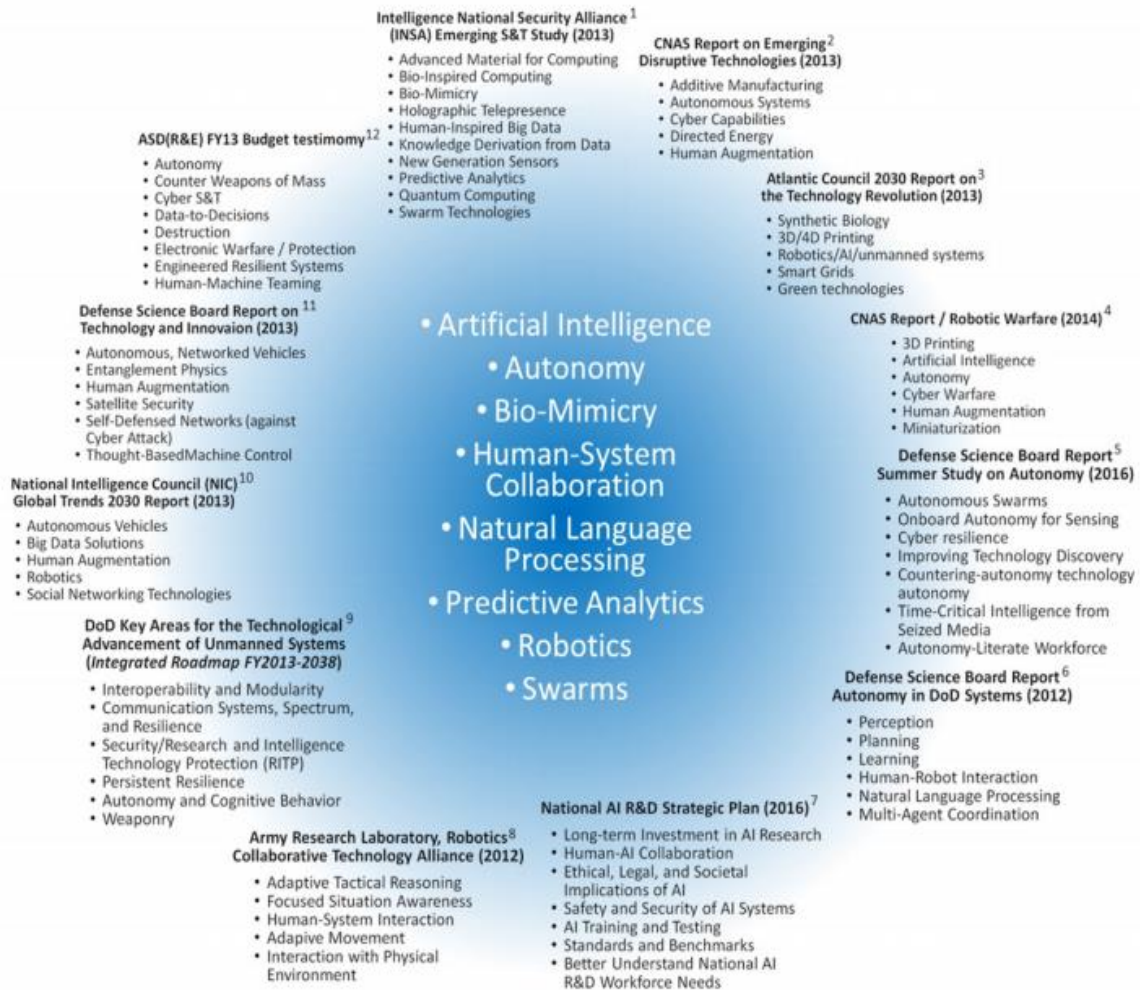
Figure 5. Core set of innovations /technologies across a representative set of recent studies and reports [13]

In the diagnostic procedure for COVID-19 [14], there is a simple and cost-efficient solution available i.e., smart devices coupled with AI frameworks [15-16]. The studies reported in the literature [17] refer this as mobile health or mHealth. These works seems to bring advantages as the smart devices are used on a daily basis whereas there is an app being developed to trace the contacts of COVID-19 positive patients. There is a re-training ongoing at Carnegie Mellon University for algorithms to meet the data requirements and prediction for COVID-19, instead of seasonal flu that was actually intended to. In the containment of COVID-19, the public health authorities need to plan, prepare and manage the pandemic for which tracking and predicting the spread is crucial. Further, those authorities must also be equipped with information about epidemiological curve and how far they succeeded in flattening it. There may also be tentative predictions on the possible impact of measures to be taken in reducing or slowing down the impact.

The National Informatics Centre under the Ministry of Electronics and Information Technology, Government of India developed a mobile application to track COVID-19 [18]. This is basically a tracking that functions with GPS and Bluetooth features to track the infection of coronavirus. Further, this app also updates the user about risks involved in COVID-19, probability of being infected with corona and govt. updates on COVID-19.

CCTV-based tracking was generally deployed by Asian countries such as India, Singapore and South Korea to identify the potentially-affected patient. In line with this, as shown in the Figure 6, China made use of AI-powered thermal cameras with face recognition to monitor its citizens [19-20].

Figure 6. AI Human Temperature Filter in identifying infected people [19]

3.2. Testing advances with AI

In this method, blood is examined by an artificial intelligence-based screening method to triage patient suspend of COVID-19 who arrives at emergency rooms. Since there is no substantially-proven standard protocols available for COVID-19 pathogenesis and treatment, it is critical and life-saving to have early diagnosis and timely treatment. A random forest algorithm was used to extract a total of 11 key blood indices [16]. This information is used to develop the final assistant discrimination tool from 49 clinical available blood test data, which were derived by commercial blood test equipment as shown in the Figure 7. In the beginning, the patient is assessed by health professionals whether he or she may be a probable case of COVID-19. As soon as the patient is identified as a suspect case, simple blood examinations are conducted since these act as the input values for AI model. The examination results are then used as input to a pre-trained model which will compute either a positive or negative result. If the output is positive in AI model, then the output cannot be said as final one and is subjected to rapid test to confirm the result. This seems to be a well-suited method to conduct preliminary assessment of suspected patients that helps them to get treated in a timely manner and suggested for quarantine.

Aalborg University Hospital, the largest hospital in the North Jutland region of Denmark, published the protocol for next stage of development in testing. Till then, manual processes were only conducted in testing and sorting the blood samples which were not only time-consuming, but monotonous too [14]. However, the procedure has been automated now by the university hospital. In this procedure, a robot-based system and intelligent transport boxes are used to ensure the samples are of excellent quality. This automation process simplified the workflows in hospitals.
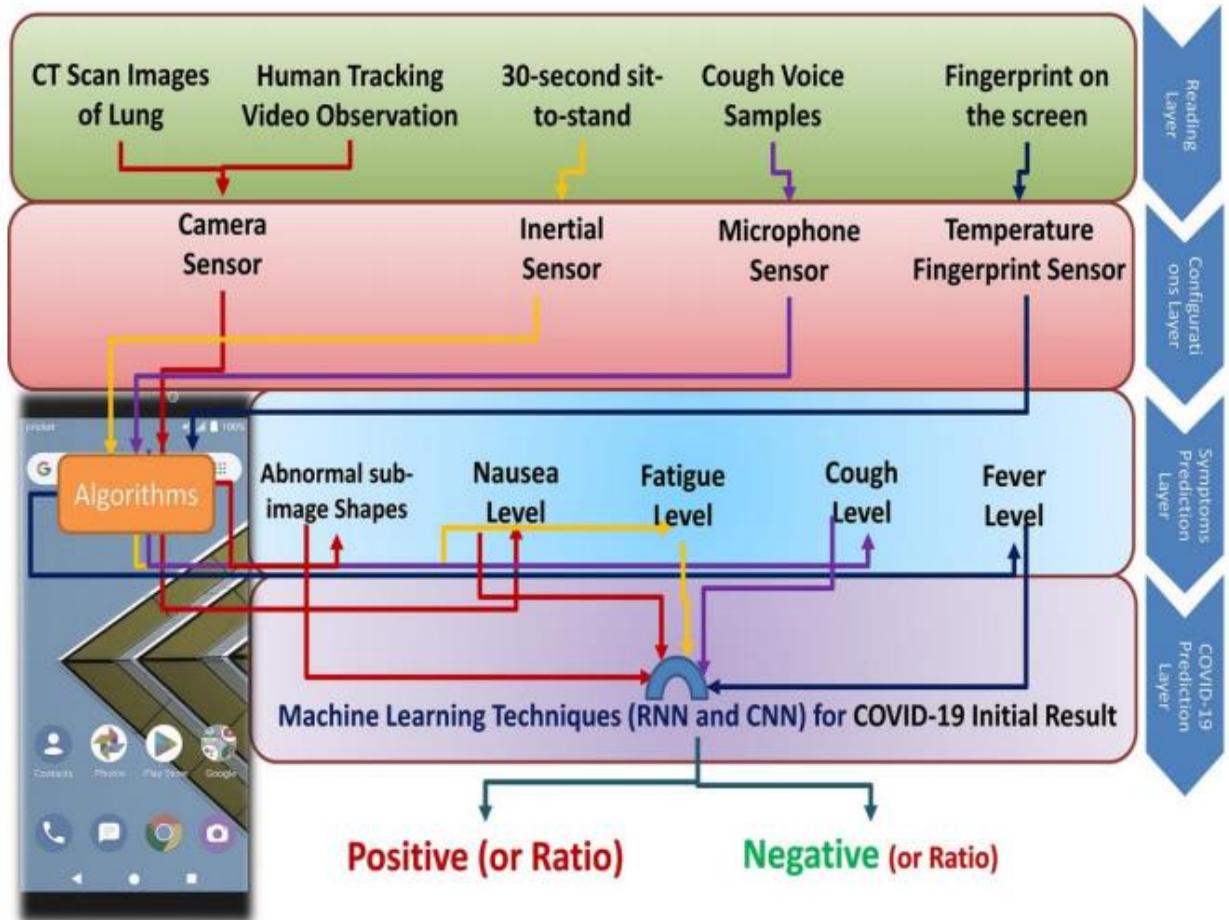
Figure 7 (a). Framework for AI-based Screening method [16]

Figure 7 (b). Records and Results Exchange using Cloud Computing [15]

3.3. Treatment

At present, researchers across the globe are putting tremendous efforts in finding an effective vaccine and develop a standard treatment protocol in order to contain the virus [14]. These actions demand substantial efforts from health science as well as computer science, especially AI and other such emerging technologies. Digital and Molecular Surveillance is one of the initiatives taken by National Research and Development in mitigating the risks of COVID-19 infection [8]. There is a need to have digital surveillance data in order to track and trace the recent movements of corona virus patients so as to develop the virus transmission chain. Molecular surveillance is a process in which the genetic sequences of SARS-CoV-2 are collected, reported and analysed. This surveillance data can provide insights about virus mutations and how to mitigate the virus by understanding its pathogenesis.

Based on the understanding about the severity of COVID-19 pandemic, medical applications are being identified by AI to contain the spread of the virus. This is primarily achieved through protein structure prediction, drug discovery and drug repositioning. With the help of AI [21], pharma industry started discovering new medicines or a combination of the existing medicines to treat the patients infected with COVID-19. This seems to be beneficial in terms of both economic and scientific perspectives, especially in the absence of standard protocols or clinically-verified medicines or vaccines.

After training the COVID-19 virus-specific dataset [14] with DL model, this model is then utilized to verify against the 4895 commercially-available drugs in order to find out the potential inhibitors with high affinities. On the whole, a total of 10 existing drugs showed potential inhibition in virus spread. For instance, HIV inhibitor abacavir, and the respiratory stimulants, almitrine mesylate and roflumilast. A data-driven model is proposed in this work for drug repurposing through a combination of ML and statistical analysis methods. Further, there was a comparison between the protein structure of COVID-19 and Ebola/HIV-1 viruses. Further, a multi-task deep neural network was also utilized to forecast the toxicity of the molecules. This intends to enhance the screening process and increment the success rate of the drug candidates.

4. Potential Impact on Artificial Intelligence

Artificial Intelligence [22] has penetrated in all facets of human life these days and its importance is heavily experienced during the pandemic COVID-19. The technological developments that have occurred in the recent decades in all the sectors made its presence an obvious one, especially if the tasks could not be accomplished by human beings alone. However, there must also be an analysis undertaken on the level of AI penetration that may potentially endanger the viability of the cities. There should be a clearly structured layout that lists out the mobility futures in order to account the disruptive impacts of Artificial Intelligence. Based on the analysis of the combined effect of levers, researchers, public policy-makers, and practitioners, one can determine the outcomes of a global crisis and systemic instability since this entity has been argued as missed from the smart city discourse [23].

A dedicated research fund of 20 million US dollars has been allocated by Microsoft [24] to make a progress in artificial intelligence and data science in COVID-19 research. These research works specifically aim at diagnostics, hospital resources and other critical areas. In the paper published by **Tan Yigitcanlar et al (2020),** various insights have been provided by the authors about the contribution of AI in developing smart cities. This research paper conducted a systematic review of the literature and the results were categorized under primary smart city development dimensions such as economy, society, environment, and governance. The systematic review of 93 research articles concluded that (a) AI is an emerging field of research and practice when it comes to smart city concept. (b) The paper primarily reviewed the literature focusing AI technologies, algorithms and its current and prospective applications. (c) In smart city concept, the AI applications predominantly focus on efficient business, data analytics, education, energy, environmental sustainability, health, land use, security, transport, and urban management areas. (d) The paper suggests that the scholarly research work that decodes the risks involved in wider AI utilization is scanty. (e) There is no vast research conducted yet upon the future disruptions of AI in cities and societies. The study outlined the present and future contributions of AI in the development of smart cities [25].

Boston Consulting Group conducted a case study in which the consultants enlisted the initiatives being taken in India that involves AI in smart city development through Integrated Command and Control Centre (ICCC). The ICCC controls as well as monitors the testing and quarantine methods, containment surveillance, health advisory information and distribution of essential services. This case study also decodes the typical challenges involved in fighting a COVID-19 like pandemic. Figure 9 shows how smart cities are able to outperform with the help of innovative solutions [12]. Amisha et al 2019 has done study summary of AI in medicine, handling with the idea as well as the present-day and upcoming applications of AI. Also discussed about pros and cons of technology to simulate intelligent behavior and critical thinking comparable to a human being [26].
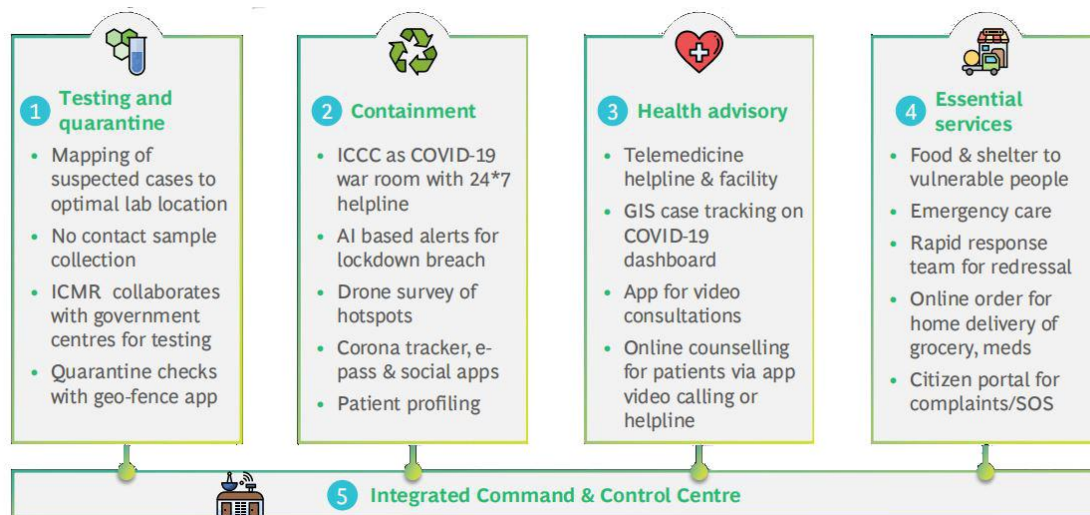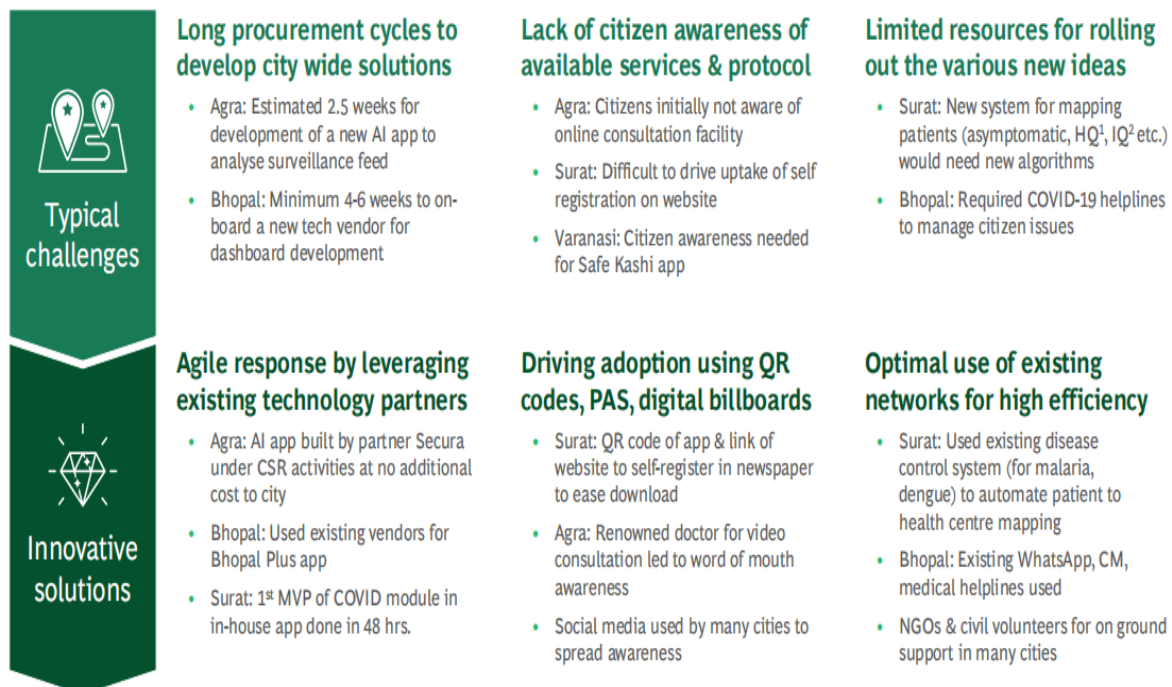
Figure 8. Initiatives by Indian Smart Cities through ICCC [12].

1. Home quarantine 2. Institutional quarantine
Source: Surveys, reports provided and interviews held with noted smart city representatives

Figure 9. Typical challenges faced and innovative solutions deployed by Indian Smart Cities [12]

5. Drones

Considering a country like India with a mass area of 3.28 million sq.km, sanitizing and disinfecting posed a considerable challenge and risk for public sanitation workers following a manual spraying process approach. To avoid risking of the manual spraying workers and their families getting exposed to the virus, automated sanitation using drones were deployed. These drones can complete the spraying task within 15 minutes compared to manual spraying taking 1 hour [27]. Padmanathan et al., 2019, provided a study on the cultural, economic, environmental, technical, and social sustainability of human beings by an advanced inter-disciplinary approach. In that survey, the authors concluded that any new business models for various industries have to deal with the defiance that presents in multiple rural conditions [28]. Based on which, to avail drone based disinfecting service, Garuda Aerospace, an ISO 9001, start company launched "Corona Killer" as shown in Figure 10. These automated disinfecting drones are capable of spraying disinfectants from 3 to 450 feet height, covering long distances at a short time without involving public workers at the very spot [29]. These drones can be used for the Swaach Bharat

campaign, to keep India clean regularly and to deter the spread of COVID - 19 or any other viral or infectious diseases. In cities like Chennai, Chandigarh, Varanasi, Raipur, Bhopal [30].

Figure 10. Corona Killer Drones Disinfecting at Chandigarh

6.Conclusion

In this research article, a detailed investigation on the impact and importance of Artificial Intelligence on COVID-19 pandemic is conducted. The authors detailed the contributions of AI in combating and containing the coronavirus pandemic such as preventive measures and tracing, testing advances and treatment. The machine learning algorithms can be leveraged to implement the preventive measures and so the awareness is created prior to its occurrence of disease outbreak. When it comes to contract tracing, the AI plays a key role in identification of the suspected people. Artificial Intelligence contributes at the place where the blood samples are filtered based on the predefined AI model. The treatment process utilizes AI in the form of protein structure prediction and drug repositioning. The dataset creation, hosting and benchmarking of the COVID-19 pandemic is crucial in order to help the researchers in drug discovery and disease prevention. There should exist data warehouses about the disease. The impact of AI upon global crisis, unemployment and other destructive should also be considered.

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