BRIEFING NOTES

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AI USE IN EPIDEMIC MODELING AND HELPING GOVERNMENTS CONTAIN THE VIRUS SPREAD

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SUMMARY

- Artificial intelligence (AI) can be used for early warnings and alerts about COVID-19. AI and related technologies can be used to isolate, track and predict how the COVID-19 pandemic will spread over time and space.
- AI can be used for data dashboards to visualize the actual and expected spread, diagnosis and prognosis of COVID-19 symptoms in individuals, such as to recognize individuals with fevers, identify voice changes, and determine lung infections, among others. It can also be used for development of treatments, vaccines, and social control.
- AI and unmanned aerial vehicles (UAV) solutions can be utilized with other technologies to transmit essential items such as medicine, medical samples, food, etc. to decrease human-to-human contact. Moreover, it can be used to support applications that provide solutions to disinfect, sterilize, and clean public places such as hospitals, clinics, government offices, etc. and reduce human-to-virus contacts.

CONTEXT

- The DeepMind sector of Google has used its latest algorithms and computational resources to identify the Coronavirus forming proteins [1].
- The super-computers and cloud computing resources of various major technology companies such as Tencent, DiDi, and Huawei are being applied to fast-track the development of a cure or vaccine and model solutions for the Coronavirus [1].
    - **China**:
        - The Health Code surveillance system has been set up by the Chinese government. Based on an individual travel history, the length of stay in high-risk areas, and the probability of exposure to people with the Coronavirus, the developed system identifies and evaluates each person's risk of infection, and ultimately determines if the person should be quarantined or not [1].
        - The Chinese start-up company Infervision has developed an AI-based solution termed InferRead CT Lung Covid-19. It has also implemented this solution in Europe to recognize Coronavirus infected individuals. Computed tomography (CT) images can detect lung infections caused by Coronavirus [1], [2]. Compared to other testing methods, this AI solution has benefits such as early diagnosis even for infected people without symptoms (asymptomatic), follow-up on the disease progression, and quantification of volume and density of the virus. Moreover, it has a high-speed response time, independence from other tests, laboratories

and transportations, as well as more efficient triage, and consequently it reduces the risk of infections and high constant quality with impressive performance features [2].

- During the COVID-19 pandemic, Chinese hospitals are using autonomous Danish UV disinfection robots (UVD), produced by Blue Ocean Robotics, to learn the layout of hospitals, move autonomously inside, disinfect patients' rooms, and destroy the DNA or RNA of any microorganisms in range by powerful ultraviolet (UV) lights in order to decrease the human-to human contacts in these situations [1], [3].
- During the COVID-19 epidemic, Chinese hospitals are using Pudu Technology's robots in the catering industry to support the medical staff [1], [4].
- SenseTime and SmartHelmets technologies that apply facial recognition and temperature detection have been used in China to recognize individuals with high fevers that may be carriers of the Coronavirus [1].
- The Japanese company Terra Drone uses unmanned aerial vehicles (UAV) to transfer medical samples and quarantine materials between hospitals and disease control centers in China with minimal risk and maximum safety and speed [5]. In quarantine conditions, these drones are applied to patrol public locations, track non-compliance individuals to quarantine rules, and for thermal imaging of violators of the quarantine rules [1].

- **Italy**: Authorities are analyzing spatial data transmitted by mobile phones of Italian citizens. Using this analysis, the government can determine how many people have followed quarantine orders or determine and control the usual distances that they have traveled every day [6].
- **Israel**: The country's internal security agency is utilizing a cache of mobile phone location data to pinpoint and label the people who may be exposed to the Coronavirus. Israel has previously considered this feature and functionality for counter-terrorism operations [6].
- **England**: Food and small supermarket shopping consignments are delivered to residents of the city during the COVID-19 pandemic crisis using a fleet of six-wheeled robots that are known as Starship Technologies delivery robot [3].
- **Rwanda**: The robots made by Belgian company Zora Bots have been used to measure patients' body temperature, recognize people without masks, observe abnormalities in patients' sound or look, and deliver medicine and other essentials to infected people [3].

- **Contact tracing** is a technique where an application is installed on certain location-tracking devices to monitor and gather time-stamped location data on movements of a person [7]. To prevent outbreaks of COVID-19, this method has been implemented as a surveillance software in Canada, Singapore, and South Korea.
    - **Canada:** AI can be trained and used to identify, track, and predict the prevalence of the COVID-19 disease. The Canadian startup BlueDot is a company that tracks the hazards of infectious diseases using AI. Several days before the Centers for Disease Control and Prevention (CDC) or the World Health Organization (WHO) announced their public warnings on COVID-19, the BlueDot's AI had alerted of the existing threat [1].
    - **Singapore:** The Boston Dynamics "yellow dog" which is equipped with a large number of sensors and cameras was applied to track and identify people who do not follow the quarantine and the social distancing regulations in Singapore. It also broadcasts pre-recorded notifications regarding the COVID-19 critical information to the public [3].
    - **South Korea:** In order to track the traveling, movements, and behaviors of COVID-19 patients and control the Coronavirus transmission chains, governmental agencies of South Korea are providing surveillance camera footage, smartphone location data, and credit card purchase records [6].

CONSIDERATIONS

AI has potential to confront and fight the COVID-19 as well as other future comparable pandemics and as an essential tool to solve various obstacles, challenges, and problems. However, using AI in this area has fundamental limitations. These shortcomings include:

- **Lack of data on COVID-19**: For training various AI models, there may not be sufficient historical data, open datasets, and similar real information on COVID-19 pandemic to work on and determine a reliable, verifiable, and valid solution for diagnosis and treatment [8].
- **Too much data (noisy and outlier data)**: The presence of large volume of data on previous similar diseases is another problem with the use of AI. These old findings and outdated data need to be revised and updated and then evaluated before one can propose novel methods for diagnosis and treatment of the COVID-19. This process is time-consuming and costly [8].
- **Existence of mutated Coronavirus**: According to daily news reports, the Coronavirus has shown new symptoms, indicating possibility of even minimal changes and mutation in the virus. Therefore, one of the challenges and issues in using the designed AI systems should be their capability to be adaptive and ability to update the models as may be required.

- **Data privacy concerns and public health essentials**: Another concern with the use of personal data to combat COVID-19 and the epidemic modelling using AI is that as soon as this pandemic has subsided the privacy of individuals' data may be compromised. Consequently, governments, private entities, and other stakeholders may be able to continue to use this information for other purposes. This fact has led to tensions between data privacy concerns and public health requirements and policies [9].

RECOMMENDATIONS:

- AI and machine learning technologies can be applied to determine how the Coronavirus gene can mutate, how it is transmitted within a population, and how it is spread among young and old populations. Furthermore, analysis of the Coronavirus effects on individual's mental health in society can be accomplished through machine learning.
- Face mask detection and social distancing monitoring in public places is an essential remedy in preventing the spread of COVID-19. The AI-based solutions can be developed by using computer vision, sensors, and facial recognition technologies.
- UAVs and drones can be used to enter polluted areas to spray disinfectants. This can reduce risks of disease outbreak and diminish human-to-virus contacts. In this regard, multi-agent spraying systems that are commonly used in agriculture can be considered.
- An AI-based belt equipped with different sensors can be used to monitor and store medical vital signs of individuals. AI models can use the data to diagnose and monitor patients' conditions. The technology can be used to observe various vital signs, namely breathing rhythm, heartbeat rate, body temperature, coughing severity, among others. Moreover, this specific belt can monitor body behavior during the day and transmit the health information to appropriate health care professionals.
- Blockchain technology enables individuals and organizations from any corner of the world to become part of a single interconnected network facilitating secure sharing of data. The tamper-proof feature of blockchain makes it resistant to unauthorized access and changes. Use of consensus algorithms and smart contracts minimize the potential for propagation of false and fake data. Blockchain-based applications can be used to monitor and control COVID-19 patients digitally through observing their symptoms and vital signs securely and reliably.

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