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EMPLOYING ARTIFICIAL INTELLIGENCE IN FIGHT AGAINST CORONAVIRUS

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ABSTRACT

Artificial intelligence (**AI**), also known as **machine intelligence**, is the study of any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. In a global pandemic such as COVID-19, technology, artificial intelligence, and data science can become critical in helping societies and governments to effectively deal with the outbreak. AI can be useful to recognize (diagnose), predict, and explain (treat) COVID-19 infections, and help manage socio-economic impacts. However, human rights, civil liberties and the fundamental principles of law may be exposed or damaged if great caution is not taken. We should commit to the safe, ethical and responsible use of AI. AI is a potentially powerful and widely applicable tool in the fight against coronavirus, but its advantages need to be hedged in a realistic understanding of its limitations. A literature search was conducted using MEDLINE, Cochrane Library, PubMed for studies/news reports/ articles published using the keywords- artificial intelligence, coronavirus but only a limited studies pertaining to the topic could be found out. This review article gives an insight into how AI can be beneficial in this COVID-19 pandemic, its potential pitfalls and the ways in which it can be employed judiciously.

KEYWORDS: Artificial intelligence (AI), Coronavirus, COVID-19.

INTRODUCTION

Artificial intelligence (**AI**), also known as **machine intelligence**, is intelligence demonstrated by machines, in contrast to the **natural intelligence** displayed by humans and animals. It is the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals.[1] Its important components are Machine Learning (ML), Natural Language Processing (NLP) and Computer Vision applications to teach computers to use big data-based models for pattern recognition, explanation and prediction.

Introduction on Coronavirus-COVID-19

Coronavirus disease (COVID-19) is a new strain that was discovered in 2019 and has not been previously identified in humans.

- Since December 2019, there has been a series of unexplained cases of pneumonia reported in Wuhan, China.
- On 31st December 2019 China notified World Health Organization (WHO).
- On 12th January 2020, WHO tentatively named this new virus as the 2019 novel coronavirus (2019-nCoV).
- On 30 January 2020, WHO announced the 2019-nCoV epidemic a public health emergency of international concern.
- On 11th February 2020, the WHO formally named the disease triggered by 2019-nCoV as coronavirus disease 2019 (COVID-19).
- International Committee on Taxonomy of Viruses named 2019-nCoV as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).
- On 11th March 2020, COVID-19 was declared a pandemic by WHO.

SARS-CoV-2 belongs to the β-coronavirus cluster. As of 19th April, 2020 more than 2.36 million confirmed cases of COVID-19 have been reported in over 215 countries and territories, resulting in approximately 1,62,958 deaths and 610,080 recoveries.[2]

The components of AI can be useful to recognize (diagnose), predict, and explain (treat) COVID-19 infections, and help manage socio-economic impacts. It is a potentially powerful tool in the fight against the COVID-19 pandemic. Since the outbreak of the pandemic, there has been a scramble to use and explore AI for these purposes. Use of AI is hampered by a lack of data, and by too much noisy and outlier data. Overcoming these constraints will require a careful balance between data privacy and public health concerns.[3] A literature search was conducted using MEDLINE, Cochrane Library, PubMed for studies/news reports/ articles published using the keywords- artificial

intelligence, coronavirus but only a limited studies pertaining to the topic could be found out. This review article gives an insight into how AI can be beneficial in this COVID-19 pandemic, its potential pitfalls and the ways in which it can be employed judiciously.

The ways in which artificial intelligence (AI) can help in combating the pandemic are –[3-7]

1. Early warnings/alerts and ability to predict Epidemics

It can warn of an upcoming epidemic and give us enough time to prepare. For example, **BlueDot**, a global AI database company, uses information from a multitude of sources including statements from official public health organizations, digital media, and global airline ticketing data, livestock health reports and population demographics to track over a hundred infectious diseases. On December 31st, 2019 Blue Dot sent out a warning to its customers to avoid Wuhan, ahead of both the US Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). They also predicted other Asian cities where outbreaks could happen, by analyzing traveler itineraries and flight paths. While *BlueDot* sounded an alarm on 31st December 2019, another AI-based model, HealthMap, at Boston Children's Hospital in the USA, sounded an alarm even earlier, on 30th December 2019.

2. Tracking and Prediction

AI can be used to track and to predict how the COVID-19 disease will spread over time and over space. For instance, following a previous pandemic of the 2015 Zika-virus, a dynamic neural network was developed to predict its spread. As a result of a lack of data, too much outlier data, big data hubris, and algorithmic dynamics, AI predictions of the spread of COVID-19 are not yet very accurate or reliable. Hence, so far, most models used for tracking and forecasting do **not** use AI methods. Instead, they prefer established epidemiological models, such as SIR models (population of an area that is *S*usceptible, *I*nfected, and *R*emoved).

May be the methods employed for A.I can identify the patients with pink eye, conjunctival congestion which are the signs of follicular conjunctivitis due to COVID-19 and perform contact tracing for these patients followed by testing and quarantine of these patients as necessary.

3. A.I. Can Speed up diagnosis, Drug Discovery and Development

Fast and accurate diagnosis of COVID-19 can save lives, limit the spread of the disease, and generate data on which to train AI models. AI may provide an image-based medical diagnosis. AI can save radiologists' time, and perform a diagnosis faster and cheaper than with standard tests for COVID-19. Infervision, a Beijing-based AI company uses its algorithm to spot COVID-19 on images of the lung and differentiate it from other respiratory infections.

A.I. can help us identify, develop, and scale new treatments faster than ever before. AI-based drug design applications draw data and insights from information engines to help generate novel drug candidates, to validate or optimize drug candidates, or to repurpose existing drugs for new therapeutic areas.

For target identification, ML is used to predict potential disease targets, and an AI triage then orders targets based on chemical opportunity, safety and druggability and then ranked them. This information is then fed into the drug design application which optimizes the compounds with desired properties before they are selected for synthesis. For drug repurposing, existing drugs approved for specific therapeutic areas are compared against possible similar pathways and targets in alternative diseases.

Researchers from South Korean and the USA have identified an existing drug, *Atazanavir*, which could potentially be repurposed to treat COVID-19. Researchers at UK AI startup have found that *Baricitinib*, a drug used for rheumatoid arthritis can be a potential treatment for COVID-19. Singaporean Researchers have identified *Afatinib*, a lung-cancer treatment, which could potentially be used to treat COVID-19. Insilico Medicine based in Hong Kong recently announced that its AI algorithms had designed six new molecules that could potentially halt viral replication.

A.I might be used to test the research question that chloroquine phosphate eye drops can play any role in the management of conjunctivitis associated with COVID-19.

4. A.I. May Help Minimize Fatality and Optimize Disease Management

A.I. can help manage the outbreak and minimize fatalities by decreasing the burden on the healthcare professionals and reminding patients on proper care procedures. For example, China is using robots to provide faster diagnostic checks, and Hangzhou city ambulances are assisted by A.I. to speed through traffic. Also, China launched an app that helps people check if they have taken a flight or train with a confirmed coronavirus patient.

5. Drones can deliver medical supplies

For example- Terra Drone is using its unmanned aerial vehicles to transport patients' samples and quarantine material between Xinchang County's disease control centre and the People's Hospital.

6. Robots sterilize and deliver food and other supplies

Robots are being deployed for many tasks such as cleaning, sterilizing and delivering food and medicine to reduce the amount of human-to-human contact. For example- UVD robots from Blue Ocean Robotics use ultraviolet light to autonomously kill bacteria and

viruses. In China, Pudu Technology deployed its robots that are typically used in the catering industry to more than 40 hospitals around the country**.**

7. Advanced fabrics offer protection

Companies such as Israeli startup, Sonovia hopes to arm healthcare systems with face masks made from their anti-pathogen, anti-bacterial fabric that relies on metal-oxide nanoparticles.

8. AI to identify non-compliance or infected individuals

China used facial recognition technology and temperature detection software from Sense Time to identify people who might have a fever and be more likely to have the virus. The Chinese government has also developed a monitoring system called Health Code to identify and assesses the risk of each individual based on their travel history, how much time they have spent in virus hotspots, and potential exposure to people carrying the virus. Citizens are thereby assigned a color code (red, yellow, or green), which they can access via the popular apps We Chat or Alipay to indicate if they should be quarantined or allowed in public. Drones also are being used to patrol public spaces for tracking non-compliance to quarantine mandates, and for thermal imaging.

9. Preventing information overload

An initiative, built on AI2's Semantic Scholar project, uses natural language processing to analyze scientific papers about coronavirus. The goal is to help researchers better analyze and understand a growing set of scholarly articles about coronavirus thus helping to combat information overload, making it easier for researchers find relevant studies.

10. Data Dashboards

The tracking and forecasting of COVID-19 has caused the emergence of an industry of data dashboards that visualizes the pandemic. Most popular dashboards include to be those of UpCode, NextStrain, John's Hopkins' JHU CSSE, Thebaselab, the BBC, the New York Times, HealthMap and Microsoft Bing's AI tracker.

11. Development of Chatbots to share free online health consultation services.

12. Management of resources and hospitalization strategies that can prioritize the riskiest patients. For example- they are undertaking a data analysis project that will inform COVID-19 readiness strategies and help hospitals take a proactive approach to manage patient populations in the inpatient and outpatient settings.

13. Using ML algorithms to determine the risk factors that make people more likely to contract and spread the virus or acquire an infection that requires hospitalization. The findings have flagged old age and chronic conditions as major risk factors for poor outcomes. But, it was also able to ferret out social risk factors, including long commutes, living in dense residential areas such as college dorms, attending public events and shopping in person for the spread of COVID-19.

14. Help to identify uninfected individuals in the community who are at risk for a severe course of illness. Health care organizations can advise these people to exercise complete precautions for self-isolation.

15. Development of a coronavirus vaccine

The key to developing a vaccine is to be able to rapidly and efficiently recreate the virus's genome sequence and build a copy of the virus which then can be used to quickly develop and validate vaccine for the virus. In a month, scientists in China recreated the genome sequence of the virus and those in Australia created a lab-grown copy of the virus from an infected patient. The cloud computing resources and supercomputers of several major tech companies such as Tencent, DiDi, and Huawei are being used by researchers to fast-track the development of a cure or vaccine for the virus. The speed these systems can run calculations and model solutions are much faster than standard computer processing.

INSTANCES OF AI IN USE FOR COVID-19 ACROSS THE GLOBE[3-8]

- In China the authorities relied on facial recognition cameras to track a person who had traveled in an affected area and instructed him to self-quarantine.
- Police in China and Spain have also started to use technology to enforce quarantine, with drones being used to patrol and broadcast audio messages to the public, encouraging them to stay at home.
- People flying to Hong Kong airport receive monitoring bracelets that alert the authorities if they breach the quarantine by leaving their home.
- In the United States, AI-enhanced thermal cameras can detect fevers.
- In Thailand, border officers at airports are piloting a biometric screening system using fever-detecting cameras.
- Arogya Setu application launched in India by the Ministry of Electronics & IT, that will enable people to identify and assess their risk of contracting coronavirus infection. Aarogya Setu is designed to keep a user informed in case she/he has crossed paths with someone who has tested positive. The app will calculate this based on cutting edge Bluetooth and location generated social graph, algorithms and AI. It also has a tool for self-testing by asking the user a number of questions. In case some of the answers suggest COVID-19 symptoms, the information will be sent to a government server. The data will then help the government take timely steps and initiate the isolation procedure, if necessary.[9,10]
- Indian medical scientists in Kyoto along with students & professors from IIT Roorkee, developed an AI based software which uses X-ray to detect COVID-19 cases in symptomatic as well as

asymptomatic patients with an accuracy of 99.69%. This allows rapid, no-contact, economical screening thus avoiding any invasive swabs also.

- Scientists at Bhavnagar based Central Salt & Marine chemicals Research Institute (CSMCRI) have developed a special mask using memberane technology which has antiviral, anti-fungal and anti-bacterial properties on the outer mask surface. Outer porous film is made from modified Polysulfone material which can kill any virus having a size of 60nm and above (Coronavirus has a diameter of 80-120nm).
- A digital test is being offered by Easee BV, Amsterdam, the Netherlands which involves the use of a smartphone and computer screen for measuring visual acuity along with spherical and cylindrical refractive errors. It is CE marked and validated as a safe method for obtaining functional and refractive data. This telephone and web based tests can help in determining the next step for an individual care without any actual contact with the patient.

Updates on some AI-centered companies targeting coronavirus[11,12]

1. Deargen

In early February, scientists at South Korea-based Deargen used simplified chemical sequences, rather than 2D or 3D molecular structures, to predict how strongly a molecule of interest will bind to a target protein. The model predicted that Atazanavir (FDA approved) and Remdesivir (not FDA approved) are the most likely drugs to bind and block a prominent protein on the outside of SARS-CoV-2. They would also like to generate new antivirals to combat SARS-CoV-2.

2. Insilico Medicine

Hong Kong-based Insilico Medicine used an AI-based drug discovery platform to generate novel molecules with the potential to bind a specific SARS-CoV-2 protein and block the virus's ability to replicate. They have synthesized two molecules which they are planning to test. Insilico is also actively investigating drugs that might improve the immune systems of the elderly—milder symptoms and faster recovery—and drugs to help restore lung function after infection.

3. SRI Biosciences and Iktos

Menlo Park-based research center, SRI International and AI company, Iktos in Paris announced a collaboration to discover and develop new anti-viral therapies. Iktos's deep learning model designs virtual novel molecules while SRI's SynFini automated synthetic chemistry platform figures out the best way to make a molecule.

4. Benevolent AI

In February, British AI-startup Benevolent AI published two articles, one in *The Lancet* and one in *The Lancet Infectious Diseases*, identifying approved drugs that might block the viral replication of SARS-CoV-2. [13] They identified Baricitinib, a once-daily pill approved to treat rheumatoid arthritis, to be efficacious against SARS-CoV-2.

5. Baidu

It has made its Linearfold algorithm (published in partnership with Oregon State University and the University of Rochester in 2019) which is significantly faster than traditional RNA folding algorithms at predicting a virus's secondary RNA structure. Analyzing the secondary structural changes between homologous RNA virus sequences (such as bats and humans) can provide scientists with further insight into how viruses spread across species. Analysis time for the Covid-19 RNA sequence was reduced from 55 minutes to 27 seconds, making it 120 times faster.

6. Alibaba

Alibaba Cloud, DAMO Academy and DingTalk have joined forces to launch a series of AI technologies and cloud-based solutions to help business decision-makers, researchers and medical practitioners address challenges across several major areas regarding COVID-19.

7. DeepMind

DeepMind (which was acquired by Google in 2014 and is now a subsidiary of Alphabet), has put its AlphaFold system to create "structure predictions" of several under-studied proteins associated with SARS-CoV-2 which might help scientists understand how the coronavirus functions. This may be of use when developing a vaccine or cure.

8. Nanox

The Israel-based Medtech company, Nanox, has developed a mobile digital X-ray system that uses AI cloud-based software to diagnose infections and help prevent epidemic outbreaks. Nanox is currently building on this technology to develop a new standing X-ray machine that will supply tomographic images of the lungs.

PITFALLS IN APPLICATION OF AI FOR COVID-19[14]

1. Subject-matter expertise is required

AI is only helpful when applied judiciously. Deciding what to predict and how to frame those predictions is frequently the most challenging aspect of applying AI. Effectively predicting a badly defined problem is worse than doing nothing at all.

2. AI needs lots of data

AI needs tons of prior data with known outcomes but there is no database of prior COVID-19 outbreaks.

3. Don't trust AI's accuracy

96% accuracy, means missing 4% of the infected people. A model's "sensitivity" is also important which indicates percent of correct predictions for individuals *who have COVID-19* (rather than for everyone). It is far worse to mistakenly suggest that a person with COVID-19 is not

sick (which might allow them to continue infecting others) than it is to suggest a healthy person has COVID-19.

4. Real-world deployment degrades AI performance

When AI models leave development and start making real-world predictions, they nearly always degrade in performance. A drop of 10% accuracy or more during deployment can occur. Therefore these algorithms should undergo independent validation before using new and high-impact AI systems.

For example- A) Measuring core temperature from thermal body measurements requires an infrared camera to get a clear and precise view of the inner face and it is affected by humidity and the ambient temperature of the target. While it is becoming more effective, CDC still maintain that thermal imaging cannot be used on its own—a second confirmatory test with an accurate thermometer is required.

B) In evaluating CT scans, a model that can differentiate between healthy people and those with COVID-19 might start to fail when it encounters patients who are sick with the regular flu.

5. Most predictions must enable an intervention to really matter

6. AI is far better at minute details than big, rare events

7. **There will be unintended consequences**

AI implementations tend to have troubling second-order consequences outside of their exact purview. For instance, social control technology in China, which uses AI to individually approve or deny access to public spaces. Government action that curtails civil liberties during an emergency (and likely afterwards) is a problem which can lead to long-term undermining of privacy.

8. AI will be biased

Bias in AI models can result in skewed estimates across different subgroups, such as women, racial minorities, or people with disabilities leading to discriminatory outcomes.

Ways to responsibly use AI to fight the coronavirus pandemic[15]

1. Data anonymization

Austria, Belgium, Italy and U.K. are collecting anonymized data to study the movement of people in a more general manner. This option still provides governments with the ability to track the movement of large groups, but minimizes the risk of infringing data privacy rights.

2. Purpose limitation

Personal data that is collected and processed to track the spread of the coronavirus should not be reused for another purpose. This concept is already in force in Europe within the context of the European Union's General Data Protection Regulation (GDPR).

3. Knowledge-sharing and open access data

Agencies must collaborate with one another and with other key stakeholders in the community, including the public and civil society organizations.

4. Time limitation

When COVID-19 pandemic does come to an end, national authorities will need to scale back their newly acquired monitoring capabilities.

CONCLUSION

In a global pandemic such as COVID-19, technology, artificial intelligence, and data science can become critical in helping societies and governments to effectively deal with the outbreak. However, human rights, civil liberties and the fundamental principles of law may be exposed or damaged if great caution is not taken. These tools should be limited in use, both in terms of purpose and time, and individual rights to privacy, non-discrimination, journalistic sources be rigorously protected.

Suggestions and new ideas are essential for progress, but so is rigor in testing and validation of hypotheses. A systematic approach, fuelled by accelerated findings using AI and bright minds in collaboration, will lead to a better outcome. We should commit to the safe, ethical and responsible use of AI. AI will be a widely applicable technology, but its advantages need to be hedged in a realistic understanding of its limitations. It is still too early to tell if, and to what extent, AI will have an impact on the COVID-19 outbreak as the number of confirmed cases and deaths rise on a daily basis and so too does the supply of data. Only time will tell that how much part it will play in the long run in curbing the spread and combating the pandemic.

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