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Review Article

Role of artificial intelligence in the diagnosis of COVID−19: A mini review

Rajeesh Mohammed PK[1], Saakshi Gulati[2], Shivangi Gupta[3]✉

[1]Department of Oral Pathology and Microbiology, KMCT Dental College, Kerala, India

[2]Department of Oral Medicine and Radiology, Sathyabama Dental College and Hospital, Chennai, India

[3]Department of Periodontics and Implantology, MMCDSR Deemed to be University, Mullana, Ambala, India

ABSTRACT

The ongoing COVID-19 pandemic due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection has resulted in a significant public health care system crisis. This disease has resulted in devastating damage to human lives and significant disruption in economies. Use of "machine-learning" algorithms as tools of artificial intelligence may help identify a suspected or infected individual with an estimation of chances of survival. These algorithms make use of recorded observational data including medical histories, patient demographics as well as any related data on COVID-19.

KEYWORDS: COVID-19; Artificial intelligence; Algorithm; Analysis

1. Introduction

Coronavirus Disease 2019 (COVID-19) has quickly turned into a pandemic involving the whole world with a very high exponential rate of growth and a lesser understood process of disease transmission. This virus stays in one's body with little or nil symptoms, although it may lead to a rapid spread and progressive severity with a fatal variety of pneumonia that has been seen in 2% to 8% of infected individuals[1-3]. The exactness of mortality, disease prevalence as well as dynamics of disease transmission is ill-defined partly due to uniqueness of challenges caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, for example, peak infectivity after or before onset of symptoms and poor understanding of its pathophysiology with multiple organs involvement[4].

The rapid spread of the novel coronavirus-19 (nCOVID-19) all over the world has raised alarms regarding this pandemic. As people continuously try to control the rapidly spreading of the virus, this pandemic has resulted in large numbers of deaths all around this world. Its rapid spreading has overwhelmed healthcare systems due to an acute shortage of important equipments along with a shortage of trained health providers. Also, there are various testing methodologies including reverse transcription-polymerase chain reaction (RT-PCR). The availability of rapid RT-PCR tests, high frequency of false negative results, delays in processing, variations in testing techniques as well as low sensitivity ranging 60%-70% have further resulted in a burden on the healthcare workers.

Computed tomography (CT) provides an insight into pathophysiology of this disease at various stages, its evolution, and detection. Although there are many challenges in diagnosing this disease, expert radiologists have reported a definitive pattern of infection characterized as "ground glass" opacities, round opacities, enlargement of intra-infiltrate vasculature, and greater consolidation which are signs of the progression of severe disease. CT scan can even detect COVID-19 at

early stages in individuals with negative RT-PCR reports, in case the patient does not show any symptoms.

Thereby, a combination of CT imaging, entire genomic sequencing as well as electron microscopy have been co-adapted for screening and distinguishing SARS-CoV-2, the virus responsible for COVID-19. However, sometimes there may be a paucity of COVID-19 testing kits due to an increasing number of cases every passing day. Therefore, a framework that may enable a quick analytical substitute for containing the spread of COVID-19 among people all over the world must be devised. Vinod and Prabhaharan in their work devised a useful methodology or tool *via* artificial intelligence (AI) that may help identify COVID-19 among people by making use of a CT image scan along with chest x-ray imaging[5]. This strategy uses a data-set of chest X-ray images of SARS-CoV-2 infected and normal individuals and makes use of a 'decision tree classifier' for locating a person with COVID-19. The accurateness of an X-ray image can be analyzed for precision, re-call score, and 'F1' score. The result or outcome is dependent upon information that can be accessed in Kaggle and Open-I stores as per the uploaded chest X-rays and CT scanning images. This test methodology has demonstrated that this newly designed algorithm has good robustness, accurateness as well as precision[1] (Figure 1).

Advancements in AI provides an effective tool for facing diagnostic challenges. There is a large amount of information available throughout the initiation of information technology and continuous as well as increase in computational ability. AI has demonstrated excellent performance in tackling the aforementioned problems or challenges. The ability to extract various patterns as well as inter-relationships from available data has highlighted this research area, especially in various tasks that involve the description of available information as well as patient-related dynamics.

Thus, applications involving deep learning and machine learning techniques could recognize images as well as segmentation, forecast series of time, analyze sentiment, control systems, simulate dynamics, and self-operate robotic systems and have been proven an effective mechanism in maintaining a record of social contacts[6,7]. All of these outcomes clearly explain attention on research activities all around the world and the use of AI is an effective tool for fighting the ongoing COVID-19 pandemic situation[8].

2. AI methodology

Temporal stages of various dynamics in current pandemic may act upon one's environment, thereby, determining consequences over societal behavior as well as status of healthcare. Reliable strategies to address the dynamics of various issues need to be designed, and information concerning COVID-19 pandemic must be collected as well as analyzed. Monitoring infectious diseases, repurposing medicines or drugs used, quick and accurate analysis of data, performing analytics on social media as well as devising various methodologies for early detection are the areas wherein AI might be playing an important role[8]. Use of AI greatly impacts the prevention of further spread or new outbreaks by adopting methodologies along with generally used tools that can adapt to a variety of serious situations quickly.

AI methodologies can be applied in four main areas: action, detection, society, and health. The phase of detection precedes the phase of action. In the detection phase, data are collected along with organizations whereas, in the action phase, various models are used for producing a result over the surrounding environment, such as simplification of various diagnostic procedures as well as development of a predictable strategy for the diagnosis of COVID-19.

3. Major applications of AI in COVID–19 pandemic

AI can be divided into the processing of natural language, machine-based learning process, and computerized vision-based devices. It uses various models to implement and analyze data as well as make decisions[9]. Early diagnosis and recognition of infection is a major factor in applying AI. AI helps in identifying infrequent symptoms speedily, thereby and raises a red alarm to healthcare management system[10,11]. It provides a quick decision at a low cost. It helps in developing management and diagnostic system for coronavirus by utilizing quick and good-quality algorithms and discovering underlying causes of infection *via* a variety of imaging tools such as magnetic resonance imaging scanning and CT.

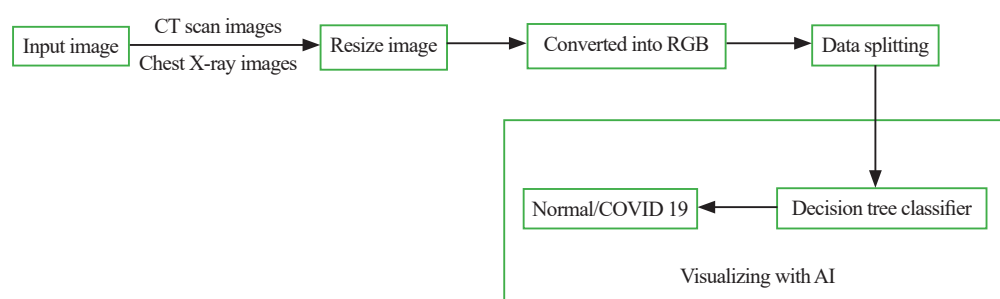By making controlled re-mediation, AI might help in constructing

Figure 1. Diagram showing artificial intelligence (AI)-based algorithm approach.

Table 1. Application of artificial intelligence technologies in management of COVID-19.

Systems	Roles	Digitalized technology	Advantages	Disadvantages	Ref
Tools for tracking SARS-CoV-2 infection	Real-time observation of occurrence of cases	Real-time input data from various technologies; wearable appliances along with smartphones; dashboards of data; maps of migration; machine learning	Enabling visualization of cases representative of disease spread; directing limitations of boundaries; directing allocation of available resources and aids in making disease-related forecasts	It might compromise a person's privacy. This technology is associated with higher costs and requires proper expertise for managing and controlling it.	[16]
Screening of infection	All populations along with individuals are continuously screened	Temperature detecting sensors; various applications on one's smartphones; infrared detecting cameras along with internet-based toolkits are day-to-day examples related to artificial intelligence	The use of artificial intelligence allows recognition of matching patients for conducting research, use of touch-based tracing methods, monitoring of isolation, by collecting detailed observations on incidence of COVID-19 and any pathological condition which might arise as a consequence of covid-19	Use of technologies such as artificial intelligence causes infringement on people's privacy, however, use of artificial intelligence helps in diagnosing and identifying COVID-19 in asymptomatic subjects by gathering data related to self-reporting of disease indications or monitoring of vital signs. All of this results in high-cost factors. Use of this technology requires expert management along with controlled regulation.	[17,18]
By tracing disease contacts	Individuals who are suspected of coming into contact with another person who is suspected of being infected with COVID-19 along with proper tracking	Artificial intelligence technology can be wearable; may use various systems associated with globally positioned satellites; various applications in smartphones; real-time tracking of individuals' mobile phones and similar devices for identifying contact history	Recognizing and quarantining all individuals who have been exposed to the virus; monitoring of transmission of the virus	If a person disables a particular application or if one's mobile phone has been missing or if the internet or Wi-Fi connection is poor or if access to mobile or smartphones is limited or absent, it can be very difficult to trace a person. Individuals who might not have been exposed to infected people but might have contact with those infected with this virus can be traced.	[18]
Tracking of individuals who have been placed under quarantine and// or are under self-isolation	Recognition and monitoring ill people and also, monitoring their period of quarantine	Smartphone apps; artificial intelligence; cameras and digital camcorders; the systems of global positioning	Isolation of infected individuals; monitoring individuals with restrictions on traveling	Use of artificial intelligence can be associated with violation of civil freedom or liberties; monitoring of restrictions on food as well as vital daily supplies. Individuals who escape from quarantine without any information and cannot be detected.	[19]
By analyzing clinical management	By performing diagnoses of sick individuals	By providing online medical consultation; performing remote or virtual treatments or surgeries or making use of various platforms for telemedicine. Additionally, artificial intelligence can be used in performing diagnostics.	Use of artificial intelligence helps in coming to decision-making using clinical tools, by improvising various diagnostic capabilities and for predicting risk factors in disease spread	Use of this technological advancement may impact medical health care privacy. Use of artificial intelligence is linked with higher expenses; also, if there is a defect in associated machinery that employs artificial intelligence can cause hampering of this process.	[19]

an intelligently designed framework with an automated configuration and also predicting the spread and propagation of COVID-19 pandemic. Thus, well-designed neural networking may also be developed following the observed characteristics of this virus[12,13].

3.1. Tracing and identifying clusters

AI provides continued updates regarding patients and solutions. This technique can be used to trace contacts of infected individuals thereby locating the contagious pathogen. This will help in localizing disease clusters control further spread. Also, AI helps in estimating further spread of SARS-CoV-2 and its pre-existing forms.

3.2. Estimation of disease in a population

AI helps in estimating the total number of active cases in a given population and the associated rate of death in a given population. AI technology helps in identifying and forecasting presence of the virus, the further possibility of its spread, and its potential distribution by making use of social networks, available data in public domain, and those undergoing circulation in various media networking sites.

AI can also predict certain accuracy of estimated numbers of COVID positive cases and various clusters that might exist in any specific area. AI aids in identifying the most seriously affected areas, people as well as countries that can further help in taking effective steps against its spread.

3.3. Improving vaccines and treatment

AI can help in improving vaccines and treatment by utilizing drug-related research. This technique can be used to develop and expand distribution of vaccines and drugs. AI could speed up real-time recognition of the virus while traditional techniques take a long period and could accelerate research processes that are highly impractical for any human[12,13]. It could accelerate drug and vaccine development of COVID-19, by formulating new tests at a much faster rate.

3.4. Reduction of workload

Healthcare staff has become overwhelmed due to a dramatic and unexpected rise in COVID-19 patients. AI significantly decreases the overall workload on healthcare workers during COVID-19 pandemic.

AI has been used for assisting healthcare workers to reduce work pressure[14]. AI can help in detection and treatment at early stages by using digitized tools and judgmental research work that provides up-to-date information[15]. AI may change the future of health medications and solve future related problems, thus, drastically decreasing workload of physicians.

3.5. Prediction of disease spread

AI could prevent COVID-19 disease by collecting real-time data and providing novel information. It could predict areas with focused clusters of infection, study the influx of the virus, and find out requirements for hospital beds as well as healthcare staff[15,16]. AI aids in preventing the virus spread and disease outbreaks by making use of data and comparing data collected during different times. AI could describe disease characteristics, various infection sources, and transmission of infection[17]. It will be gradually proven to be critical for fighting this pandemic as well as any other epidemic condition in the future. This tool can be utilized to treat numerous illnesses as a preventive measure and to formulate different protocols for treatment. In near future, AI will play an important role in prevention and prediction[18,19] (Table 1).

4. Conclusion

Fast spread, high infectivity, and mortality rates of COVID-19 have exercised heavy strain on health care systems worldwide. Restricting one's physical contact, early detection, and continuous monitoring of overall health status of patients with COVID-19 is important for management of COVID-19. Analyzing the available information related to COVID-19 using algorithms based on AI may contain the further progression and spread of the virus. AI technology can also help to develop anti-COVID-19 vaccines, perform contact tracing, predict outcomes of patients, spread awareness, and handle workload of associated medical personnel.

Conflict of interest statement

The authors declare no conflict of interest.

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Authors' contributions

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