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The Role and Applications of Artificial Intelligence Approaches in The Health Field: A Literature Review

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Abstract
Since the emergence of the Corona pandemic, physical social distancing, wearing masks, sterilizing and washing hands, and regularly testing temperatures have become important solutions to avoid the risk of infection with the Corona virus. But the presence of weakness in health care systems, overcrowding, and the system of community behavior is the main challenge during the pandemic period. Despite the prevention methods and restrictions on travel, the virus has spread widely in all countries of the world, so it is necessary to consider the role of medical technologies with the emergency situation. global health systems. AI, cloud computing, big data and robotics have an essential role in the health system. AI is an important technology that has a major role in various fields. This study highlights the most important current research and proposed models on the role and applications of AI to confront the Corona pandemic. The main objective of this research paper is to discuss four of the core issues, methods and algorithms used within the field of AI to fight the Corona pandemic, which are: early detection and diagnosis, prediction of the spread of the Corona virus and disease outbreaks, drug discovery, and vaccine development. This study examines in depth these controversial research topics to reach an accurate and concise conclusion. Thus, this study makes important recommendations regarding future research directions related to AI's applications.

Keywords: *Artificial intelligence (AI), Coronavirus pandemic, Coronavirus, COVID-19, Machine learning (ML), deep learning (DL).*

1. Introduction

With the emergence of the pandemic at the beginning of 2020, the human community is facing very difficult challenges at the global level, with only one medical case causing an unexpected spread of infection as the Corona virus has spread to more than 200 countries in the world and more than 1.4 million people have died worldwide due to the outbreak of a pandemic Corona [1]. Machine Learning (ML) and Deep Learning (DL) technologies have an important role as they have been used to combat COVID-19 [2]. AI's methods such as ML, DL, computer vision applications, natural language processing, augmented reality and virtual reality technologies, are able to create models and algorithms for accurate diagnosis and prediction of the spread of the Corona virus, which leads to the discovery of treatment and vaccine development, thus preventing the outbreak of Corona Virus and the occurrence of a global epidemic disaster [3]. AI's applications and algorithms used in healthcare have an important role. It aims to reveal important information gleaned from big data and help

healthcare policy makers and clinicians make critical decisions. The principle of AI is based on the development of approaches and models based on complex algorithms to carry out tasks effectively and efficiently [4]. Although AI's systems are complex, the application of AI's methods in diagnosing the disease will determine the treatment and reduce errors [5]. During the Corona pandemic, the application of AI's methods to health care research has increased, including diagnosis and early detection, which reduces the risk of death [6]. In addition to the classification of infection risk and prediction of prevalence rates through the actual analysis of previous data [7] [8].

Extensive current research in the field of AI has led to a significant improvement in combating the Corona virus through diagnosis and prediction. Researchers have relied on AI-based methods to identify, classify and diagnose medical images to determine the risk of infection and to limit the spread of disease. Therefore, AI has sometimes outperformed humans in some healthcare tasks, resulting in more effective and reliable results [9] [10]. Therefore, this research paper focuses on a literature review on critical issues, namely, the role and applications of AI's methods in combating the coronavirus pandemic using key AI's methods that helped diagnose disease and predict the rate of spread, namely ML and DL. This research paper presents the role of AI's applications for both ML and DL in the field of health care to fight the Corona pandemic and finds a classification of these applications to draw results that serve researchers in this field. In addition, the study reveals the scientific contribution of researchers by providing targeted guidance for future research on the role of the AI's approach in facing the Corona epidemic. The remaining parts of this paper are organized as follows. The second section describes the main applications of AI in the COVID-19 pandemic, categorized into four categories: early detection and diagnosis, spread prediction, drug discovery and vaccine development. The third section is the critical discussion and the fourth section concludes the work.

2. Current AI Contributions in Combating the Corona Virus Epidemic

DL and ML are among the most important AI's technologies that researchers have focused on in the literature and related research, and they are the two core approaches to the methods used in AI's applications to combat the Corona pandemic, in addition to other technologies. Through the use of ML technology, a machine's ability to learn and find eloquent patterns from raw data is expanded upon which AI-based algorithms rely. On the other hand, DL has complex problems can be solved by learning from representations. The DL can also be used to help improve planning, treatment, and patient outcomes related to the coronavirus. This paper classifies the current contributions of AI's applications to combat the coronavirus pandemic into four categories: early detection and diagnosis, spread prediction, drug discovery and vaccine development. The following subsections provide a detailed discussion of these categories of AI applications related to the purpose of the study.

2.1. AI for Early Detection and Diagnosis of coronavirus

Quarantine of positive cases of COVID-19, early diagnosis and prediction of spread are effective approaches to combating the COVID-19 pandemic. The primary and universally standardized test for detecting and confirming patients infected with MERS-CoV is reverse transcription-polymerase chain reaction (RT-PCR) [11]. However, it faces many different limitations, such as cost, time consuming and requires specific materials, equipment and tools [12]. Moreover, another problem faced by most countries is the lack of testing kits due to budget constraints. Thus, this standard method is not suitable to meet the requirements of rapid diagnosis during the Corona pandemic [13]. On the other hand, other methods that are very useful in detecting, diagnosing and analyzing medical data of patients infected with coronavirus are DL and ML models based on AI, and Internet of Things (IoT) [14]. By Alizadehsani et al. a method called COVNet was developed to identify MERS-CoV cases based on a DL approach and a neural network model for examining chest x-rays and computerized tomography (CT) images of patients [15]. Also, an approach based on the genetic sequence of coronaviruses that can process large and complex genomic data sets has been applied by Chiara et al. [16] For example,

Dananjayan et al. focused on understanding the protein structure of the virus and supporting the development of treatment procedures for other similar diseases that could help Google DeepMind's AI algorithms [17]. Besides, using AI in order to know the extent of damage and deformation to the lungs caused by the Corona virus and also determine the percentage of viral infection Izdihar et al. They developed a program called CAD4COVID with their partner Thirona by Delft Imaging to create CAD4COVID-CT to be used in clinical examination. This program is available globally and free of charge [18]. Furthermore, Shi et al. Create a rapid detection platform by aligning X-ray and CT scan data of positive patients along with standard data to correlate changes and rapid automated detection methods [19].

2.2. AI for Prediction of coronavirus Spread and Outbreak

Currently, a large number of research studies aimed at focusing on the application of ML's algorithms to predict COVID-19 infections have been conducted. For example, Rao and Vasquez proposed a ML's algorithm to speed up prediction and identification of cases infected with COVID-19 through the use of a web-based survey. on a mobile phone [20]. Besides, Maghdid et al presented an approach based on smartphone sensors (microphone, camera, temperature, inertia) using ML's algorithms to identify and predict the initial stage of some symptoms of COVID-19 [21]. Furthermore, Metsky et al. They developed an approach This approach detected 67 viral species and subtypes, of which COVID-19 is one. Their approach relied on ML's algorithms to design DNA detection assays [22]. Additionally, for predicting length of hospital stay in people with COVID-19-associated pneumonia, Qi et al. A ML-based CT model was designed based on a data set of 52 patients with laboratory-confirmed cases [23]. The designed model is based on two algorithms, including Random Forest and Linear Regression. By McCal, lHealthMap [24] and Allam et al. BlueDot [25] was developed using ML's algorithms that can efficiently predict virus outbreaks. In addition to another ML-based prediction model, Guo et al. introduced a model called XGBoost. This form was used to diagnose coronavirus to analyze whether a person should be isolated due to COVID-19. Several studies have been conducted to collect training data from the current pandemic and to develop an accurate pandemic prediction model [26]. Lazer et al. introduced an approach called Google Flu Trends that uses online research to estimate and predict influenza activity in real time using AIand big social data [27]. This forecasting and forecasting enables health officials to develop better response plans and manage the epidemic. AI-based prediction models may not represent true transmission patterns due to insufficient data sets [28].

2.3. AI for Drug Discovery

In the case of the Corona pandemic and the presence of a fast-spreading and dangerous virus that leads to many deaths, the design of drugs with the help of AI is the key to progress in the process of producing drugs for Corona virus disease [29]. Shin et al. presented a Molecular Transformer Target Interaction (MT-DTI) model that analyzes different drugs previously available for different viruses, such as HIV, Ebola, and Zika, to verify its efficacy against MERS-CoV, a pre-trained DL's model [30]. An innovative way to redesign drugs and discover different drugs that are suitable for genetically similar viruses is molecular fusion mimicry. It uses a wide range of ligands that interact with a protein in different directions and conformations, demonstrating different binding modes to predict ligand affinity using a DL database. Hence the use of baricitinib, which was previously used in the treatment of rheumatoid arthritis [31]. Besides, Patankar trained the Long Short-Term Memory (LSTM) model to screen 310,000 drug-like compounds from the ZINC database to inhibit the RNA Dependent RNA Polymerase for COVID-19 [32]. Furthermore, Tang et al. developed an advanced deep Q-learning network with the fragment-based drug design (ADQN-FBDD) to produce effective drugs against COVID-19 [33].

2.4. AI for Vaccine Development

This section discusses research on developing vaccines based on AI. In general, vaccines have revolutionized global health and significantly reduced the spread of infectious diseases. Vaccines confer protection against pathogens by stimulating immune memory responses against key proteins expressed by the relevant pathogen. Although it may take many years to develop conventional vaccines, it is very slow compared to a rapidly spreading pandemic. In addition, due to the delay the virus may mutate into another form which reduces the effectiveness of the vaccine.

Several data centers and laboratories have provided COVID-19 vaccine research based on AI's methods. Besides, some studies have used ML technology in developing the vaccine. However, the vaccine development process is expensive and time consuming. Although, it is necessary to develop vaccines using AI, big data, and the Internet of Things, along with a deep understanding of molecular and structural biology, basic virology, and immunological non-information. Studies have proven that AI is one of the accurate ways that can help in developing vaccines during the Corona pandemic period [34]. AI is one of the most convenient and rapid ways to develop drugs and vaccines to combat the outbreak of COVID-19, and is considered the most effective method. In the current studies, an effective solution for a new drug for candidates against the COVID-19 pandemic has been developed, and this method is based on AI, which has been considered an encouraging solution [35]. For example, Beck et al. used of AI has been applied in repurposing existing atazanavir drugs to combat and treat COVID-19 patients [36]. McGowan et al. have designed a CD8 T-cell vaccine for HIV that can be applied to other pathogens. They used the diversity measure of the HLA profile of individuals within a population and the sequence diversity of an individual's CD8 T-cell immune repertoire to assess HIV protein. Furthermore, analysis of HLA adaptation and functional immunoreactivity data enabled the identification of regions within the protein that provided high conservation, recognition of HLA within a population, and low prevalence of HLA adaptation [37].

The most important step in vaccine design is the identification of antigenic proteins that stimulate immunity in the host. ML technology is very effective in data mining and in analyzing big data such as proteins. In addition, it greatly reduces experimental work to discover new vaccines. Dimitrov et al. applied three best performing ML's models (xgboost, RSM-kNN and RF) to a set of 317 known bacterial immunogens and similar non-immunogenic bacterial subjects. The models were validated by internal cross-validation in 10 sets of the training set and the external test set. They all showed good predictive ability, but the xgboost model showed the best ability to identify immunogenic factors and identified 84% of known immunogens in the test set [38].

3. Critical Discussion and Future Directions

AI has the potential to help us address many of the critical issues to confront the Corona pandemic using models based on AI technologies in the healthcare sector. It works to predict the spread, early diagnosis, and others, so it is a powerful tool in crisis management [39]. Moreover, it has become a tool in the fight against COVID-19 and related infectious diseases. However, the application of the AI-based model has certain limitations [40].

AI faces limitations due to lack of data that leads to enough data available to train AI's models, insufficient methods to work on them, and also potential problems due to big data, and lack of modification of methods [41]. ML has had a significant impact in the healthcare field, but although many ML studies have been conducted to combat COVID-19, the use of ML is still limited in providing more efficient results [42]. Due to lack of evidence, dominance of big data, and computational complexities, predictions of COVID-19 with AI remain unreliable and highly imprecise [43]. Another difficulty is synchronization with external data sources for the organization's internal infrastructures, big data systems (databases, networks, sensors, applications, etc.) [44]. An important problem is that there is often a basic assumption about statistical covariates or cell phone data and difficult models to simulate that avoid the need to collect basic epidemiological details. However, for the evolution of COVID-19 epidemics, the assertion of this view remains unreliable about the number of cases that lead to outbreaks, and the behavioral reactions of infected individuals make it difficult to modify them

quickly or understand them accurately [45]. Besides, ML's algorithms provide prediction of basic features (e.g., prediction of infection spread, prediction of patient survival) [46]. Despite this, it has not been addressed in the reviewed literature. To this end, a large number of COVID-19 patient data must be available in order to determine the interrelationships between these features and how this affects the prevalence or survival rate of patients. In contrast to other areas, the emergence of COVID-19 and its impact on humanity requires that patient data be publicly available [47].

Based on the above literature review, there is a need for further model development and data set specifically on COVID-19 or related infectious diseases. And also conducting collaborative research in this field to improve the ability of AI in the health field. As well as sharing conclusions. Besides, in order to improve and develop methods of combating future epidemics such as COVID-19 using AI's technology. In addition, it can take into account future research trends such as predictive modeling, real-time patient monitoring by developing specialized IoT structures based on AI with big data to solve epidemic issues. Furthermore, focusing on critical decisions such as collecting central and global COVID-19 data sets is useful for developing intelligent systems for prediction, diagnosis, spread, and development of treatments and vaccine. In addition to expanding goals to improve AI approaches to medical imaging analysis, it will help accurately examine patients' radiological and pathological reports by device, with clinicians making appropriate treatment decisions. Furthermore, keeping patient information in a private cloud for hospital and physician management provides ways to more securely store patient data on the cloud and access health records via AI-embedded technology.

4. Conclusion

AI-based model is very effective in healthcare, although it has some limitations. Using of AI algorithm-based technologies enhances rapid detection of COVID-19. The literature showed that AI-based technologies are highly efficient during the COVID-19 pandemic. However, it is restricted due to insufficient data set and poor handling. This paper deals with a literature review on AI-based technologies to address epidemics in medical care. For example, the main technologies are ML and DL. The paper focused on the role of AI in facing the Corona virus pandemic. This paper highlights promising research areas about AI technology for COVID-19 diagnosis to reduce human interaction in infected settings, service delivery, and management of health emergencies. Besides, it turned out that he needs time resources and ample financial support to confront epidemic situations. Therefore, it can be concluded that AI-based technologies have a major role in combating the COVID-19 pandemic through a variety of effective applications and viable solutions such as early detection, diagnosis, and prediction of the spread of coronavirus and disease outbreaks, drug discovery and vaccine development. Furthermore, this paper addressed the limitations and obstacles that must be resolved in order for AI to succeed in combating the COVID-19 pandemic. Finally, this paper outlined some key points and future directions for researchers related to AI applications.

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