ISSN: 2586-7652 (Print) Vol. 04, No. 01, March 2021
ISSN: 2635-7607 (Online)
International Journal of Advanced Engineering
Source: http://ictaes.org
Manuscript received: December 25, 2020; Revised: January 31, 2021; Accepted: February 2, 2021

AI Applications to Combat COVID-19 Pandemic

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Abstract

The novel outbreak of corona virus (COVID-19 or SARS-COV-2) is spreading worldwide increasingly. Soaring COVID-19 positive cases culminated in an urgent need for pandemic monitoring and supervision. In these scenarios, the implementation of Artificial Intelligence techniques can potentially provide analytical and decision-making assistance. We plan to examine the essential role of AI in the diagnosis, detection, recovery and response of the COVID-19 pandemic. We reviewed a variety of research work on how and when to implement AI to counter the COVID-19 pandemic. Assessing the efficacy of AI for COVID-19, we have segregated its application toward Novel COVID-19 into seven different aspects. We pivoted mainly on the Abstract, Methodology, and Conclusion of the particular model and looked at the plausibility of how and where it fits best to combat the novel Corona virus.

Keywords: *Corona virus, COVID-19, SARS, MERS, Deep Learning*

1. Introduction

About 96 million people have been affected globally by novel Corona virus with death tolls of about 2.08 million. The Chinese authorities reported SARS-like and MERS-like viruses in their communities (Wuhan, China) in December 2019. The World Health Organization proclaimed the outbreak of the virus to be an international public health emergency in January 2020 and a pandemic in March 2020 [1].

Artificial intelligence (AI) refers to a computer science field dedicated to the creation of systems that perform tasks that generally require human intelligence [2]. The applications of AI extend from education, recreation, robotics, and agriculture to health sectors, finance and what not. Various AI techniques can be implemented to assist medical industry in quickly controlling and maintaining COVID-19 pandemic. With the help of these, policy-

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makers, government and health professionals can better understand the COVID-19 virus and implement their action according to it. AI technology can improve planning, controlling and monitoring of the global COVID-19 pandemics and also learn and build the system to predict upcoming pandemics in future.

2. Principal Applications of AI for Novel COVID-19 Pandemic

AI tools can be implemented for analysis, screening, prediction, monitoring and prevention of COVID-19 pandemic. The principal application of AI at different stages of COVID-19 can be summarized into seven different sections as shown in Figure 1.

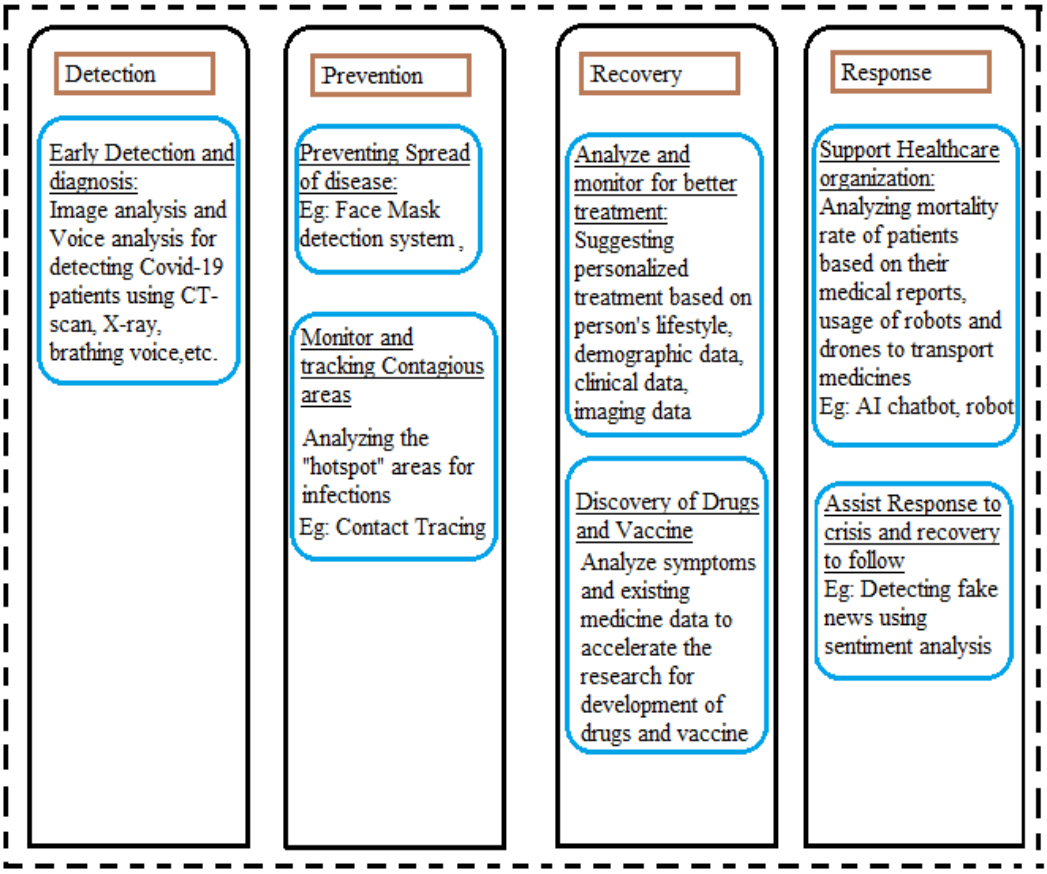


Figure 1. Application of AI at different stages of COVID-19 pandemic

2.1. Early detection and diagnosis

AI can assist to the timely diagnosis of COVID-19 by examining irregular patterns of symptoms and alert them to take precautionary measures. Using suitable AI algorithm implementing imaging technologies such as CT scan, X-ray images, MRI scan and audio technologies such as Breathing and coughing voice, it can assist infected people to diagnose the new disease. A binary classifier is used in [3] to distinguish the cough sound of COVID-19 positive patient with a healthy person's cough sound and also with the cough sound of Asthma infected person. Similarly, a system of GRU neural network implemented with bidirectional and attentional mechanisms can classify 6 clinically significant respiratory patterns hence identifying patients with COVID-19 infection [4].

We can contribute to the high-speed, high-precision diagnosis of the disease compared to traditional methods using AI techniques as shown in Table 1.

Table 1. Research Paper related to application of AI in early detection and diagnosis of COVID-19

Papers	AI Technology Used	Description	Performance Metrics	Dataset used
[5]	CNN with VGG16 architecture and synthetic data augmentation technique	Classifies COVID-19 cases from X-ray images.	Sensitivity:93.28%, Specificity:94.61%, Precision :94.90%, Accuracy: 94.88% F-score: 93.10%	[6],[7],[8]
[9]	Recurrent Neural Network, Long Short Term Memory	Performs early diagnosis of COVID-19 evaluating different acoustic features.	Precision, Recall,F1-score,AUC, Accuracy	Voice, cough, breathing sounds from different United Arab Emirates hospitals
[10]	Random forest Algorithm	Accurately identify COVID-19 using blood test sample	Accuracy:95.95% Specificity: 96.95%	Blood samples collected from different hospitals of Lanzhou and Gansu

2.2. Prevent the spread of disease

Various machine learning algorithms can be used to determine and forecast the location of the next outbreak based on the use of travel, payment and communication data. This study may suggest that policy makers and governments should take appropriate steps to prevent the spread of disease. Advanced deep learning algorithm has been paired with geometric strategies for secure social distancing and face mask detection in public areas [11]. Comparison of various pre-defined deep learning models can be implemented for Face mask detection system as shown in Table 2.

Furthermore, Haar Wavelet Transform and Local Binary Pattern can be implemented to measure the temperature of an individual without physical touch [12]. Since fever is a common symptom in patients with COVID-19, the Human Face Thermal Recognition can play important role in the pandemic.

Usage of Face mask Detection and Thermal recognition application in the entrance gate of offices, schools, and banks can help to prevent the spread of disease in a large context. Similarly, AI techniques can analyze and predict the future need of beds and medical equipments to fight against the infection. Also, it can suggest policy makers and government for the need of lockdown and border checks to track the disease in real-time.

Table 2. Comparison of Accuracy between different models for Face Mask Detection System

Papers	Architecture Used	Introduced Year	Accuracy (%)
[13]	LeNet – 5	1998	84.6
[14]	AlexNet	2012	89.2
[15]	SSDMNV2 (single shot multibox detector and MobileNetV2)	2020	92.64

2.3. Contact Tracing

Several countries have introduced contact tracking applications based on Mobile history, Bluetooth, contact information, network-based API, mobile tracking data, card transaction data, and various other media. Amid the COVID-19 outbreak, digital contact tracing application used by different countries has helped to combat the virus as shown in Table 3 [16]. The implementation of the AI algorithm to analyze data obtained from these sources can accelerate the task of contact tracing and therefore contribute to the rapid flattening of the COVID-19 curve. In

[17], a solution framework has been proposed to prevent and monitor the COVID-19 pandemic involving effective contact tracing in smart cities

Table 3. Worldwide implementation of digital health technology for COVID-19 contact tracing

Countries	Description	Technology Feature	Reference
Austria	Stopp Corona app notifies users of potential exposure.	Bluetooth technology	[18]
Australia	COVIDSafe app notes the date, time, distance and duration of contact with other users and notifies users of potential exposure.	Bluetooth technology	[19]
China	Close contact detector app provides users with unique QR codes.	Interfaces with other widely-used apps such as WeChat, Alipay and QQ. blood test sample	[20]
Germany	Corona-Warn app scans identification codes on nearby phones and notifies user upon exposure to proximal code.	Bluetooth technology	[21]
Ghana	GH Covid-19 Tracker app provides detailed information on event, location after potential exposure.	Bluetooth and GPS technology	[22]
Singapore	TraceTogether app	Bluetooth technology	[23]
Switzerland	SwissCovid app previous information about users in close contact. Cantonal authorities notify other users of exposure.	Bluetooth technology	[24]

2.4. Analyze and Monitor for proper treatment

AI can provide proper treatment for the new disease in quick time as number of infected people is increasing rapidly. The AI algorithm can intelligently analyze patient health data, imaging data, demographic data, lifestyle, and other data to provide economical and personalized treatment to improve the traditional symptom-driven and generalized treatment [25].

Since the convalescent plasma from the body of COVID-19 recovered patients can be used to boost the immunity of the COVID-19 positive patients, machine learning algorithms can be implemented for the best selection of convalescent plasma to transfuse to the critical Covid-19 patients [26]. It can provide quick and effective decision-making in medical sector.

2.5. Drugs and vaccine Discovery

Owing to the large rise in the number of COVID-19 infected people, there is an imminent need for medicines and vaccines for new infections. The task of drugs and vaccine discovery can be accelerated if the behavior of virus be well known. Machine learning algorithm namely SVM, Linear Regression and KNN are used to find the sequence of protein in the virus [27]. Similarly, time series analysis can be done using Recurrent Neural Network (RNN) and LSTM model to predict the mutation rate of virus [28]. It analyzes the nucleotide and codon mutation separately [29].

AI can examine the symptoms and available medication data and recommend effective medicines in order to accelerate medical research. It can become a helpful tool for the development of vaccines and test designs for diagnosis.

2.6. Support Healthcare organization

There is an instant need for a decision-making framework for health professionals to set priority for the care of patients due to the large rise in COVID-19 positive cases. We can process the clinical, radiological, and laboratory data of COVID19-related patients in order to predict the mortality rate with different machine learning algorithms such as Boruta, Random Forest, and Associative trees.

Various machine learning techniques like random forest (RF) and artificial neural network (ANN) methods with LC-ARIMA model can prediction of mortality rates [30]. This may assist the healthcare organization to triage the patients by analyzing their mortality risk [31].Similarly, the system implementing three machine learning algorithms namely SVM, Regression model and ANN survey and predict patient's health condition. It can act as great decision making tool and helping hand for health professionals [32]. AI can predict the future possibility of cases and alarm the healthcare organization to be ready for it. Furthermore, the application of AI can accelerate training and education for healthcare employees.

2.7. Assist response to crisis and recovery to follow

Covid-19's soaring cases are hitting around the globe and there has been fake COVID-19 information on social media and social networking sites. By implementing the sentimental analysis, the fake content can be identified and removed. Decision Tree can be used to classify and filter out fake COVID-19 related news [29]. It implements the dataset of total 399 news which consists of 299 fake news and extracts features from the news headlines, Linguistic Inquiry and Word Count Engine [33]. For fake news detection, a deep diffusive unit model can work as helpful tool which accepts multiple inputs from different sources fuse them and generates output [34]. Table 4 shows comparison of different classifiers for Fake News Detection based on its accuracy.

In order to help people recognize COVID-19 symptoms and prescribe punitive measures, many hospitals and clinics have provided automated AI assistants and chat bots. Furthermore, from the current COVID-19 pandemic data, various deep learning algorithms can learn and develop the framework to report potential outbreaks.

Table 4. Comparison of different Classifier for Fake News Detection

Papers	Classifier	Accuracy (%)	Dataset Used
[35]	Support Vector Machine	89%	Ott et al. reviews dataset
[36]	Lagrangian Support Vector Machine	90%	Ott et al. reviews dataset
[37]	Logistic regression	78%	Reviews Amazon website

3. Conclusion

In order to counter the devastating virus that impacts worldwide, the healthcare sector needs the assistance of advanced machine learning, IOT, big data, and AI services. Through monitoring, controlling, and continuously participating in the production of vaccines, we can tackle the ongoing pandemic with the combined implementation of AI and health professionals. In a nutshell, AI can be quite useful for monitoring and preventing the spread of virus and the outbreak of COVID-19 can be completely eradicated by more and more research in this field.

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