

18th September 2020

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Role of Machine Learning in Pandemic Prediction and Management

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ABSTRACT: The Corona Virus Disease 2019(COVID-19) disease is caused by the new virus, Severe Acute Respiratory Syndrome Corona Virus 2 which has a higher potential for spreading quickly when compared to its predecessors such as Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). Since, there is no known medical treatment or medicine to cure the COVID-19 disease, various control measures such as lockdown, social distancing, and wearing masks and frequent hand hygiene are being followed. In parallel, the healthcare industry, biomedical and drug industries, scientists, researchers, biochemists are working hard for repurposing the existing drugs and for discovering new drugs. The data is collected in huge volume since the occurrence of the virus. Artificial intelligence, machine learning and deep learning algorithms are extensively used for potential applications in regard to COVID-19. This paper highlights some of application tracks where machine learning and deep learning play a major role.

KEYWORDS: Artificial Intelligence, COVID-19 – Deep learning, Machine learning, Research Issues

I. INTRODUCTION

The entire world is suffering by the disease COVID-19, caused by the new corona virus, Severe Acute Respiratory Syndrome Corona Virus 2(SARS-CoV-2). Due to the spread of the virus over almost all countries of the world, the World Health Organization (WHO) declared the virus as pandemic [1]. The virus spreads through which is transmitted through respiratory droplets generated when an infected person coughs, sneezes or speaks.

The COVID-19 becomes a very crucial issue for the following reasons

- The virus is new and it has higher transmitting potential when compared to its predecessor
- There is no acquired immunity against the infection as the virus is new
- There is no known specific medical treatment or medicine to cure the disease
- Almost all countries of the world, even including developed countries have only limited medical infrastructure to accommodate the infected people
- Mortality rate due to the COVID-19

In view of the above difficulties, government authorities, public health organizations, healthcare industries are taking continuous countermeasures such as (i) wearing face masks (ii) social distancing (iii) frequent washing of hands (iv) lock down against the infection

Despite the above control measures, the infected persons are quarantined and medical treatment is being given according to the symptoms and conditions of the patients. Since the mortality rate due to COVID-19 has to be taken into account due to its significant value, COVID-19 turned to be the most urgent issue to be tackled by healthcare industry.

On one side, hospitals are being equipped with the required additional medical infrastructure; integrated treatment such as treating with both Ayurvedic and allopathy medicines are being adopted; isolation of infected people is being done. Mild infected cases are quarantined at home with required monitoring and treatment.

On the other side, scientists and researchers from different domains such as biochemistry, microbiology, chemistry, etc are working hard to discover drugs for COVID-19. In addition, healthcare industry is in need of artificial intelligence and machine learning techniques as the data collected is so huge where manual extraction of knowledge and inferences are consuming large time and effort. In this paper, the potential applications of machine learning for finding effective solutions for COVID-19 issues are described. Also, need for integrating machine learning with other technologies such as Internet of Things(IoT) and big data are highlighted

II. MACHINE LEARNING FOR COVID-19

Healthcare domain continuously archiving the data related to patient record. Personal health information in electronic format, Electronic Health Record(EHR), clinical data, medical data, scanned images such as CT scan, MRI scan, ultra sound scan, X-ray images, etc are archived for further analysis. In the case of COVID-19 also, data are being archived in hospitals. There are many global level databases such as Google, World Health Organization(WHO), etc are archiving COVID-19 related data. The data is continuous increasing in its volume. Extraction of meaningful insights from such a huge data is a tough task. Machine learning is a branch of computer science which makes machines to mimic human brain by making the machine learning algorithms to get trained from massive and historical data. With the acquired intelligence, they can help in making decisions such as in giving early warning to public, prediction about the diseases, diagnosis, assessment of associated risks, etc. The usefulness of artificial intelligence in case of pandemic such as COVID-19 is shown in Fig. 1 and Fig 2.

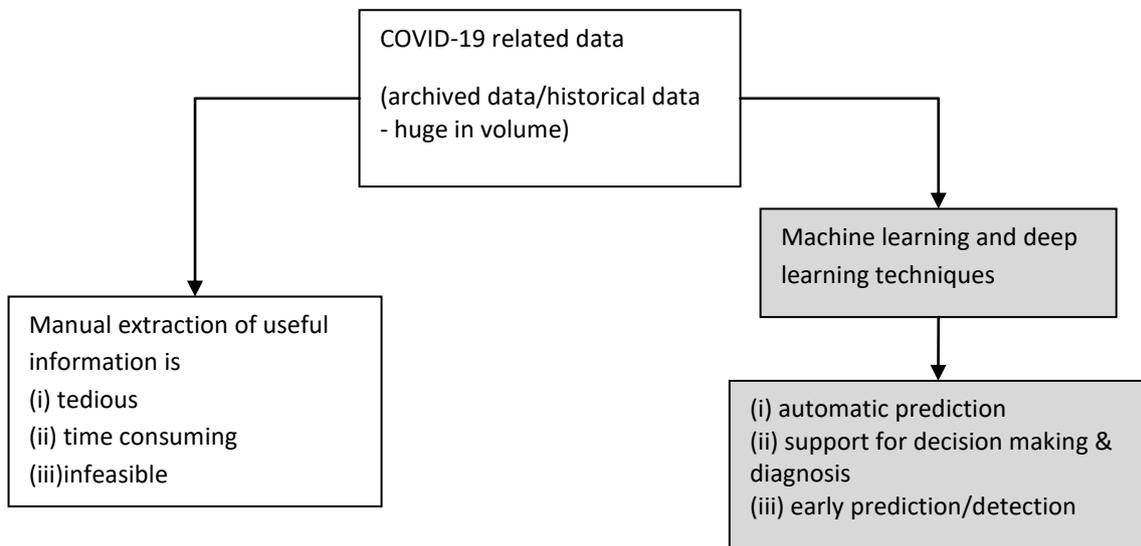


Fig. 1 Role of machine learning for COVID-19 issues

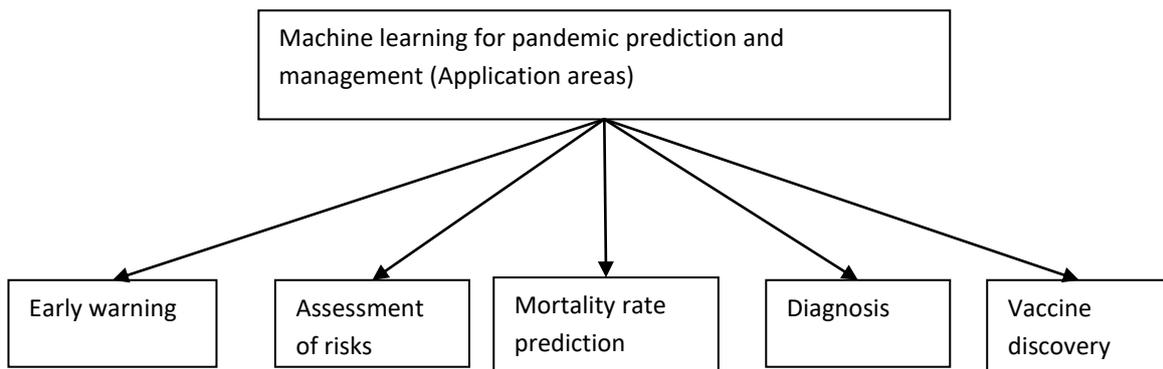


Fig. 2 Application areas of machine learning for pandemic prediction and management



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Different applications areas are briefly described below.

Early Warning

Time series based statistical methods and differential equations based mathematical models are used to predict the dispersion of virus. Surveillance systems such as BlueDot and *HealthMap* could predict and give early alerts. These systems are machine learning based systems which analyze the data archived in global databases such as Google. Machine learning based tools help in controlling COVID-19 pandemic by providing predictions about different aspects such as genetic evolution of the virus, when the rate of infection is set to peak and also the number of undetected cases which in turn help the government authorities to take different control actions such as right planning of transport and food supply, arranging the required number of quarantine zones well in advance, performing preliminary testing or screening in required zones where the virus is likely to spread, etc[2].

Assessment of Risks

From WHO databases, the most common symptoms of COVID-19 infection are found to be fever and cough (67.8%). According to this study, 43.8% of patients are found to have fever on admission to hospitals and 88.7% of patients are found to develop fever during hospitalization. In addition, vomiting and diarrhea are found to be uncommon symptoms with their occurrences as 5% and 3.8% respectively. The other factors that should be included while assessing the is that whether the person under assessment has been in close contact with the infected person. From the available public databases, classification models say for example based on decision tree can be developed. Such models can predict the associated risk level with a person into different categories, namely, mild, moderate and high. This kind of assessment is very important as it helps in deciding how many cases would be in need of medical facility. Because, even countries like USA has only limited medical infrastructure when compared to that of infected cases

Mortality rate

Another important area of research is the prediction of mortality rate due to COVID-19. From the preliminary reports and data collected, the mortality rate due to COVID-19 is higher when the infection is present in persons who already have other diseases such as diabetes, heart diseases, kidney diseases, etc. [2]. This analysis is very important because these people are considered as risky and they are likely to have Intensive Care and ventilators

Diagnosis

CT Scan is one of the test to detect the presence of COVID-19 infection in lungs. This kind of scan is very important in people having higher risks. Convolutional neural networks with deep learning are very efficient in different the COVID-19 infected lung CT scans from that of other kind of lung images[3]

Drug discovery

Efficiently mining large scale chemistry data is essential for drug discovery which can be flexibly done using deep learning algorithm [4]. In addition, it helps in determining the structure of protein associated with COVID-19 which helps in determining vaccine formula[5].

III. CONCLUSION

The entire world got affected by the COVID-19 and different countermeasures are being taken up in different domains. Scientists and researchers from all domains are continuously taking efforts to develop vaccine. In this paper, different applications area where machine learning and deep learning are useful in developing efficient solutions for COVID-19 issues are discussed. In addition, the machine techniques need to be integrated with other digital technologies viz., the IoT, big data analytics and cloud in order arrive still better combating solutions.



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