


Survey of Recent Applications of Artificial Intelligence for Detection and Analysis of COVID-19 and Other Infectious Diseases

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ABSTRACT

The purpose is to illustrate how artificial intelligence (AI) technologies have been used for detection and analysis of COVID-19 and other infectious diseases such as breast, lung, and skin cancers; heart disease; and others. Specifically, the use of neural networks (NN) and machine learning (ML) are described along with which countries are creating these techniques and how these are being used for COVID-19 or other disease diagnosis and detection. Illustrations of multi-layer convolutional neural networks (CNN), recurrent neural networks (RNN), and deep neural networks (DNN) are provided to show how these are used for COVID-19 or other disease detection and prediction. A summary of big data analytics for COVID-19 and some available COVID-19 open-source data sets and repositories and their characteristics for research and analysis is also provided. An example is also shown for artificial intelligence (AI) and neural network (NN) applications using real-time COVID-19 data.

KEYWORDS

Artificial Intelligence (AI), Convolutional Neural Networks (CNN), COVID-19, Deep Neural Networks (DNN), Infectious Diseases, Machine Learning, Neural Networks

BACKGROUND

Infectious diseases are illnesses caused by harmful organisms (pathogens) that get into human body from the outside. The most common pathogens that causes infectious diseases are viruses, bacteria, fungi, and parasites. Humans can get infectious diseases from other people, bug bites and contaminated food, water or soil.

Corona Virus Disease 2019 (COVID-19) is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first case was identified in Wuhan, China, in December 2019. It has since spread worldwide, leading to an ongoing pandemic (World Health Organization, 2020).

European Centre for Disease Prevention and Control (ECDC) (2021) has been posting weekly open-source COVID-19 related datasets for free download that includes data on hospital and ICI

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admission rates and current occupancy for COVID-19, and data on testing for COVID-19 by week and country.

The Office of Data Science Strategy (ODSS) of National Institute of Health (NIH) (2020) has made available open-access data and computational resources to address COVID-19 that includes CAS (Chemical Abstract Service) COVID-19 antiviral candidate compounds dataset of nearly 50,000 chemical substances for use in applications including research, data mining, machine learning, and analytics. CAS is a division of American Chemical Society (ACS).

Artificial Intelligence (AI) has been used in medical imaging as decision-making support systems for lesion detection and segmentation as discussed by Calisto et al. (2022). AI techniques have been used for diagnosis of COVID-19 include AI-empowered medical image acquisition, segmentation, diagnosis and follow-up. Many investigators have used different image segmentation methods in COVID-19 applications (Shi et al., 2020).

Recent extensive studies have been presented in several books with detailed COVID-19 related studies of applications of artificial intelligence used for creating predictive models for decision making in this pandemic and include those of Abdelrahman (2020), Bandyopadhyay and Dutta (2020), Hassaniem et al. (2020), Santosh and Joshi (2021), Zhang (2020), Al-Turjan et al. (2021), Marques et al. (2021), and Raza (2021). Further discussions of these extensive studies are presented in this article.

MACHINE LEARNING AND COVID-19

Machine learning (ML) is based on the premise that an intelligent machine should be able to learn and adapt from its environment based on its experiences without being explicitly programmed. The availability of open-source data sets with COVID-19 data allows the experimentation of using machine learning techniques and deep neural networks for the prediction and diagnosis of COVID-19 using Computed Tomography (CT) scans and x-rays. CT scans show detailed images of any part of the body, including the bones, muscles, fat, organs and blood vessels.

Shuja et al. (2020) provided a comprehensive survey of open-source data sets that included categories of biomedical images, textual, and speech data. As COVID-19 test kits are in short supply, medical image-based diagnosis provides an alternative method of COVID-19 diagnosis. According to Shuja et al. (2020), the combination of artificial intelligence (AI) and open-source data sets practical solution for COVID-19 diagnosis that can be implemented in hospitals worldwide.

According to the World Health Organization (WHO) (2020) some of the leading hospitals across the world are utilizing artificial intelligence and machine learning algorithms to diagnose COVID-19 cases using Computed Tomography (CT) scans and X-ray images.

Rao and Vazquez (2020) showed that identification of COVID-19 can be quicker through artificial intelligence framework with use of machine learning algorithm when used with a mobile phone-based survey when cities and towns are under quarantine.

Bandyopadhyay and Dutta (2020) provided a validation of COVID-19 by Machine Learning approach using performance metrics of accuracy and Root-Mean Square-Error (RMSE) using a Recurrent Neural Network method.

Zoabi et al. (2021) created a model that predicted COVID-19 test results with high accuracy using only eight binary features: sex, age ≥ 60 years, known contact with an infected individual, and the appearance of five initial clinical symptoms. Zoabi et al. (2021) indicate that their framework of can be used, among other considerations, to prioritize testing for COVID-19 when testing resources are limited.

NEURAL NETWORKS AND COVID-19

Pham (2020) presented a comprehensive study on classification of COVID-19 on computed tomography with pretrained convolutional neural networks (CNN). Pham (2020) found that using

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