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Artificial Intelligence Techniques for COVID-19

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Abstract

COVID-19 pandemic is considered the most subsequent global disaster. Imaging technologies like computed tomography (CT) scan and X radiations (x-rays) play an important role in handling coronavirus but these technologies alone are not sufficient. Artificial intelligence (AI) strengthened the imaging application and assisted the medical staff. AI-based convolution neural networks can be used for the assessment of coronavirus infection. Several kinds of machine learning and deep learning algorithms are used for the diagnosis of COVID-19. The major benefit of the AI-based approach is acceleration in diagnostic and treatment procedures. Artificial intelligence has an important role in the detection of a huge number of cases. By combining data of the imaging model with that of laboratory outcomes, screening and detection efficiency for COVID-19 are enhanced. AI help in the fusion of data obtained from different sources for precise and effective diagnosis. Due to increased computational ability, AI is capable of handling a huge quantity of data. AI also predicts that if this virus will influence the future generation by the analysis of previously collected data. The technology of AI proved beneficial in the formulation of COVID-19 vaccine.

Keywords: COVID-19, pandemic, computed tomography (CT) scan, X radiations (x-rays), Artificial intelligence (AI)

Full length article **Corresponding Author*, e-mail: fatmauaf@yahoo.com

1. Introduction

COVID-2019 is an infection of the respiratory tract induced due to a recent coronavirus referred as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), originated in December 2019 and quickly evolved in the whole world [1]. Critically suffered people with COVID-19 reported a significant death rate. The usual clinical properties of COVID-19 patients include respiratory symptoms, less white blood cell count, fever and pneumonia [2, 3]. Nevertheless, responsiveness of RT-PCR is comparably low [4]. According to the clinician's report, this technique has decreased positive reports in the initial phases of illness. So SARS-CoV-2 virus cannot be completely removed, despite the negative RT-PCR outcomes [5]. Moreover, during an interval of 6-48 hours for the verification of the SARS-CoV-2 through RT-PCR, patients may disseminate the virus among caregivers and other patients [6]. The x-rays technology is initial method to detect COVID-19 with benefit of cheap and less dangerous to human health [7]. Radiologists must carefully identify patches of white color carrying water and pus that are extremely problematic and takes time. Additionally, the expert doctor or radiologist may also accidentally detect other disorders like pulmonary tuberculosis as COVID-19 [8]. The error rate is high in x-rays technology; consequently, a Computed tomography (CT) scan could be used for a more effective diagnosis [9]. Nonetheless, these CT scans are costly as compared to X-rays for people [10]. Artificial intelligence (AI) has been employed in medicine and generated a lot of studies for the detection of several diseases like breast cancer detected from mammographic images and diagnosis of brain tumors from magnetic resonance (MR) images [11]. Artificial technology is a breakthrough technique that uses computerized algorithms to analyze complex data. The most significant medical feature of artificial intelligence is to define images as part of diagnosis. Diagnosis with the help of a computer system has revealed great specificity, precision and sensitivity for the identification of minor radiographic problems, with the capability of enhancing public health [12]. AI promises to increase tissue-based evaluation and characterization [13]. Due to its success in the field of disease diagnosis, epidemiology, treatment, and drug discovery, it is assumed that AI could be a promising technology to deal with the challenges, mankind is confronting recently [14]. It is declared that AI facilitates academic and medical research of COVID-19 and upcoming crisis [15]. On the outbreak, a set of measures were adopted by China against the proliferation of coronavirus, using AI-based technologies [16].

The data of people suffering from COVID-19 can be collected and evaluated by new algorithms like machine learning (ML) to get an understanding of viral transmission,

later enhance diagnostic efficiency and accuracy, to develop new effective clinical perspectives and to recognize the susceptible people through several genetic as well as physiological properties. Deep Learning (DL) and ML are a set of artificial intelligence areas comprising of numerous algorithms which supply brilliant models for recognition of significant projects. A subdivision of AI is ML that is involved in modeling the culture of many demographic models [17]. ML has been utilized extensively in the categorization of COVID-19 genome, survival estimation of high-risk covid-19 patients, CRISPR-based identification assay, and developing possible drugs against covid-19. One subset of ML is DL in which structural Neural Network (NN) models are developed for better learning of various algorithms of back propagation and feed-forward. From previously two decades, DL is surpassed in different activities. Some of the exceptional cases of DL do not require such a massive data for training. Deep Convolution Neural Networks, Deep Belief Networks, and Deep Neural Networks are included in DL algorithms. Admiringly, by working in military sectors, medical and technological areas brought out novel AI-based DL and ML procedures (Fig. 1) in the tough time of COVID-19. DL and ML assist in COVID-19 detection and provision of asymptomatic diagnostic procedures for keeping medical personnel away from affecting pathogens [18].

2. Use of Machine Learning Models for Covid-19 Prediction

ML offers support to develop objective, automatic and complicated algorithmic techniques to analyze mathematical or biomedical and multi-mode data. ML has already displayed capability for containing, diagnosing, therapeutic tracking and detection of several ailments [19]. This technique can be classified as: Supervised learning procedures initiates with a database training procedure and generates a specific method to analyze output values. The methodologies are capable of providing results from inserted information with complete training procedure, differentiate outcomes with real results, assumptions and adjust the model relative to the findings [20]. Unsupervised learning techniques are utilized when data is not labeled or classified [21]. The technique deduces a method to obtain hidden patterns or information from the un-classified dataset. Semi-supervised learning is in the middle of supervised and unsupervised learning strategies, in which both classified and un-classified datasets are utilized for the training method. It techniques examine smaller classified data and larger un-classified data [22, 23]. Reinforcement learning technologies are linked with the learning environment through action in recognizing mistakes [22]. The machine learning procedure initiates with collecting data independently i.e. from several resources. ML algorithms are structured by utilizing other concepts like theory control, probability and statistics, etc. in order to evaluate data and obtain novel and interesting information or invisible pattern from previous experiences [24]. This leads to the optimization of the model ameliorating the latest data records and rules [25].

2.1. Supervised ML algorithm

ML systems are employed to construct forecasting simulations of COVID-19 infection through a classified data record. The general models (table 1) include artificial neural network (ANN), naïve Bayes, decision tree, logistic regression and support vector machine [26]. Naïve Bayes algorithm is engaged in labeling training functions when data records are distinguished on the basis of particular features [27]. In decision tree algorithm, to eliminate extra information from the data record, the pruning procedure is utilized [21]. This algorithm has been utilized as among the most efficient algorithm because of its expertise in dealing with all kinds of data, understandings and simplicity [28]. Logistic regression algorithm is employed to classify ML roles in which the dependent and independent characteristics are computed. The algorithm is utilized when dependent characteristics have double values like 0 or 1, no or yes, right or wrong and negative or positive [29]. ANN mimics tasks of the human brain and is recognized as nodes, technically called the artificial neurons. The neurons interconnect and transfer data in different forms and every neuron has a particular mass specified for it, which represents its roles and tasks [30]. The assembly of an ANN has many layers that receive data, give input, classify or extract information. Every layer performs a task to transfer data to obtain the optimum results. The critical functions of triggering and transfer are carried out by neurons [24]. Support vector machine (SVM) is basically an algorithm which is used to categorize learning regression projects. Database points are depicted in support vector, are separated into various plots and assembled with common assemblies of the common groups [31].

3. Deep Learning Algorithms for COVID-19 detection

Among two remarkable branches of artificial intelligence, DL is fundamentally the latest version of conventional ML. DL architecture (Fig. 2) are generative adversarial networks, Auto-encoders, convolutional neural networks, recurrent neural networks, and hybrid networks like convolutional neural network-Auto-encoder (CNN-AE) and convolutional neural network- recurrent neural network (CNN-RNN) [11]. Several DL methods for Covid-19 diagnosis are presented. These include 2 dimensional convolutions neural network (2D CNN) and visual geometry group (VGG).

3.1. Two Dimensional Convolution Neural Network (2D-CNN)

Over-fitting resulted from gap is a major problem while operating DL models due to the reduced quantity of samples and increased quantity of learning parameters. To mimic this problem convolutional system is used. This model uses the 2D image as input thus minimizing the process of preprocessing. Utilization of differentiated tasks for transforming volume between layers happens in convolutional neural network (Fig 3). The output is generated by the combination of convolutional and pooling layers and then transferred to connected layers. Other methods like batch and dropout are more helpful for greater learning [32].

Table 1: Machine learning models - performance analysis

	Accuracy	Specificity	Sensitivity
Decision Tree	High	Moderate	Moderate
Logistic Regression	High	Low	Low
Nave Bayes	High	High	Very Low
Support Vector	Moderate	Very Low	High
Artificial Neural Network	Low	Low	High

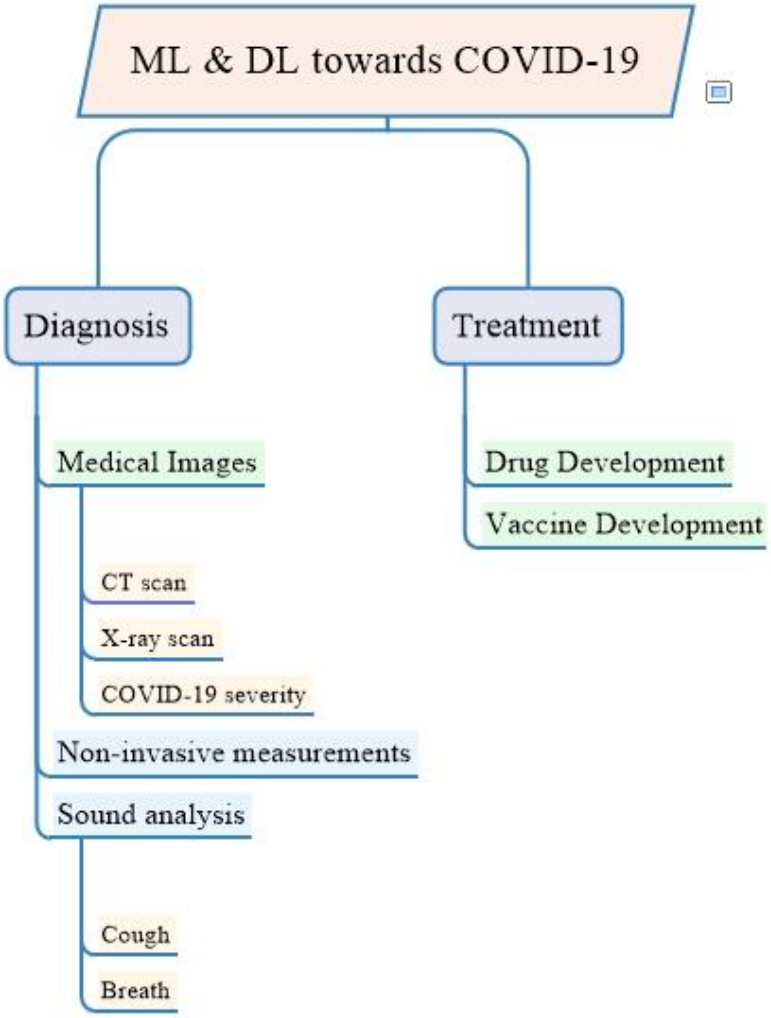

Figure 1: A taxonomy on survey of Deep Learning (DL) and Machine Learning (ML) research studies related to COVID-19 detection and treatment.

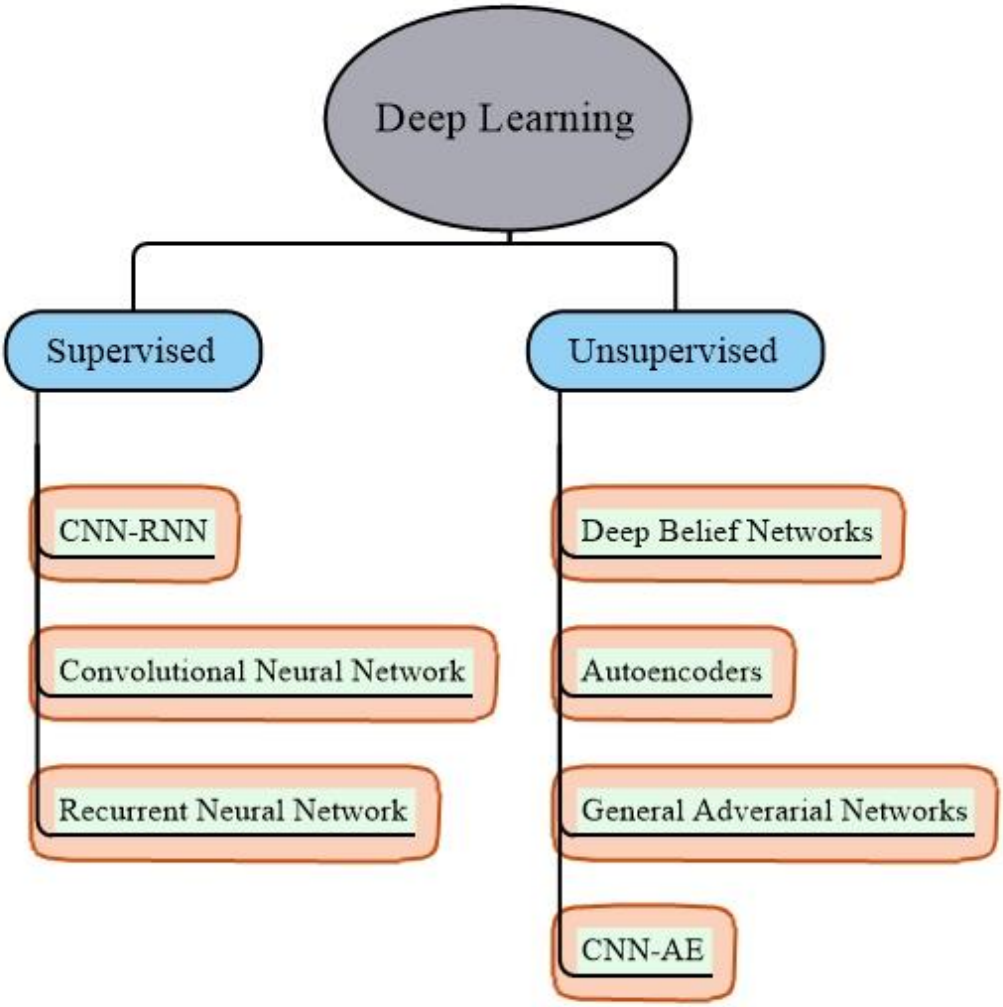

Figure 2: Illustration of several DL methods employed for COVID-19 detection

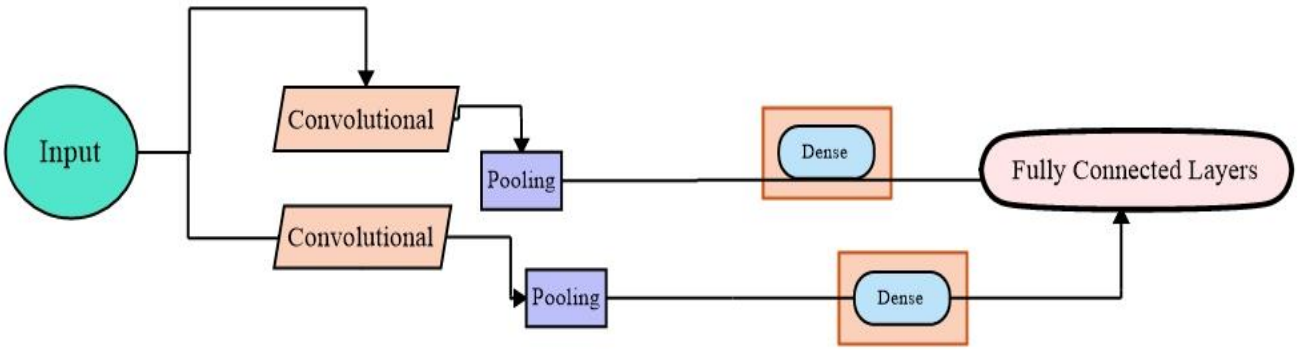

Figure 3: Conventional 2D-CNN construction required for COVID-19 detection

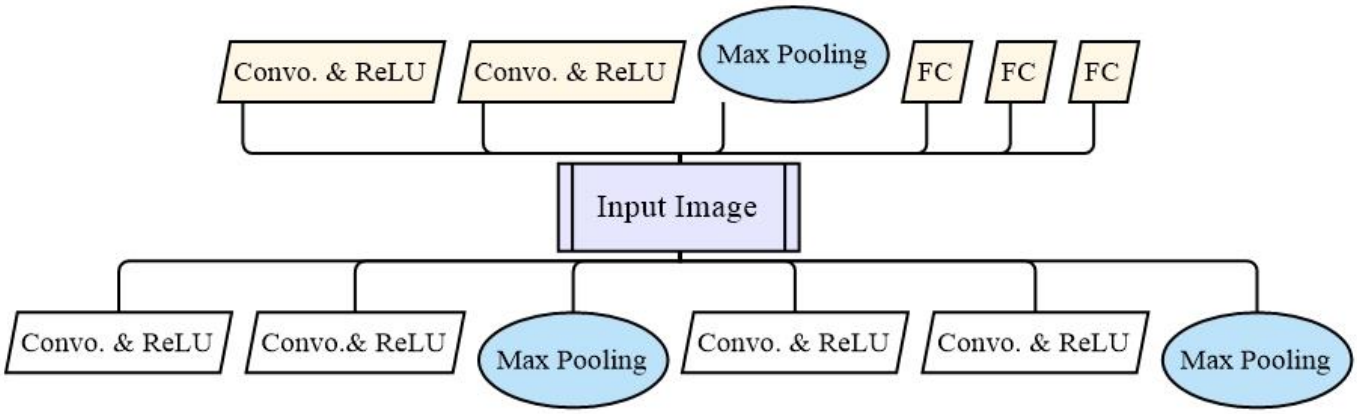

Figure 4: Building blocks of VGG architecture for COVID-19 detection

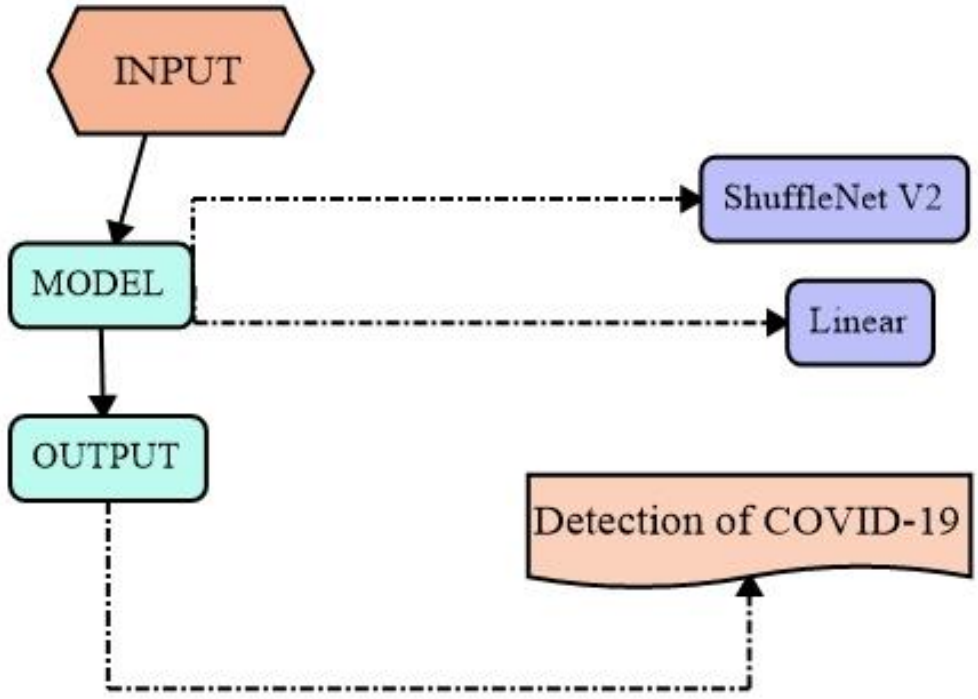

Figure 5: A common form of Shuffle Net for COVID-19 detection

3.2. Visual Geometry Group (VGG) Net

It is composed of very few convolutional layers, utilizing the rectified linear activation function (ReLU). Softmax classifier gives the final layer for classification. There are three versions of VGG-E known as VGG-11, VGG-16, and VGG-19. All of these consist of 3 FC layers but there are several conventional layers like 13 in VGG-16, 8 in VGG-11 and 16 layers in VGG-19 (Fig. 4) [33].

3.3. Shuffle Net

Formulation of this model is especially for those devices having less figuring power [34]. This design performs two major functions, like maintaining the efficiency of the network along with it reducing the figuring cost. This model is composed of pooling and convolutional layers, a pyramid of entity of shuffle net, and an FC layer (Fig. 5). It beats Mobile Net despite its limitation for only meager models [15].

Conclusions:

COVID-19 disorder has expanded all over the globe. Medical imaging technologies are playing a crucial role to fight with COVID-19 pandemic. Current review analyzed the accuracy, safety, and efficiency of AI to deal with COVID-19 disorder. AI is used for the detection of coronavirus at early stages and further surveillance of infected individuals. Multiple kinds of algorithms are used in AI for improving the treatment constancy. Imaging programs and diagnosis are evaluated which sums up the entire applications of AI for COVID-19. Imaging models like CT scans and x-rays demonstrated the efficacy of AI. In the future, analysis based on these models will be used for different organs infected by viruses due to their specialties in COVID-19. Analysis based on solution orientation will be carried out using AI. This would assist physicians and radiologists to know well about coronavirus so that in the future examination of x-ray and CT scan images will be much effective.

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