

# A Review on Effectiveness of Artificial Intelligence Techniques in the Detection of COVID-19

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**Abstract**—The Corona virus Disease 2019 (COVID-19) is an epidemic and life threatening disease that has an abundant influence on the public health of people all around the world affecting their normal day to day life. The medical monitoring of the infected patients reveals various symptoms that can be analysed, classified and the output can help the physicians to treat the new cases. In this paper we have done an extensive research of the various Machine Learning(ML) and Deep Learning (DL) algorithms employed by the researchers and health workers over the COVID-19 data obtained from the affected patients in the classification of the disease. This extensive analysis will help the future analysts to consider the effective technique that can provide them faster results during both the phases of training and inference. We have given a comparative analysis of the various ML/DL techniques employed for COVID-19 and its remarks.

**Keywords:** COVID-19, Machine Learning, Deep Learning, Epidemic

## I. INTRODUCTION

The outbreak of Covid-19 has begun in 2019, December. This was initially named as 2019 Novel corona virus[1], as this disease was found to be caused by virus from the family of corona. The first case of the infection of this Sars-cov-2 virus has been reported in Wuhan city, China [2]. This has been announced as a pandemic in March 11, 2020 by World Health Organization[3]. As of August 28, 2020, the number of patients affected by covid-19 worldwide are 24,920,024. The death rate of patients is 841,486 and 17,303,818 patients has been recovered from the infection [4]. The symptoms of this infection may vary from fever, dry cough to, lack of smell and taste, shortness of breath[5]. It is advised to seek medical attention when any of these symptoms occur. For the diagnosis of this corona infection, RT-PCR(reverse transcription polymerase chain reaction) kit is used widely across the country. Different types of tests are available for detecting corona virus infection. They are swab test, nasal aspirate, tracheal aspirate, etc[6]. The process of diagnosing covid-19 using this rt-pcr kit is a tiresome one. It may take from hours to days to get the result of the tests[7]. This long duration of diagnosing period leads to the rapid spread of

the infection. This corona virus is easily prone to change their genetic properties[8], which emerges as a new form of virus. As a result, developing a vaccine for this covid-19 has become a challenge. Many organizations from different countries has been involved in the process of developing the vaccine for corona virus. As of august 2020, nearly 200 covid-19 vaccines are in the processes. Even though the RT-PCR is assumed as golden standard for diagnosing covid-19, it also has the possibility of producing negative results [9]. Hence, there arises a necessity to develop a new technique that gives more accuracy in diagnosing the disease. Since this is a new pandemic, there will be a limited amount of dataset for research. So, besides exploiting the available patient's data, we can also make use of the chest X-rays and the chest CT images of the patients. Deep Learning has been considered as the best technique for processing medical images and also for developing a new diagnosing method from the CT images of the affected patients. Different techniques are being proposed based on the usage of deep learning for diagnosing the covid-19 infection within the short span of time, which in turn reduces the spreading rate of the infection.. In the diagnosing process of covid-19, differentiating the community acquired pneumonia from the corona virus infection plays a major role. In order to reveal the exact difference between the CAP and Covid-19, several techniques has been introduced such as dual sampling attention network[10] [11], which aims at categorizing the infection based on the presence of pneumonia. For automatically segmenting the infection regions from the CT images[12], inf-net technique[13] has been discussed. Another method employs structured representation learning[14], which improves the computer aided methods of diagnosing. Improved marine predator algorithms are used [15][16] for segmenting the medical images. To overcome the unavailability of large amount of dataset, transfer learning techniques which includes adversarial network has been employed[17], to generate synthetic datasets and also merges the structured data with unstructured[18], which helps in diagnosing the disease with more accuracy. Deep Transfer Learning methods are

also employed to develop a new diagnosing method for covid-19 [19]-[21]. With the application of convolutional neural networks, many methods has been suggested to detect the presence of corona virus infection from the chest CT images and chest X-rays [22][25]-[27]. Supervised Learning technique has been used, which aims at reducing the negative results produced by RT-PCR diagnosing method and the labelling required manually and to raise the effectiveness of the diagnosing process[9][28][29]. The use of data science in diagnosing the disease has also been suggested[30]. In order to deal with unbalanced datasets, an activation function has been introduced [31] and included in the process of diagnosing the disease. Methods has been proposed to predict and forecast the number of patients that can be affected within a particular span of time [32][33]. Though many methods has been proposed for diagnosing covid-19 with more accuracy, each method may has its own drawbacks which should be overcome by new techniques.

## II. DIFFERENT TECHNIQUES FOR DIAGNOSING COVID-19

### A. Differentiating COVID-19 and CAP

A system for detecting covid-19 at the early stage [10] has been suggested which also diagnoses covid from community acquired pneumonia. In order to lighten the imbalanced distribution of the affected regions in the chest CT between covid and CAP, a dual sampling attention network is proposed. For training-validation, 1588 patient's medical data which includes 2186 CT scans are collected and 5-fold cross-validation is done..For the testing evaluation, another set of testing dataset including 2057 patients with 2796 scans were employed. Attention of the deep learning model has been refined to improve the focus on the infected regions and also increases the classification performance. A VB-Net toolkit is established to segment the infected regions of the lungs automatically. This system obtained accuracy, sensitivity and specificity of 87.5%, 86.9%,90.1% respectively. However, the probability of identifying covid as CAP is more and it should be eliminated by training more datasets.

In a framework for automatically classifying the pneumonia lesions [11] from covid-19, a noise robust method is proposed to segment the CAP lesions from the CT scans. The aim of this system is to learn from the noisy labels for the segmentation purpose. In this, a novel Lesion classifying network has been proposed to efficiently deal with the sores with many measures and surfaces. A dataset containing examined image of 558 victims, having pneumonia and corona virus infection has been used. The proposed function is independent on a certain CNN and it can be merged with various training schemes. It has been proved that the proposed methodology achieves more rightness than the other image classifying networks. However, the performance of the system may degrade with

the increase in the noise of the labels, as it requires more pre processing of the labels.

An Inf- Net based automatic covid infection segmentation from CT images has been proposed by Deng-Ping Fan, et al[13]. The aim of this system is to segment the affected parts from the CT slices. It also deals with the problem of gathering large amount of data within the short span of time. For this, a semi supervised method has been established, which only requires less number of labelled images and also exploit the available unlabelled images. In this Inf-Net, a decoder has been employed to cluster the high-level characteristics and create a universal map. Then, the inferred reverse attention and explicit edge-attention are used to model the contours and improve the representations. This system focus on classification of corona virus infected regions in the lungs, but in practical it requires to classify the covid patients before segmenting the affected regions.

An approach for diagnosing Covid-19 by employing Structured Representation Learning[14] has been suggested, which aims at minimizing the requirement of the physicians and improving the rate of diagnosis of Covid-19 and Community Acquired Pneumonia(CAP). Here, in order to explore the features of a CT scan image, a novel latent depiction is proposed, which can encrypt the data from variety of exposures of the features. For each type of feature, a neural network is created which ensures the completeness of the system. In this, all images are pre processed using a V-Net model, in which after the segmentation of the infected regions, 189 features were extracted from each CT image. This system obtained an exactness of 95.5%. Here, the inclusion of patient's clinical data can help in improved performance of the system.

### B. Marine Predator Algorithm

An improved marine predators algorithm [15]has been used for segmenting corona infected regions from the CT scan images. Here, a fuzzy thresholding technique has been employed, which is the combination of two swarm intelligence methods. The MLT method is considered for segmenting the images. To evaluate the progression of MPAMFO, two types of trials were conducted, one based on natural grey scale images and another one considering the Covid-19 CT images. This MPAMFO can be improved as a multipurpose image classification method, which may help in improving the system's overall efficiency.

### C. Generative Adversarial Network

Abdul Waheed, et al [17] proposed a data augmentation method using auxiliary classifier GAN. This paper aims to be an answer for requirement of large amount of input data for convolutional neural network. Here, the CNN is used to find the corona virus disease using the chest radiograph, but to compensate with the huge requirement of training data, Adversarial Network rooted system known as CovidGAN is employed. This model creates a synthetic X-ray of the

chest, which when fed as input to the CNN, produces an efficiency of 95%. However, cross-centre validations should be conducted and the quality of the synthetic data should be improved to obtain correct results.

Mohammad (Behdad) Jamshidi, et al [18] proposed a deep learning based methodology for detecting the presence of corona virus infection. Deep Learning methods such as Generative Adversarial Networks (GANs), etc., has been employed in this system, which integrates the sources of data from structured and unstructured form. It also helps in rapid diagnosis, which further helps for better treatment. However, this system deals with less number of data. The number of data taken into consideration should be increased which helps in improving the efficiency of the system.

#### *D. Implementation of Deep Transfer Learning*

An automatic detection system for covid-19 has been suggested[19], that uses deep transfer learning. In this, chest X-rays of the patients have been used for training the system, because some radiological signatures of covid patients will be revealed in the X-rays which enables easy diagnosis of the infection. Deep learning approaches are used for automatic diagnosis, as this approach can efficiently train the large datasets as well as small datasets. In order to produce a fully unmanned diagnosing system, the Xception model of CNN has been employed. In this, 70% of the total dataset has been used for training the system, which includes the datasets of corona virus infection positive patients, pneumonia confirmed but covid negative patients and other infection patients. This system obtained an accuracy of 97%, which is the highest when compared with other models such as SVM, random forest etc. However, in order to improve the quality of chest X-ray images, pre- processing techniques such as gain gradient filter should be employed.

A classification model for covid-19 infected patients has been discussed by Y.Pathak,et al,[20] which employs the deep transfer learning technique. Here, the chest CT images has been used to classify the corona virus infected patients from others. Since, forecasting the bilateral changes from the Chest Computed Tomography is difficult, transfer learning technique is used. Besides, in order to deal with highly unbalanced and fuzzy data, a top-2 smooth loss function is used. Also, an activation function called Softmax is used. This system uses 413 corona infected patients data and 439 pneumonia affected patients data. In this, an accuracy of 96% is obtained in training and 93% is obtained while testing the data. However, a detailed representation of the proposed system should have been provided for better understanding of the system. The use of Transfer Learning and Model Integration [21] concepts of deep learning in diagnosing Covid-19 amplifies the available small amount of dataset regarding covid-19 and uses the models ResNet-101 and ResNet-152 for the fusion of the data. Here, the chest X-ray, which is given as input

is segmented as normal, pneumonia or covid-19, after the process of diagnosing. This system achieves an efficiency of 96.1% but still large and real datasets can be used in order to shoot up the efficiency of the system. A method for automatic detection of covid-19 has been proposed[22], which employs the transfer learning technique in diagnosing the presence of corona virus infection. This system aims to validating the efficiency of the systems proposed for image classification in medicine field over the years. Here, two datasets are used, which contains radiograph of corona infection confirmed victims, pneumonia affected victims and patients under normal conditions. This system obtained an accuracy of 96.78%. However, for detailed analysis, more number of corona affected patient's dataset is required, which when used may improve the efficiency of the system.

Subhankar Roy, et al [23] discussed a method for classification of covid-19 markers from lung ultrasound images. Here, a fully explained lung ultrasound dataset has been used. In this, a new network which is obtained from transmuter networks has been proposed, which forecasts the intensity of the disease according to the input given and also provides localizations of the infected regions in a weakly supervised way simultaneously. However, for learning deep accurate models, this system requires the dataset to be larger, heterogeneous and more balanced. Also, here the dataset used were limited, all of them were collected from few hospitals located in Italy.

Yadunath Pathak, et al [24] proposed a grouping model for covid-19 affected patients. It is difficult to classify patients. Besides, in order to address the limitations of the existing classification methods such as HOG and SVM, here a dual direction LSTM network is proposed, along with the density model network. Also, another procedure is used to adjust the parameters of DBM network. This system obtained an accuracy of 96%. However, this system has been validated on only two benchmarking datasets. When the number of validating datasets increase, the performance of the system may degrade.

#### *E. Convolutional Neural Network*

An approach for the application of deep learning method in managing the covid-19 has been proposed[25]. This system utilizes the CT images of the patients and employs ten different convolutional neural networks in order to differentiate between covid and non- covid patients. For this, CT images of the 108 patients having confirmed corona virus infection and the CT images of 86 patients with other infections including pneumonia has been used. Here, CNNs such as GoogleNet, ResNet-101, Xception, etc were used to find the difference between covid and non-covid infections. As a result of this system, the CNN- ResNet-101 has been defined as high sensitive network for diagnosing corona virus infections. Residual Learning is used for training this Res- Net-101. In this, even though the Xception Convolutional Neural Network has more efficiency, it has

a disadvantage of having less sensitivity than Res-Net-101. The main limitation of this system is the performance of this system is not matched with the performance of the radiologists and also, patients with negative RT-PCR result for covid-19 has been excluded.

A contemporary model for sensing Covid-19 has been suggested [26], which is based on Bayesian Optimization. Here, a Convolutional Neural Network has been used to extract the differentiating features of the chest X-ray images. These features were given as input to algorithms such as SVM, decision tree and k-nn. Bayesian optimisation procedure is applied to enhance the parameters of the used machine learning algorithms. In this, Public radiology datasets of covid-19 has been used for training and testing the network. Here, the SVM algorithm has obtained an accuracy of 98%. Also, the proposed CNN obtained an accuracy of 97%. However, when more number of datasets are used to increase the system's efficiency, the calculation time of the system may differ.

An hybrid model for sensing corona infection has been discussed [27]. This system employs 2D curvelet transform for recognizing the corona affected patients. The chest X-ray image obtained from the patients is given as input to the 2D curvelet transformation algorithm and the coefficients are obtained. Using those coefficients, feature matrix is constructed. Also, the coefficients are enhanced using the Chaotic Salp Swarm Algorithm (CSSA). One of the Deep Learning networks called EfficientNet-B0 model is employed to detect the presence of corona virus infection in the chest X-ray of the patient. Here, 2905 chest X-rays are used for training, which comprises of 1341 images of normal person, 219 images of corona confirmed patients and 1345 images of the pneumonia affected patients. For testing, a total of 581 images are used. This system obtained an accuracy of 99.69%, with low calculation cost and high robustness.

#### F. Weakly Supervised Techniques

Zhongyi Han, et al [28] suggested a method for screening covid-19 accurately. In this, a novel technique of instance learning is used for diagnosing covid-19 with less labels. Here, a weakly supervised learning concept is proposed that combines the attention framework and the instance learning. A small 3D cubes can be interpreted from the 3D chest images, which is considered as a cluster of instances by AD3D-MIL. This system achieves an accuracy of 97.9%, but here one label is assigned to a group of instances. So there is a possibility of the label to be wrong, which degrades the performance of the system.

Shoaping Hu, et al [9] discussed a supervised deep learning concept for the detection of covid-19 from the CT images. This has been proposed as an alternative for RT-PCR, which is considered as a standard for diagnosis, that may also produce false negative results while diagnosing covid-19. This system aims at reducing the need for

manual labelling of the CT images and also improves the accuracy of the diagnosis and also distinguishes between Covid and non Covid diseases. In this system, performance evaluation for each particular task was done with 5-fold-cross-validation and it employs five validating metrics, which are accuracy (ACC), sensitivity (SEN), etc., But this system is not distinct enough in differentiating Covid and CAP (Community Acquired Pneumonia).

Xing gang Wang, et al [29] proposed a deep learning based method for auto diagnosis of covid-19 using the weak labelled chest CT image of the patients. Here, the chest CT images were obtained from the patients, they are pre processed and given as input to the deep neural network, which predicts the presence of corona virus. For training, 499 volumes of chest CT were considered and for testing, 131 volumes were used. This system took around 1.93 seconds to complete the diagnosis process and has produced an accuracy of 0.901. It has a positive prediction value of 0.840 and the negative prediction value of 0.982. This method has an advantage of training the lung segmentation model using the unsupervised learning method. In experiments, the results of this system had been compared with different deep learning classifiers.

### III. CONCLUSION

Since COVID-19 is a great pandemic that threatens the entire world and health workers are struggling to identify the symptoms due to the varied symptoms shown by various infected patients, the use of technology can assist them in dealing the pandemic. It is observed that Artificial Intelligence plays a major role in various applications including medical field. This survey projects the applications of various Intelligence system techniques for the unearthing of new COVID instances. Many techniques such as multi view representation, marine predator algorithm, adversarial networks, transfer learning methods has been used to find the presence of corona virus infection. All these AI based techniques has its own limitations such as not differentiating the covid lesion from pneumonia lesions, lack of more corona infected patient's datasets, low quality of the available datasets, unavailable of the clinical data of the patients etc. All these constraints has to be defeated or cleared in order to increase the effectiveness of diagnosis of the infection. The overall review of the various techniques applied has been presented to the future data analysts. Using this, the drawbacks of the currently used techniques can be easily found, which can be useful in developing an irreproachable method for diagnosing the corona virus infection within a less amount of time, that saves the life of many people.

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