REVIEW OF COVID-19 DETECTION USING CHEST X-RAY IMAGES

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ABSTRACT

Covid-19 is a disease affecting the whole country concerning health-related problems. Today approximately around thirty lakh people have died due to this disease worldwide. The majority of people have died because fast and efficient detection techniques of covid-19 were not present. Because of late finding of covid-19 in patients, proper treatment was not possible. The majority of the studies suggest that this disease infects the lungs primarily and the infection caused due to the virus could spread in the lungs results in a lack of oxygen in the blood. For prediction of infection in the lungs, X-ray images and CT scans are mainly used. However, CT scans are expensive and not so easily accessible to every individual in this world. But X-rays are less costly and widely accessible around the world. Deep learning and artificial intelligence are integral components of machine learning methods for classifying images, text, and other types of objects into different categories and classes. Deep learning provides features like feature extraction in images and classifying them into categorical form. It takes input as a dataset of images which will be processed in a way that the common feature in all images could be used to predict the presence of a feature in the testing dataset. After data cleaning and pre-processing of images, the CNN model is implemented to train the dataset and evaluate the prediction. Further in this paper we have mentioned different strategies and methods to implement prediction of covid-19. We reviewed 44 research papers related to Covid-19 to evaluate the conclusion with references in this field of work.

KEYWORDS Covid-19. ResNet 18. ResNet 50. Chest X-ray images. CNN. Deep Neural Network

1. INTRODUCTION

Covid-19 has proven to be one of the most severe diseases with viruses mutating every two to three months. Viruses (like MERS, SARS, Flu, etc.) in the earlier time interval [2, 3] came into the picture, the viruses only existed for acute time intervals [4]. Today around the world, scientists and researchers from every country are participating in diagnosing Covid-19 with the information available on the development of vaccines. In the current situation, when the entire world is suffering from this pandemic [5], the development of the vaccine is taking a lot more time than expected because of the unidentified behavior of the virus and its changing pattern with time. Methods such as plasma therapy and lung x-ray images are used for the predicition and prevention of Covid-19[6, 7], but a permanent solution to this disease is still not available for citizens of the world. With people dying every day due to this disease [8], and Covid-19 detection or testing cost is very high which is not affordable to every individual in this world and due to the large population in some countries, testing is becoming very difficult [9]. From March 2020, the dataset of Covid-19 infected and non-infected cases were available on platforms like Kaggle and GitHub [10] which can be further used to identify patterns in chest x-ray images and extract common features in all Covid-19 infected people. Covid-19 detection has become a priority in the whole world because of its serious threats to the human species affecting the lungs of people and damaging it to the extent that can cause death [11]. Throat infection and breathing problems became one of the common symptoms among all Covid-19 infected patients. The covid-19 disease is one of the most dangerous threats to the world impacting the world financially as well as medically. Covid-19 infected patients should be kept in isolation [12] where proper treatment could be provided keeping all safety measures in check, involvement of all medical staff is highly important for

contaminating the disease. The rate of transmission in Covid-19 disease [13] is very high resulting in a formation of a chain where every individual is infecting many other individuals, so to stop this transmission Covid-19 affected patients should be kept away from non-covid-19 patients. Medical imaging [14] is also a technique of finding and predicting the impact of Covid-19 on the human species. CT scans and x-ray image analysis [15, 16] could to performed for computing the classification of Covid-19 and Non-Covid-19 patients. Researches are reviewed and arguments are presented in this paper with our point of view and conclusion.

2. LITERATURE REVIEW

In [17], the author mentioned the usage of a deep neural networks framework for creating a capsule- based system called COVID-CAPS. This framework is made for working with a small dataset of chest x- ray images because of the sudden emergence of the Covid-19 virus and the presence of few dataset modules online at the time. For creating this model very few parameters were used for optimizing the accuracy of the model. In [18] author mentioned the public database that was created using other available databases and from articles that are published recently. Image augmentations were performed on the dataset to evaluate the classification into normal, covid-19 pneumonia, and normal pneumonia with help of pre-trained models used for validation and testing. In [19], the author mentioned three cases in Wuhan in the country of China where the first emergence of covid-19 was observed. In [20], the author mentioned shortcomings of the "RT-PCR" test which is utilized for testing the presence of coronavirus in the body. The author pointed out the low positivity rate of the RT-PCR test and focused on image processing techniques used for solving the classification problem. SoftMax activation function was used for classifying images and producing output as a probability distribution of output nodes. Then features extracted from the output of the SoftMax layer were sent to the classifier which then produces output with an accuracy of 98%. In [21], the authors presented a medical diagnosis of the covid-19 virus in the human body which included the study of symptoms like fever, throat infection, a stomach infection, and MERS.The author also mentioned the features extracted from the chest scan where different findings were observed. The author proposed the treatment of covid-19 with the use of chest x-ray images [22]. They built the CNN model and trained it on the collected dataset and achieved higher accuracy in terms of correctly detecting true and false covid-19 cases. In [23], the authors reviewed the emergence of covid-19 disease in Wuhan, China, and still unknown source of the virus. The author also mentioned viruses entering different countries because of people traveling through the air as the disease is highly transmittable from individual to individual. In [24], the importance of image segmentation is mentioned along with the image feature extraction in abnormal parts of the lungs. The author also emphasizes the importance of the quality of the image for analyzing all features that are not normal or healthy patients. Starting with the usage of SVM for classifying pneumothorax and eliminating all image background abnormalities and noise for ensuring good quality of the image. Feature extraction in images was implemented using the local binary pattern technique. In [25], the author describes different findings in covid-19 infected patients compared to normal patients using CT scans. These findings consisted of consolidative pulmonary opacities, bilateral pulmonary parenchymal ground- glass, and rounded morphology, and peripheral lung distribution. These findings were further used to classify Covid-19 patients from non-Covid-19 patients. In [26], the author used a dataset containing chest x-ray images with the frontal view with 123 parameters. In [27], Covid-19 detection through deep learning algorithms is discussed by the author and reviews the process. In [28], the author implemented research on the impact of Covid-19 disease in the kidney and concluded that Covid-19 directly affects the kidney. In [29], research was established on 50 patients infected with Covid-19 and further divided them into good and bad groups based on the recovery rate of patients. It was observed that 50% of patients infected with Covid- 19 had a very bad recovery rate and had symptoms for a longer duration of time.57 days of ongoing symptoms were observed in some patients which were highest among the group. In [30], the total number of people

infected with Covid-19 and a total number of people who died from Covid-19 are mentioned. In [31], Vector gadget classifier which is a deep learning method to detect Covid-19 infected patients using chest x-ray images was used as a preliminary test for the virus. Multiple parameters were optimized for acquiring an accuracy of 97.48% through the deep learning method. In [32], In this paper author describes a new deep learning framework that can be used to classify and detect covid-19 patients with good accuracy and precision. The author implemented the COVIDX-NET model which will be tested on a dataset of 50 images where 25 images are true Covid-19 positive cases. After implementing this model, the author was able to get an accuracy between 89% to 91%. Further, in [33], the authors conversed about the impact of Covid-19 in 196 countries around the globe and proposed a solution as an artificial intelligence method that focuses on models used such as Googlnet, ResNet, and Inception. In [34], the authors state all limitations of using CT scans for detecting abnormalities in the lungs such as portability of CT scans, availability of CT scan centers, and cost of CT scan around the globe. The author suggests the use of an alternative CT scan which is CXR for easy detection of Covid-19. The author also mentions the relationship between pneumonia and Covid-19. Further, in [35], the role of artificial intelligence is examined for detecting Covid-19 with the help of a simple CNN model. Implementation of AlexNet which is a pre-trained model is used for classifying Covid-19 is initiated with an accuracy of 98% whereas accuracy with some changes and modification in the model is observed as 94.1%. In [36], the authors implemented a customized dataset with the use of two sub-patches with dimensions 16*16 and 32*32 by using 150 images dataset. Further, these patches were used for training the model, and a total of 3000 image patches were used.

Table 1 Dataset Distribution	Train	Tests
Healthy Person	1345	238
Covid-19	490	86
Infected Patient Pneumonia	3632	641
Infected Patient		

In [37], the authors raise concern over the lack of facility to detect covid-19 and projected models containing binary and multiclass classification techniques where binary classification included classification into Covid-19 and non-Covid-19 and multiclass classification included classification into Covid-19, non-Covid-19 and Pneumonia because pneumonia and Covid-19 are similar to some extent. Results obtained are 98.01% and 87.02% for binary and multiclass. In [38], the author emphasizes the performance of the RT-PCR test which is currently used for detecting Covid-19 disease, and alternative medical methods to diagnose this disease in the field of biological science. In [39], the study of the evolvement of Covid-19 throughout the time interval is described by the author. In [40], the author mentioned the most important concern of the virus mutating itself over some time and the presence of 4,300 strains around the globe, so early detection of the virus in the human body is very important to contain the disease from spreading throughout the world. Therefore, the author proposed a KE Sieve Neural Network model for detecting covid-19 without the usage of any instrument inside the human body. This model achieved an accuracy of 98.49% which is still very relevant for society. In [41], the mean age of Covdi-19 infected patients was calculated at a hospital in Rawalpindi with the percentage of symptoms affecting the patients. The study concluded with the mean age of patients as 44 years and symptoms of Covid-19 as cough with the highest percentage followed by fever and difficulty in breathing. Loss of smell and throat infection showed in minimal patients. In [42], the author describes

the importance of image classification in the field of medical sciences and implemented a CNN-based model for classifying diseases such as pneumonia. Three methods were used for classifying and compared to compute the best framework available for a small dataset. These three methods comprise SVM, VGG16, and InceptionV3. While performing these three experiments, the author observed that deep learning frameworks are better than SVM because of their better performance on small datasets. This comparison is very helpful for researchers working in this field as a sufficient dataset is not available every time. In [43], the author proposed a deep learning model where chest 100 x- ray images for detecting covid-19 and out of 100, 70 were recognized as true positive cases. The author also performed this model on 1431 chest x-ray images of pneumonia patients. The evaluated accuracy of the model is 96% for detecting Covid- 19 and 70.65% for non-Covid-19 cases. Lastly, in [44], the author proposed an interesting study on 101 Covid-19 patients and rolled out all symptoms and effects of Covid-19 on the human body. This study can be used for treating different symptoms with different medications available in the world.

3. DISCUSSION

Covid-19 disease caused a huge outbreak in the whole world today with an increasing number of cases on daily basis. With viruses mutating every minute and the lack of medical treatment facilities around the globe, the detection of Covid-19 has become very difficult and costly around the world. So, the detection of Covid-19 using chest X-ray images provides some advantages over other detection techniques because of its easy availability and cost-effective nature. However, Covid-19 cannot be detected with 100% accuracy by analysing chest x-ray images as it needs advanced medical diagnosis methods such as RT-PCR but it can be used as a preliminary test before RT-PCR. Individuals will not have to wait in queues for the Covid-19 test which causes more risk of spreading as they can be tested at home using this deep learning model and if any abnormalities in chest x- ray images are observed they can move forward with more advanced tests. Detection through deep learning will bring a systematic way of testing and keeping track of all covid-19 patients. As X-rays are easily available and less costly every individual can access the benefits of this detection technique. This approach can also be referred for the future in case we encounter a similar situation and hence can prevent the pandemic.

4. CONCLUSION

Covid-19 detection is needed around the globe urgently as a total of 220 countries are affected by this disease and over 3,370,000 deaths are reported till now. Late detection of Covid-19 is one of the main reasons for the high number of deaths worldwide. With the collaboration of medical experts and deep learning techniques, a proper model can be created for testing humans with the covid-19 disease. Pretrained models which performed accurately in previous researches such as the Xception model, Resnet model, and VGG16 model can be used to detect Covid-19 with some modifications such as hyperparameter tuning and image augmentation. Optimization of the model can lead to a more relevant and real-world solution for detecting any kind of lungs related disease. In the future, the advancement of machine learning and deep learning can lead to major changes in medical diagnosis methods and help build a better and disease-free world together.

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