CNN based Covıd -19 Pneumonıa Classıfıcatıon

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Abstract

The symptoms of COVID-19 pneumonia could resemble those of other viral pneumonia. As a result, it may challenging to determine the root of your disease without testing for COVID-19 or other respiratory infections. To ascertain the differences between COVID-19 pneumonia and other kinds of pneumonia. Since the COVID-19 pandemic broke out, researchers from all over the world have concentrated on leveraging artificial intelligence (AI) technology on different medical data of COVID-19-positive patients to identify or classify different elements of the disease, with promising reported findings. These research findings may aid in diagnosis and contribute to our growing understanding of how SARS-CoV-2 affects the lungs. We offer a Convolutional Neural Network based Covid-19 pneumonia classification using TensorFlow and Keras. The suggested technique is based on CNN and classifies Covid-19, normal, and pneumonia using images of pneumonia. If more feature extraction techniques are included to support the CNN method and correctly classify COVID-19&pneumonia, it is projected that the success of the results would grow. We have shown that applying deep CNN to photos can be effective and useful.

Keywords: — *C*ovid-19, pneumonia, deep learning, TensorFlow, CNN

1. Introduction

Since the 2019 coronavirus illness (COVID-19) outbreak began in December 2019, more than a million people have died globally as a result of COVID-19. In addition to causing fever, flu-like symptoms, cardiovascular harm, and pulmonary injury, COVID-19 can have an impact on various organ systems. Pneumonia is the primary symptom of COVID-19 at the time of initial presentation. Once they reach the severe illness stage, the fatality rate is about 60%. Since chest CTs are conducted for causes other than pulmonary symptoms as well, it may be possible to detect patients with COVID-19 using an automated technique that may opportunistically screen chest CTs for the disease. [1]. People are affected by COVID-19 in many different ways, but the most common symptoms are lethargy, dry cough, and fever. A rash on the skin, aches and pains, a sore throat, diarrhoea, conjunctivitis, headaches, loss of taste or smell, and a change in the colour of the fingers or toes are some of the less frequent symptoms .Infected individuals must be isolated in order to contain COVID-19 outbreaks; if an infected individual is not isolated, they may spread the disease to others. Using isolation or quarantine to contain a person effectively stops the virus from spreading. [2]. Magnetic resonance imaging (MRI) and computed tomography (CT) are also helpful. Due to their higher sensitivity than CXRs, CT images are currently the most useful imaging evaluation for diagnosing COVID-19- infected patients. However, hospitals only admit patients with serious issues, and there aren't many CT scan units available. Several machine learning (ML) methods can aid in the creation of CAD tools. Convolutional neural networks (CNNs) are among the best techniques currently available for computer vision (CV) tasks. Many techniques, including lesion segmentation, brain tumour segmentation, and automatic heart size estimation, have been applied in the medical field to help with CAD problems[3]. Machine learning is widely used in several fields, including malware detection, mobile malware diagnosis, healthcare, and data recovery. It keeps going up. Convolutional neural network (CNN)-based deep learning, an advanced ML structure, was developed in 2012. It succeeded in winning the most prestigious computer vision competition in the world for the classification of ImageNet. Deep learning methods enable data recognition in computer models composed of numerous processing layers on top of one another. They are particularly useful for those who specifically train a computer model to carry out classification tasks based on written or audible data. LeCun et al. claim that deep learning models have great precision and, in some situations, can result in better output[4].Real- time reverse transcription polymerase chain reaction (rRT- PCR) from a nasopharyngeal swab is currently the accepted method of diagnosis. Although current recommendations do not recommend using chest X-ray imaging for routine screening, it may be beneficial for diagnosis in cases where there is a strong suspicion of infection based on symptoms and risk factors[5]. To categorise the COVID-19 and Pneumonia and increase process accuracy, we are presenting a recognition framework based on the structured two-dimensional convolutional neural networks (CNNs) of Alex Net.

2. Related Work

Gengfei Ling.et.al. [6] Even experienced doctors might make mistakes when it comes to diagnosing pneumonia since different types of pneumonia can appear extremely similar on CT scans. The LDA-SVM (Linear Discriminate Analysis—Support Vector Machine) classification algorithm in the field of machine learning is introduced to address the issues of inefficiency, coarse granularity, and poor accuracy against the backdrop of enormous data. Images' characteristics are extracted using LDA, and the sub- datasets with robust fusion features are classified using an SVM classifier.

Xi Ouyang.et.al [7] We create a dual-sampling attention network to detect COVID-19 from community-acquired pneumonia (CAP) in chest computed tomography (CT). To focus on the infection regions in the lungs when making diagnoses, we particularly suggest a novel online attention module with a 3D convolutional neural network (CNN). Take note of the uneven distribution of the infection regions' sizes between COVID-19 and CAP, which is partly attributable to the quick progression of COVID-19 after the onset of symptoms. Therefore, in order to lessen the uneven learning, we created a dual- sampling technique. We gather 2186 CT scans from 1588 patients for a 5-fold cross-validation during the training- validation stage. During the testing phase, we use a different independent, sizable testing dataset that consists of 2796 CT scans from 2057 individuals.

Sing-Ling Jhuo.et.al [8] Information for adopting preventive measures for public health can be found in the trend prediction of influenza and its accompanying pneumonia. This study used a multilayer perceptron (MLP) to predict the number of influenza patients and the associated pneumonia by using meteorological and pollution characteristics, as well as the number of acute upper respiratory infection (AURI) outpatients. Temperature and relative humidity are used as meteorological data, while carbon monoxide (CO) and particulate matter 2.5 are used as air pollution parameters. Outpatients and inpatients are both included in the patient prediction. This report also includes assessments of regional data for various age groups. This research may lead to influenza preventative measures.

Masahiro Hayashitani.et.al [9] Based on the results of the method, medical staff offers preventative treatment in a field trial. We demonstrate that the study lessens the effort of the medical personnel and decreases the number of patients who get aspiration pneumonia. In order to lessen the workload associated with treating aspiration pneumonia, we suggested the prediction approach to the department of neurosurgery. Age, sex, and vital signs from electronic medical records are used in the prediction approach. In KIH, we presented the technique.

Mei-Jung Lyu.et.al [10] Alzheimer's patients must rely completely on high-quality care services to extend their lives because there is presently no cure for the condition. In addition, it has been discovered that the beginning of pneumonia can hasten the development of dementia and potentially result in death. The emotional stress experienced by carers as a result of this has escalated to an unacceptable level. In order to provide care for patients with Alzheimer's disease and lessen the challenges faced by carers, the goal of this study was to develop a Smart Dog music therapy and pneumonia detection system, which combines a robotic dog, cloud technology, a multi-agent system, an adaptive network- based fuzzy inference system (ANFIS), a web application, and sensor technology .Following the system's use, carers were questioned to ascertain its applicability in caregiving tasks and whether it enhanced their overall experience. Most of the carers who were surveyed felt that the system had improved things.

Qiuli Wang.et.al [11] One of the most important aspects of the pneumonia diagnosis process is pneumonia screening, which can increase radiologists' productivity and prevent treatments from being delayed. In this paper, we offer a deep regression framework that learns multi-channel pictures and multi-modal data simultaneously to imitate the clinical pneumonia screening process. They presented the framework's benefits in three different ways. The capacity to screen for serious infections such as pneumonia is improved by the visual features of multi- channel images, which can offer more visual features than a single image channel. Second, the suggested framework analyses chest CT scans using a recurrent convolutional neural network, which can automatically extract numerous image attributes from multi-channel image slices and interpret them as brief video frames. Third, primary grievances and demographic data can offer priceless prior knowledge that can enhance the features of photographs and further advance performance. In more than 900 clinical situations, the proposed paradigm has been thoroughly validated. The proposed framework noticeably raises sensitivity by 3.1% while increasing accuracy by 2.3% over the baseline.

Irin Sherly et al., [27] proposed ECG signal quality improvement using different types of filters. Irin Sherly et al., [28] proposed ensemble based prediction for issues related to heart using gradient boosting algorithm. They used four different datasets from various hospitals with 14 features and shown gradient boosting can perform well in all the four datasets. The existing systems tend to predict the disease only using few attributes of patients with less accuracy. Jackson et al. developed a deep learning model to extract features from dengue fever using random forest algorithm. They acieved a higher accuracy when compared to existing models [29].

Irin Sherly et al., implemented IoT-based animal penetration monitoring in their system.With the aid of a camera, the wildlife is documented. The forest officials receive a GSM notice along with the alarm stating that an animal has been found in [30]. The Honey Badger Algorithm-optimized Faster Region-based Convolutional Neural Network (HBA-FRCNN) is presented in their research for CHF prediction with improved diagnostic precision. The Delayed Normalised Least Mean Square (DNLMS) preprocessing method is used to remove noise from the noisy input ECG signals, such as muscle contraction, electrode contact noise, and various noise artefacts. Discrete Cosine Transform (DCT) and fast Fourier transformations (FFT) are used to extract the

electrocardiographic complex (QRS complex), which consists of the Q, R, and S waves. To address missed target detection, overfitting, and computational expense, the target detection box and anchor parameter for the FRCNN model are modified using the HBA technique [31].

In order to understand its daily exponential behaviour and forecast the reachability of the COVID-2019, Revathy et al. [32] recommended using machine learning models. Comparing the KNN method to any other machine learning algorithm, it produces good results.The existing systems tend to predict the disease only using few attributes of patients with less accuracy. It also generates more false positives which may lead to misdiagnosis and untimely treatment. Detection is not possible at an earlier stage in most of the cases as it turns out to be insignificant for which the patient doesn't consult a medical physician. To overcome this situation, people who suspect their heart's condition is getting worse can undergo our simple prediction analysis which is comparatively cost and time efficient and the results generated have optimal accuracies too.

3. Methodology

A. Data Description

All categories of images for the prediction and categorization of lung images were collected from the Kaggle Open Database. Utilising the Keras preprocessing image data generator tool, we must input our data set and construct size, rescale, range, zoom range, and horizontal flip. Then, using the data generator tool, we import our image dataset from the folder. In addition to setting the target size, batch size, and class mode from this function, we also set the training, testing, and validation parameters here.

B. Proposed Method

To categorize COVID-19 and Pneumonia and increase process accuracy, we are presenting a recognition framework based on the structured two-dimensional convolutional neural networks (CNNs) of Alex Net.

Training a deep learning algorithm capable of categorizing COVID-19 and pneumonia pictures, preprocessing data, and visualizing the photos is the suggested approach for this project. Following feature extraction, we use the Covid-19 and Pneumonia image datasets to build an Alex Net CNN and categorize the data as Covid-19, normal, or pnemonia. If more feature extraction techniques are included to support the CNN method and correctly classify COVID-19 and pneumonia, it is projected that the success of the results will grow. We have shown that applying deep CNN to photos can useful and effective.

C. Train the Dataset using ALEXNET

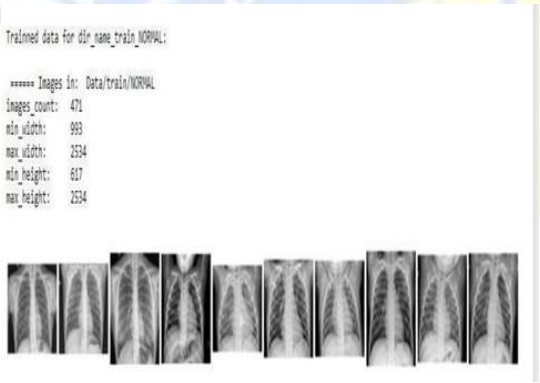

Figure 1: Training the dataset

To train our dataset using classifier and fit generator function also we make training steps per epoch's then total number of epochs, validation data and validation steps using this data we can train our dataset. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning method that can take in an input image, give various elements and objects in the image importance (learnable weights and biases), and be able to distinguish between them. Comparatively speaking, a ConvNet requires substantially less pre-processing than other classification techniques. ConvNets have the capacity to learn these filters and properties, whereas in primitive techniques, filters are hand-engineered. A ConvNet's architecture was influenced by how the Visual Cortex is organised and is similar to the connectivity network of neurons in the human brain. Only in this constrained area of the visual field, known as the Receptive Field, do individual neurons react to stimuli. Their network consists of four layers with 1,024 input units, 256 units in the first hidden layer, eight units in the second hidden layer, and two output units.

D. Convolutional Neural Network

Convolutional Neural Network is generally used for image processing but then it could also be used for prediction by using a modified pattern recognition using categorical values. In our system, we initialize the process by converting the categorical values of the dataset into a vector form, which bypasses the pixel conversion of the image process. Then, the contents of the input layer is given to the convolution layers, where the process is followed by the application of kernel, which is a set of filters used for feature extraction. Then, it processes the values accordingly and extracts the feature map. Stride could also be used for better efficiency. Also, border problem solving is done using padding with 0s. The pooling layer is used to reduce dimensions provided to reserve all the important features of the given data. Max pooling is used here with 2*2 dimensions, but average pooling could also be used. The feature map is flattened and made into a 1-dimensional array, which is then input into the fully connected layer, where classification is carried out using the pre-trained patterns in the datasets. If the value of an attribute ranges within a specified limit it recognizes the value pattern and classifies the patient as susceptible or not and the output is displayed accordingly. Filter size 64 would be optimal for the system to achieve maximal performance.

4. Experimental Results and Discussion

A. Deploying the model in Django Framework and predicting output

In this module the trained deep learning model is converted into hierarchical data format file (.h5 file) which is then deployed in our django framework for providing better user interface and predicting the output whether the given chest X- ray is covid-19 / pneumonia / normal.

The Convolutional Neural Network (CNN) is a deep learning technology that helps in feature extraction and categorization of images. For COVID disease prediction, we employed CNN to train and test image data.

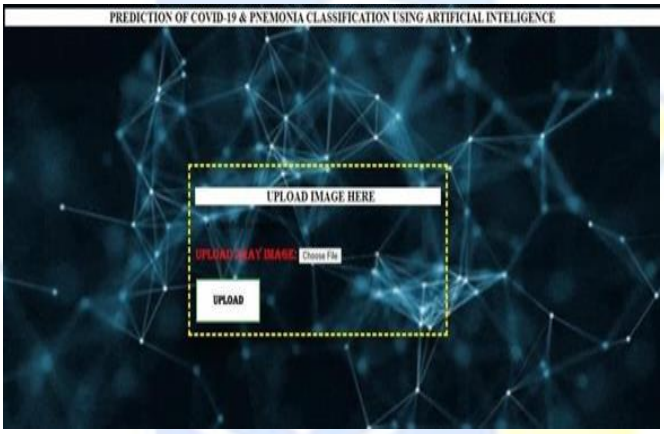

Figure 2: Home page of the prediction system

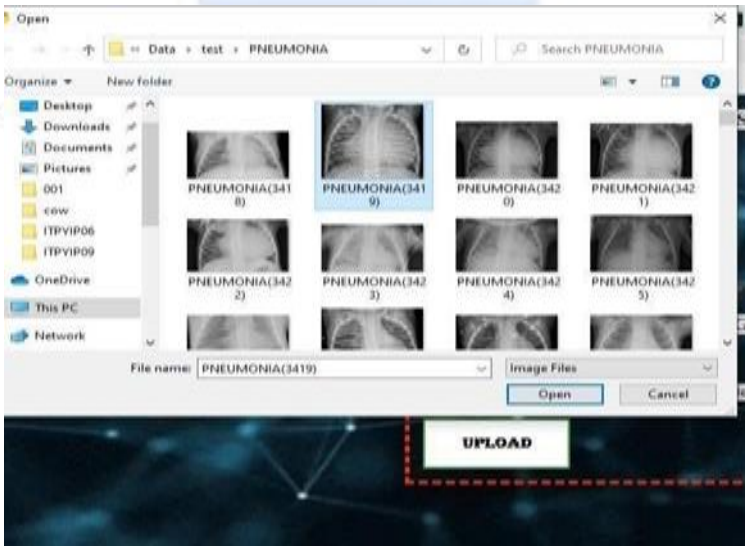

Figure 3: Uploading the images to find the result

Figure 4: Output image

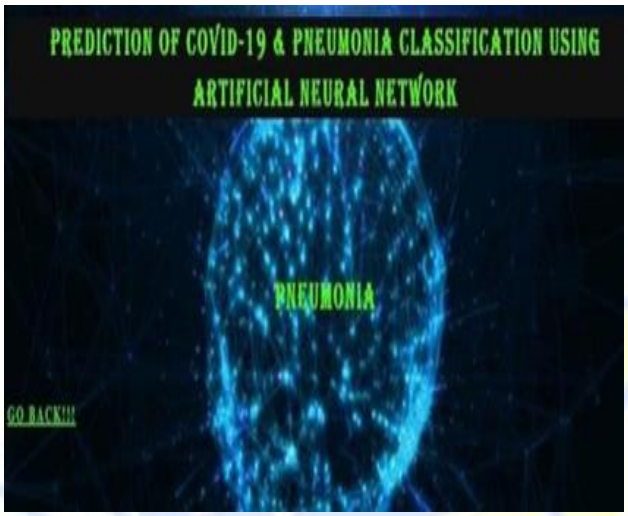

Figure 5: Prediction output

The model result clearly states that there were a total of 10 epochs, and each epoch had a time taken to process the image. The time is mentioned in seconds. Initially, the epochs were gradually increased from 95%, but starting with epoch 5, they continuously produced effective results, with a 98% overall accuracy. In comparison to other models that are accessible, val_loss is extremely minimal, val_accuracy is likewise excellent, and the time taken for each epoch is also efficient.

5. Conclusion

In forecasting the COVID 19 instances using only the X-ray pictures, AlexNet and the 4- layer convolutional neural network have been shown to be really worthwhile and have given us praiseworthy results. We are able to attain approximately 98% accuracy with them, which is far greater than many other concurrent research projects taking place in the field. However, because there is currently a dearth of data, we cannot entirely rely on these models' outputs for real-world implementation in the medical sector. Therefore, we can state that a more thorough availability of the necessary data is required. In a Future Enhancement is to deployment real time this process by show the prediction results in web application or desktop application and optimize the work to implement in Artificial Intelligence environment.

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