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Design and Development of a Clinical Decision Support System for Early Detection of COVID-19

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Abstract - *The Novel corona virus (COVID-19) outbreak has raised a worst situation in all over the world. The spreading rate of COVID-19 is rapidly rising every day throughout the globe. Deep learning techniques proved themselves to be a powerful tool in the clinic for the automatic detection of COVID-19. This paper aims to overview the recently developed systems based on deep learning techniques using medical imaging X-ray.Utilizing chest X-ray images has life-saving significance for the patients and radiologist. There are several types of COVID-19 detection test can be done like swab test, nasal aspirate test, tracheal aspirate test and blood test. But these tests having high false-positive rate so need to move for more preferable deep learning model for a high accuracy. In this study, ResNet50 model is trained for the diagnosis of COVID-19. This is convolution neural network architecture in Covid-19 detection using chest x-ray images. X-ray imaging scanners in almost every region and here it plays a vital role. It can also be used in situations where the possibilities and RT-PCR tests*

Key Words: **COVID-19, X-Ray Images, Deep Learning, ResNet50, Convolution Neural Network.**

1.INTRODUCTION

The coronavirus (COVID-2019), quickly spread around the world and became a pandemic. Screening suspected patients and the early diagnosis of COVID-19 is the best way to prevent its outbreak within a society.The early detection of this virus may give faster and smoother medical recovery. For the correct diagnosis of COVID-19 machine learning techniques, deep learning models, and convolution neural networks (CNNs) have been widely applied in recent years. RT-PCR kits gave false positive results so the transmission of this virus from one infected person to a healthy person quickly. By using chest X-ray and without a radiologist we can see effective results of the deep learning-based systems.

Huge amount of chest x-ray data available on various sources to train a specific deep learning model. Every model requires a different size of input data for processing. Pretrained models will automatically resize all the inputted chest X-ray image dataset. And preprocess as well as augment the dataset and after training the data it extracts significant features from it. Testing and validation is also important to check the accuracy and loss of the model and according to these features, model learn to automatically classify the input image.

2. Literature Review

A way of epidemic prevention and blocking transmission is live monitoring of infected /suspected persons. In this study, we have proposed a smart edge surveillance system that is effective in remote monitoring, warning and detection of a person's fever, heartbeat rate, cardiac conditions and some of the radiological features to detect the infected (suspicious) person using wearable smart gadgets. So, this system is helps to detect COVID-19. We could not stop this spread of the virus but we can early detect this virus so that it helps to stop transmit from one infected person to a healthy person [1]. It will also keep the patient's data record for analysis and decision making using edge computing. The terminologies like the internet of things (IoT) and Edge Computing playing an important role in this disaster. This monitoring process could be more efficient by using parallel computing technologies. Innovations in technology having rapid effects on human life it may be clinical life or any other.

The proposed model here consist of [2] multiple sources of data including, text messages, online communications, social media and web articles can be very helpful in predicting the growth of infection. Community behavior plays a vital role in the rate of spread this virus. Using this data with Machine Learning (ML) and Deep learning, researchers can analyze where and when, the disease is likely to spread, and notify those regions to do arrangements according to that it is imperative to develop a control system that will detect the Covid-19. One of the solutions to control the current havoc can be the diagnosis of disease with the help of various recent technologies. Logistic regression and Naive Bayes classifier can also give better results than other methods.

In another study the authors in [3], Machine Learning based approaches for detecting COVID-19 using clinical text data. Machine learning and natural language processing used for big data-based models for pattern recognition, explanation,

and prediction. Classification is one of the major tasks in text mining. These purposes can be beneficial to diagnose and predict COVID-19. For text mining we have to train data from massive amount of data in machine learning. The machine Learning approach can give the correct diagnosis for COVID-19. The perfect diagnosis can save radiologists' time and can be cost-effective than standard tests for COVID-19. The text is unstructured so it needed to be refined such that machine learning can be done. The classification is performed to classify the given text into a number of different types of viruses. After applying the traditional machine learning algorithm logistic regression and naïve bayes classifier we get to know the classified output entered data of patient belongs to which mentioned virus. So that it is one of the easy ways to reduce radiologist's efforts as well as the contribution of technology in medical service.

Robust Technique to Detect COVID-19 using Chest X-ray Images[4] framework designed to find survival rate of COVID-19 patients. The first collected dataset arranged according to their labels and arranged in two classes i.e. COVID-19 and other diseases (i.e. SARS, MERS and ARDS). If COVID-19 is detected then it is further classified to find the survival rate of patients. For this by using Deep Learning convolution neural network (CNN) with seven layers. Converting the input image into grayscale image and resize it. Classify it is from COVID-19 or other virus. Processing the chest x-ray of COVID-19 patient this framework will give results the infected patient is going to survive or not.

S.Tabik introduces in a[5] COVIDGR dataset and effective chest x-ray based methodology to detect COVID-19. Because high quality collection of Chest x-ray playing an important role in the diagnosis of a patient. Chest X-Ray test using COVIDGR dataset is one of the most time/cost- effective assessment. In this study, they have designed high clinical quality named COVIDGR-1.0 dataset that includes four levels of severity Normal-PCR+, Mild, Moderate and Severe. We identified these four severity levels from a recent COVID-19 radiological study. We also propose COVID Smart Data based Network (COVID-SDNet) methodology. It combines segmentation, data augmentation and data transformation. With a high generalization capacity for COVID-19 classification based on CXR Images.

Author Yun Ju[6] designed a framework for Accurate Detection of COVID-19 Using K-EfficientNet Deep Learning Image Classifier and K-COVID Chest X-Ray Images Dataset. In this study, they implement the K-COVID dataset and concept of progressive resizing as well as data-augmentation, transfer learning that allows us to get a very good accuracy after training and classify the images according to the K-EfficientNet deep learning method. It classifies the image it is from COVID-19 positive class or from normal.

Jessica Steinmann [7] discussed a start to finish covid-19 detection using a deep learning approach. It is confirmed that fever and cough are the most common symptoms of a COVID-19 infected person. This study indicates that deep learning has the prospect of diagnosing diseases through cough sounds. In this algorithm work completed on five modules sound extraction, sound feature extraction, cough detection, cough classification, and COVID-19 diagnosis. After the cough classification model train under KNN, SVM, Random Forest, and RNN classifier and diagnosis of COVID-19.

M. Chowdhury[8] designed and developed an efficient model of learning through one-shot , In one-shot learning is a classification task where one example (or a very small number of examples) is given for each class, that is used to prepare a model. A phase by phase learning approach for effective detection of chest X-ray images. After training a model through one-shot learning, PNN (Probabilistic Neural Networks (PNN)) classifier is used for the classification of COVID-19 image. Average accuracy of 96.4% is reported with training only 300 samples

Ningwei Wang, HongzheLiu[9], designed a deep learning based model integration by using transfer learning. data enhancement operations such as rotation, sharpening, brightness, and translation operations are required to improve the quality of images. After preprocessing, they have trained Nvidia GTX 2080 GPU, and modify the output layer to adapt the ResNet backbone. And then they train and test the model on ResNet 101 and ResNet152. ResNet101 and ResNet152 gives good effect fusion. This model aims that the transfer learning, model integration and classify chest XRay images according to three labels: normal, COVID-19 and viral pneumonia. This model gives 96.1% of chest X-Ray images accuracy on the test set.

ZehraKarhan and Fuat Akal in[10], in this model combines the capabilities of generative adversarial network (GAN) and transfer learning which is commonly used in the biomedical field. This model can work on small image dataset too. In this study, authors use transfer learning for feature extraction and fine-tuning. VGG-16 deep learning model used for localization and classification tasks, respectively, SGAN is an application of GAN made of two deep neural networks Generator and Discriminator. It is used to label the subset of

data and classifies labeled images in their respective categories.

3. PROPOSED MODEL

Early detection is very necessary to prevent the risk of virus transformation .For this purpose chest X-ray are used to train deep learning algorithm and finally the image will be classified using the ResNet50 model. Image dataset required to be preprocessed and augmented under the specified model to obtain high accuracy. And model will learn to compare features through a training process. Below mentioned workflow is maintained to a diagnosis of COVID-19.

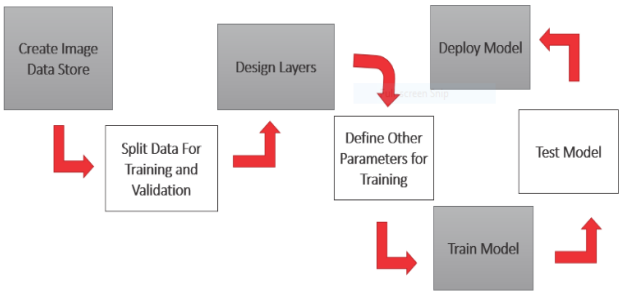

Fig -1: Block Diagram of Proposed Model

Image Dataset: It includes COVID-19 positive and negative patient's chest x-ray. This is 2D raw image dataset having different pixel quality and image size.

Pre-processing: Developing image quality by removing noise and resize the dataset image in 224*224. This step is important for an alignment of data and fast training of the model.

Augmentation: Image processing followed by the image augmentation for random flipping, scaling shearing, translation and rotation of image. This task is performed to obtain all the data in the same format.

Resnet50: Residual network having 50 layers architecture. First layer has 64 filters with kernel size7*7. Model will downsample the images by changing the stride rate. Each layer contain identical blocks used to provide output of previous layer to following layer and help to reduce the vanishing gradient problem. 70% dataset is used for training and 30% dataset for testing. Total 38 layers are responsible to classify the input image to the mentioned category.

Classification: For the classification performance of the model, a test dataset is used. Softmax layer of ResNet50 Categories that test images are either Covid positive and normal.

4. CONCLUSION

This paper review shows various approaches for accurate diagnosis of Covid 19 virus. It begins with the concept of Covid-19 detection using a different method including CNN. CNN also provides proposed model based on ResNet50 for the early Covid-19 detection system. This makes a remarkable impact on the medical field. The proposed model gives accuracy, simplicity and flexibility by using a limited dataset. ResNet50 is time efficient solution for training. The proposed deep learning algorithm has different external and internal validation accuracy but by improving the image dataset we can increase the overall accuracy of the model.

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