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Artificial Intelligence Based Detection And Classification of Diseases using Chest X-Ray Images

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Abstract: *The pandemic of coronavirus disease 2019 (COVID-19) has resulted in an increased demand for testing, diagnosis, and treatment. Reverse transcription polymerase chain reaction (RT-PCR) is that the definitive test for the diagnosis of COVID-19, however, chest X-ray radiography (CXR) may be a fast, effective, and affordable test that identifies the possible COVID-19-related pneumonia and tuberculosis. This study investigates the feasibility of employing a deep learning-based decision-tree classifier for detecting COVID-19, PNEUMONIA and TUBERCULOSIS from CXR images.*

Keywords: COVID-19

I. INTRODUCTION

A coronavirus is a kind of common virus that causes an infection in your nose, sinuses, or upper throat. Most coronaviruses aren't dangerous. In early 2020, after a December 2019 outbreak in China, the World Health Organization identified SARS-CoV-2 as a new type of coronavirus. The outbreak quickly spread around the world. COVID-19 is a disease caused by SARS-CoV-2 that can trigger what doctors call a respiratory tract infection. It can affect your upper respiratory tract (sinuses, nose, and throat) or lower respiratory tract (windpipe and lungs). It spreads the same way other coronaviruses do, mainly through person-to-person contact. Infections range from mild to deadly. Pneumonia is an acute infection of the lungs that produces coughing, fever, chills, muscle aches, and difficulty breathing in those who suffer from it. The pneumonic infection has been noted throughout human history, with mentions of the disease appearing during early Greek civilization. However, despite our long history with the disease, pneumonia remains a serious medical concern throughout the global community today, with millions of cases of pneumonia-related hospitalizations and deaths worldwide. Each year, over 1.5 million children die of pneumonia, mostly within developing nations. Tuberculosis (TB) is a contagious, infectious disease, due to Mycobacterium tuberculosis (MT), which usually lasts throughout the life course and determines the formation of tubercles in different parts of the body [1]. MT has very ancient origins: it has survived over 70,000 years and it currently infects nearly 2 billion people worldwide [2]; with around 10.4 million new cases of TB each year, almost one third of the world's population are carriers of the TB bacillus and are at risk for developing active disease. As mentioned above all the above diseases have the similar symptoms such as cold, cough, fever and it majorly affects the respiratory system. It can range from simple fever till causing deaths. The reason that it may reach till death might be unavailable medical attention, delay in detection and also nature of human body. Since these three diseases have similar symptoms there have been huge misdiagnosis in detection of these diseases which has created huge inconveniences in human life. Though there are several research made on how can these diseases be classified and also how can recent technologies be implemented for this purpose. AI is a most emerging technology which is being implemented on almost all the fields and medical domain is one of the fields where AI is proven to be “A Blessing in Disguise”. The existing methods to detect these diseases are RT-PCR for Covid-19, Chest X-RAY is for Tuberculosis and Pneumonia but they are very time consuming and sometimes not reliable due to complexity of similarities between the diseases. After several research many models are created using Artificial intelligence which will efficiently detect any one of the diseases e.g. a model that can detect if a person is infected by Covid-19. With the development in technologies Deep Learning which is the model of Machine Learning is being used almost in every field and hence increasing the efficiency of Machine Learning. Our project is to develop a model using deep learning a model of machine learning which aims to detect and classify the disease efficiently based on the Chest X-RAY image of the suspect. Our

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approach is to detect three infectious diseases while the existing model detect only one disease with good accuracy and can be reliable with less time consumption.

The organization of manuscript has been arranged in the following way: section 2: Discusses the related works with a brief outline o f the contributions presented in the past ,.In section 3: the working mechanism of the proposed architecture is explained. Sections 4: Methodology in order to measure the accuracy of the proposed classification mechanism and section 5 describes the results obtained and finally in section 6 a conclusion has been drawn from the whole work.

II. LITERTURE SURVEY

Authors/ Year	Title	Work carried out	Advantages	Disadvantages
Jesus Ajejandro Alzate Grisales, Daniel Arias Garzon/20-21	COVID-19 detection in X-Ray images using Convolutional Neural Networks	These papers approach uses existing deep learning models to process these images and classify them as positive or negative for COVID-19.	1. This approach shows how existing models can be helpful for multiple tasks. 2. This model achieves the accuracy of 97%.	1.Sometimes the results cannot be generalized widely. 2.There are only a few large open access datasets of COVID-19 X-ray image
Lei Rigi Baltazar/ 2021	Artificial intelligence on COVID-19 pneumonia detection using chest x-ray images.	In this Paper, we developed AI-driven models designed for COVID-19 pneumonia detection using CXR images. It also identifies different kind of pneumonia	We pursued two different strategies to access the impact of the data distribution and provide a quantitative comparison between two study designs adopted in previous works.	In a typical computer desktop with an approximate runtime of two minutes to analyze an image hence, Deemed scalable and can facilitate automated screening of COVID-19 cases in remote areas.
Stephanie A.Harmon,Thomas H.Sanford/2020	Artificial intelligence for the detection of COVID-19 pneumonia on chest CT using multinational datasets	AI as a screening tool to detect covid-19. Integration of AI with X-Rays and CT in order to despite the latest progress of medical imaging and radiology fighting against Covid-19.	1.It has less dependency on the quantity of data. 2.It provides best protection to imaging techniques. 3.It is widely used in frontline hospitals.	AI Models become more complex algorithms and lose their explain ability.
Ruihua Guo, Kalpdrum Passi and Chakresh Kumar Jain	Tuberculosis Diagnostics and Localization in Chest X-Rays via Deep Learning Models	It has demonstrated DL systems which have the potential to increase capacity and aid TB diagnosis.	It has the potential to augment the capacity of, and improve overall TB diagnosis and care.	1.It is expensive. 2.Treatment adherence goes beyond the biological sphere and healthcare providers acknowledge patients need that go beyond the supervision of medication taken
Rachana Jain,Meenu Gupta	Deep learning-based detection and analysis of COVID-19 on chest X-ray images	In this work, we have taken the PA view of chest x-ray scans for covid-19 affected patients as well as healthy patients. After cleaning up the images and applying data augmentation, we have used deep learning-based CNN models and compared their performance.	Exception net has the best performance and is suited to be used. We have successfully classified covid-19 scans, and it depicts the possible scope of applying such techniques in the near future to automate diagnosis tasks.	The high accuracy obtained may be a cause of concern since it may be a result of overfitting.

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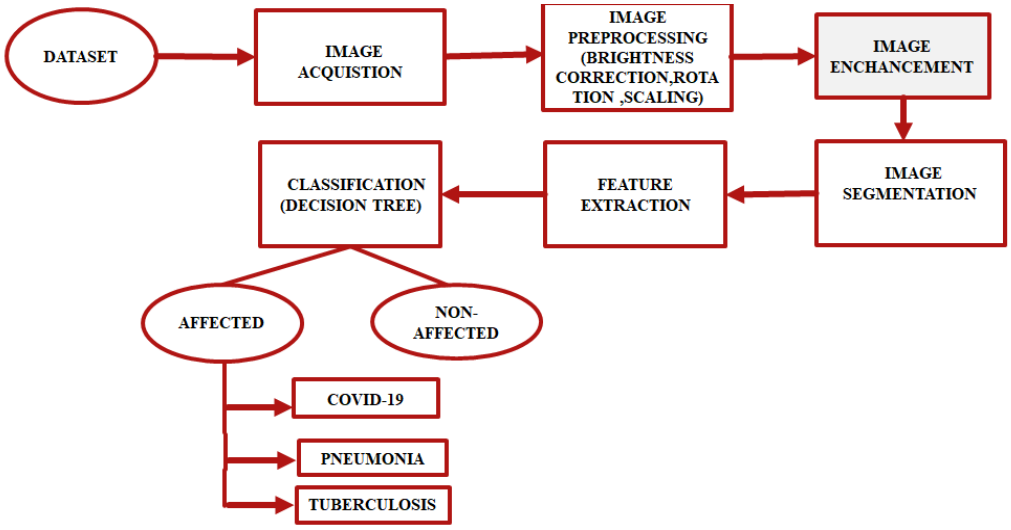
III. SYSTEM ARCHITECTURE



IV. METHODOLOGY

Source of Chest X-Ray Images

For the training and development of AI-based classification models, COVID-19, PNEUMONIA, TUBERCULOSIS (TB), and NORMAL chest X-ray images were downloaded from KAGGLE DATASET. During the development of classification models and preparation of the DATASET for the present study, new images of COVID-19, PNEUMONIA AND TUBERCULOSIS images of GitHub resource. The images were also downloaded from google.

Selection of Images for the Study

The downloaded images were manually curated to filter out a similar type of images and retain only the posteroanterior view chest X-ray images, a total of 2000 chest X-ray images (original images) were taken for training and testing of the AI-based models. Further, we distributed the original images into images for COVID-19, PNEUMONIA, TUBERCULOSIS and NORMAL, respectively.

Dataset Preparation

For the training and testing of AI based models, the original image dataset was divided into 90% training dataset and 90% external validation dataset. As the number of images was limited, we generated different types of augmentations through an open-source augmentation tool CLoDSA. Thus, a different type of training, external validation datasets, for chest X-ray images were generated. Out of the datasets, one dataset comprised of original images, and other datasets consist of single augmentation images, while the combination of the former different types of datasets generated a combined dataset. All the different types of datasets were used to train and validate the different types of AI-based chest X-ray classification models. The combined dataset used 1200 and 800 images for training and external validation of AI-based models, respectively. Furthermore, for the model training and internal evaluation of AI based models, all the training datasets were further split into 90% training datasets and 10% internal validation datasets. Additionally, we used external validation dataset to evaluate the performance of all the models for COVID-19, PNEUMONIA, TUBERCULOSIS (TB), and NORMAL chest X-ray images.

V. TECHNIQUES USED

We used the deep learning approach; in deep learning we have used CNN method to train and validate different types of AI-based models. As we are using CloDSA technique which is open-source technology it is based on python libraries which is created using NumPy, tensorflow and OpenCV method. OpenCV is used for reading the images. CloDSA will accept 2 methods, one is what type of parameter another is augmentation type. We have taken 3 convolutional layer,

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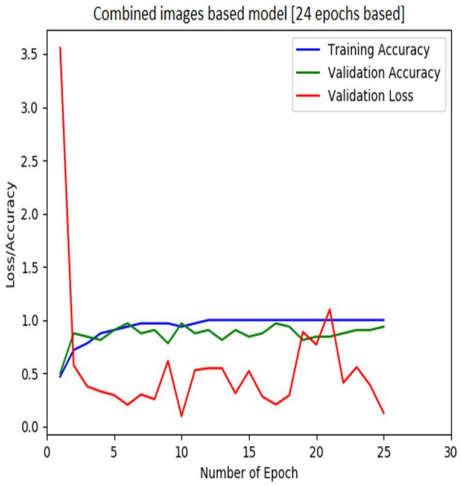
followed by average pool layer, fully connected layer and the SoftMax layer. convolutional layer basically works on filters. Filters are nothing but feature extraction. Once you select the filter, the features will be applied, no need to do it manually. CloDSA layer will be used till image enhancement next the model will be trained by next three layers that will be created at last SoftMax layer will consist of decision tree. Feature selection, extraction and classification includes several convolution layers followed by max-pool layer. We are using 256 features that is nothing but 256 different convolution layer which contains different 3*3 filter values. 256 features are common across all the disease.

VI. RESULTS AND DISCUSSION



This graph represents that we have trained our model using 24 epochs-based model.

Figure 1 : Upload an image

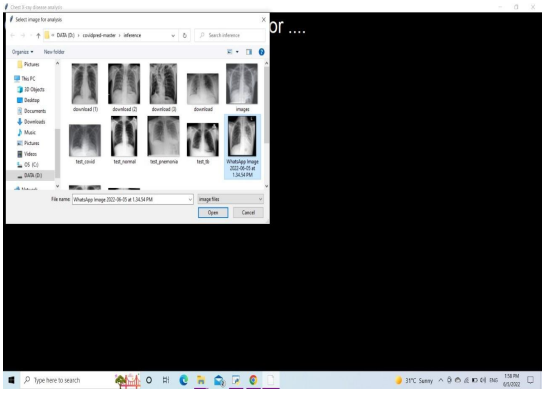


Figure 2: Select an image from the folder

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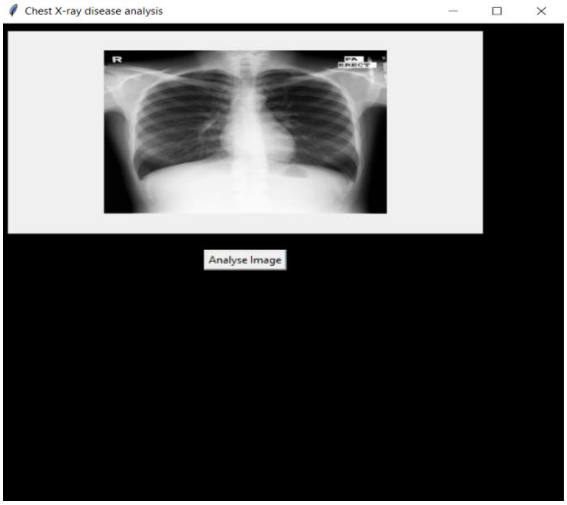

Figure 3: Analysing the image

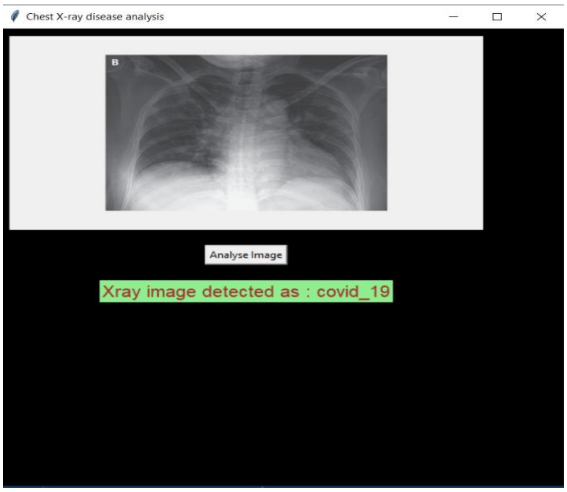

Figure 4: Detected disease is COVID-19

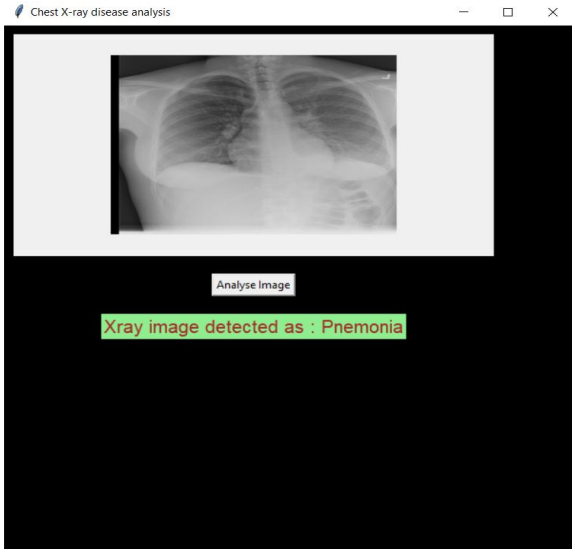

Figure 5: Detected disease is PNEUMONIA

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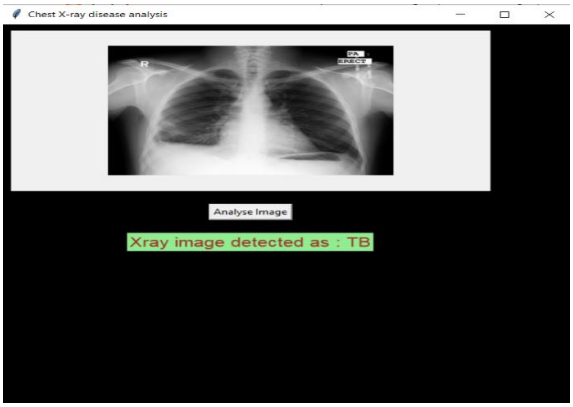

Figure 6: Detected disease is TUBERCULOSIS

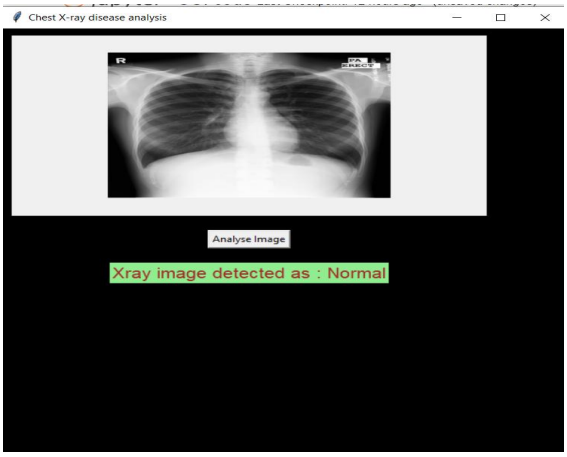

Figure 7: The detected x-ray is NORMAL

VII. CONCLUSION

AI-based classification can help rapid diagnosis of COVID-19 and other major infectious diseases. The models that are being developing by us are proof of the concept that cost-effective, user-friendly, and noninvasive AI-based methods can be developed for COVID-19. Our proposed system is used to classify the diseases like COVID-19, PNEUMONIA and TUBERCULOSIS based on CLODSA augmentation method and the proposed model has accuracy of 92 % in classifying the diseases when compared to existing models. The AI-based models which will be developed by us may be evaluated for its use in clinics, as diagnostic or clinical management of patients. Our system classifies the diseases

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