Lung Disease Detection using Deep Learning

Shiva Kumar R Naik, Sanath Kumar B, Sai Kalyan V, Saladi Satya Sainadh, Sai Sandeep S,
School of Computer Science and Engineering, REVA University

***Abstract*— Nowadays, with the breakdown of covid-19, lung disease was one of the world's leading causes of mortality. As a result, the technological developments and procedures that allow rapid and earlier detection are critical in today's environment. From the beginning to the present, medical professionals have found lung illness analysis and study to be the most fascinating research area. Because detecting of this condition requires effort and screening gear is costly, an automatic detection approach that reduces testing time is needed so that the patient can obtain proper medical care and treatment as soon as needed. To accomplish this task, a model was recommended using CNN that may be utilized to detect lung disease using chest radiographs. The game plan for lung disease identification is to use CNN classification. The suggested model employs the CNN algorithm, which is most often used in deep learning to analyses visual information. During training, the X-Ray picture is smoothed and transmitted to fully connected neural network layers after passing through the Convolution layers. The neural network then predicts and matches the output class to the actual output. The neural network's weights are then modified based on the comparison.**

***Index Terms* — COVID-19, Pneumonia, Deep learning, Lung disease detection, convolutional neural network (CNN)**

I. INTRODUCTION

Lung disorders are the third biggest cause of death today, after ischemic heart disease and stroke. When you breathe, the oxygen in your lungs is distributed throughout your body. The cells in your bodywork and require oxygen to grow. Humans breathe roughly 23,000 times per day on average. Breathing difficulties have been experienced by people with lung diseases. Lung diseases include a variety of pulmonary ailments such as pneumonia and covid-19, as well as lung cancer and other respiratory issues. A novel lung illness, COVID-19 or coronavirus was found in 2019 among all the lung disorders. This disease makes a huge impact on the lungs and respiratory system. The sickness normally takes 14 days to manifest its symptoms. COVID-19 is diagnosed using a procedure that takes 2-4 hours for patients to identify if they have been infected or not.

X-ray scans of the chest can be used to detect a variety of lung illnesses. Since the infected patients, X-ray images must be diagnosed by a radiologist. However, a medical practitioner's
skill is required to detect the condition. As a result, there could be a number of misleading results.

Artificial Intelligence is now widely utilized to examine the RNA structure of various viruses and in research to find treatments and vaccines for them. AI is being used in health care systems in a variety of ways, including disease prediction, patient monitoring, RNA structure analysis, finding novel treatments and therapies for disease cure, and generating vaccinations for a variety of diseases. Artificial intelligence (AI) approaches can be used to analyze the chest X-rays to create a system. that can detect/classify. The chest X-ray is a determining factor; if the X-ray is normal, patients can return home and await laboratory findings, but if any other test is performed, the results will be delayed, and patients will be anxious until they receive them. This is where the significance of the research we conducted comes into play. As a result, X-rays are useful in the early detection of this condition and can also be used as a screening tool. As a result, AI models that are simple, precise, and faster are helpful in overcoming the problem of disease detection delay and supporting patients in early detection and cure.

Deep learning, which is a model that uses deep (many) layers and requires a long computation time, is one of the most prominent AI techniques. CNNs are a sort of technique which is frequently utilized in pattern recognition (CNN). So in this paper, we use an X-ray image to detect various lung illnesses using a CNN. Large datasets are utilized in the creation of different classifiers. The next part outlines our methodology, which includes a deep learning approach.

II.OBJECTIVE AND SCOPE

1. Detect COVID-19.
2. Detect “Pneumonia”.
3. Detect "lung opacity”.
4. Detect “normal”.

In order to detect the above we are using X-ray image and we are using Convolutional neural network (CNN) deep learning technique.

III.LITERATURE REVIEW

D. Harshita, M. Krishna Pranthi, M. Reethika at [1] has explained about the new covid-19 is a highly infectious viral infection that has become endemic, posing significant concerns throughout the world. It's critical to identify the cases ahead of time so that we can prevent the pandemic from spreading. However, the main disadvantage is the scarcity of check kits. To overcome this, AI can be helpful or even used in COVID monitoring and detection. This work includes a CheXNet-based version for COVID prediction from chest X-rays. In this proposed version the patients are classified into covid and normal. CheXNet is a Convolutional Neural Network version that was trained on the ChestXray14 dataset to detect anomalies in lungs X-ray. In general, this version became longer to cover all of the points.

The evaluation and observation of lung illnesses is the most exciting research ¼ of caregivers from the beginning to the present day, according to Swati Mukherjee [2] under the supervision of Prof. Bohra. To address this issue, a machine like this can only assist in lowering the percentages of people who are at risk of dying by means of early detection of malignant growth. Multiple systems are offered by and through, although a large number of them are still speculative plans. The overall performance of a neural community model is examined in the resultant philosophy to deal with the problem of recognising malignant cells in photograph data, which is a common problem in healing imaging applications.

Rajpurkar, P., Irvin, J, Zhu, K, Yang, B., Mehta, H, Duan, T, Ding D., Bagul, A., Langlotz, C, Shpanskaya, K., Lungren, M.P, Ng, at [3] that the experts were able to spot pneumonia via lung X-rays to a level that was superior to that of professional radiologists. To match CheXnet's scores, they use a validation set described by four practicing intellect radiologists. results to that of radiologists. According to our data, CheXNet surpasses the average radiologist on the F1 metric. CheXNet has been enhanced to identify all 14 illnesses in chest X-ray and deliver up-to-date findings for all 14 illnesses.

Mark Sandler, Andre Howard, Menglong Zhu, Andrey Zhmoginov, and Liang at [4] explained that they offer mboxMobileNetV2, a unique mobile structure that increases mobile models' performance in a variety of activities that is cutting-edge of activities and standards, as well as across a range of industries variety sizes of models, in this work. We also present effective strategies for utilizing these mobile models to item identification in a unique architecture we call mboxSSDLite. They also show how to create a mobile segmentation model with Mobile mboxDeepLabv3, a reduced version of mboxDeepLabv3 that is based on shortcut connections between the narrow bottleneck layers of a reverse residual structure. The lightweight expansion layer serves as a bridge between the two expansion layers, depth convolutions to sort features, which cause non-linearity. We also noticed that non-linearity in the thick layers must be lowered in order to maintain presentational power. They show case how this builds performance and describe how this design came to be. Finally, their strategy separates the input and output zone from the change's naturalness, providing a valuable framework for further research.

Muhammad Farooq and Abdul Hafeez at [5] explained that the scientists are exploring a new technique to detect Covid-19's existence and differentiate from other kinds of respiratory disease, such as pneumonia, because to the ease with which it moves accurately and quickly. The goal of this project was to provide an open-source dataset with open access as well as a robust Convolutional Neural Network for distinguishing COVID19 individuals from those other pneumonia infected patients. To construct rapid and flawless neural networks, they apply training approaches such as progressive normalization, irregular learning rate discovery, and astute learning rates.

IV.PROPOSED SYSTEM

A.System Architecture

System architecture is a theoretical design that describes about the structure of the system, function, and other features. An architectural specification is a systematic explanation and system representation arranged in a way that allows analyzing about the system design and behavior.

system components make up system's architecture. To implement the overall system the working of built-in subsystems is needed. Languages for describing of the
system architecture has been attempted to define, and they are collectively known as architecture description languages.

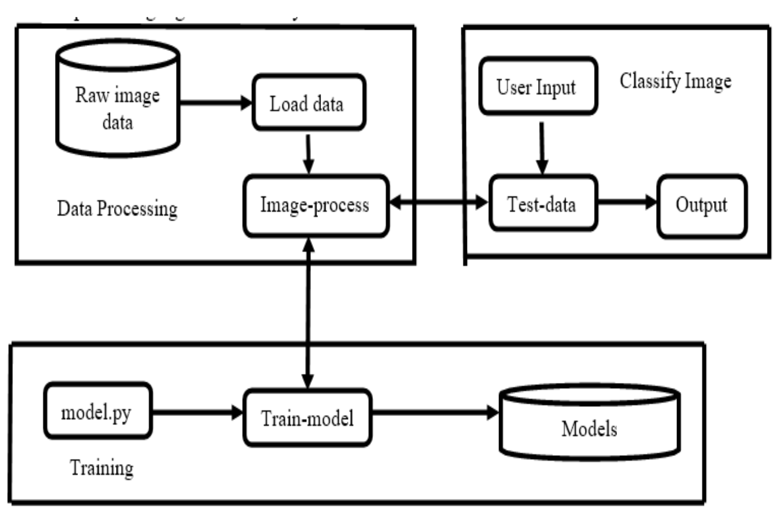

Fig 1. System Architecture

1. *Data Processing*

It comprises of raw X-Ray image files of Covid-19, Pneumonia, and Normal patient in the data processing. Next, we input data to test and train the x-rays before carrying out the process.

2. *Training*

The code for training is in the file model.py, which will then be running with the training model from Python IDLE.

3. *Classify Image*

In this final block the user selects an image which should be tested, and the model analyzes the input image using its deep CNN technique before showing it as Covid-19, Pneumonia, lung opacity, or Normal.

B.Use Case Model

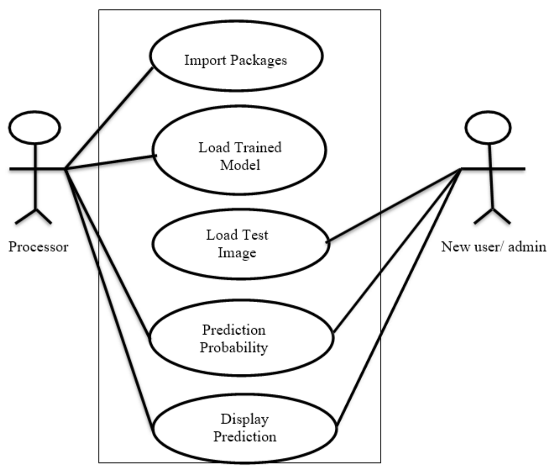

Fig 2. Use Case model of disease detection.

Model flow:

- ✓ The preprocessor must import packages into the model.
- ✓ The preprocessor must load the trained the model.
- ✓ The user loads the test image into the model.
- ✓ The model should have high prediction probability.
- ✓ The model will predict the final output based on user's input.

C.Sequence Diagram

It illustrates interactions in a logical order. It covers the entities present in the scheme as well as the data switch sequence among the entities required to carry out with thefunctions for that particular scenario.

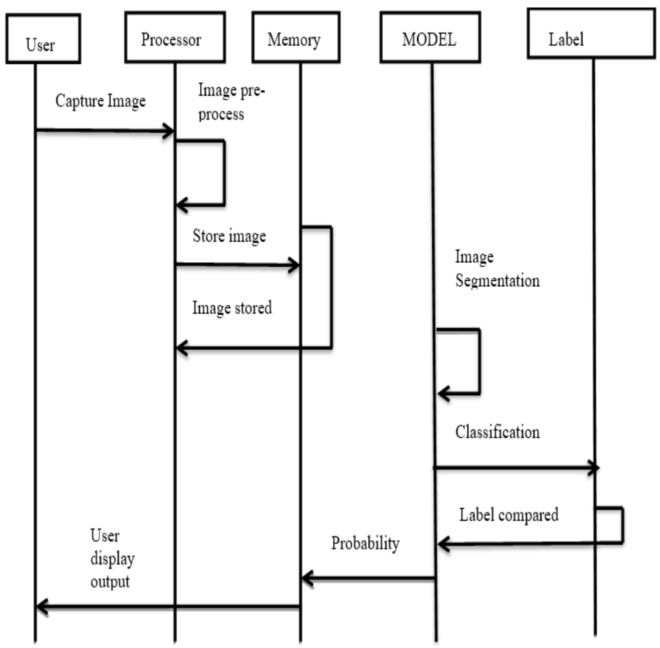

Fig 3. S Sequence diagram of disease detection.

Steps:

- Image segmentation is performed within the model, and the images are categorized as Covid-19, Normal, or Pneumonia, with the probabilities kept in the memory.
- When the image is captured by the user it is sent to a processor where the image pre-processing takes place where images are converted into the same width and height and is stored in the memory and when the user captures the image the prediction is displayed.

D.Class Diagram

It is a form of fixed structural figure that depicts the structure of a system by displaying the classes, properties, actions, and inter-object connections between the entities.

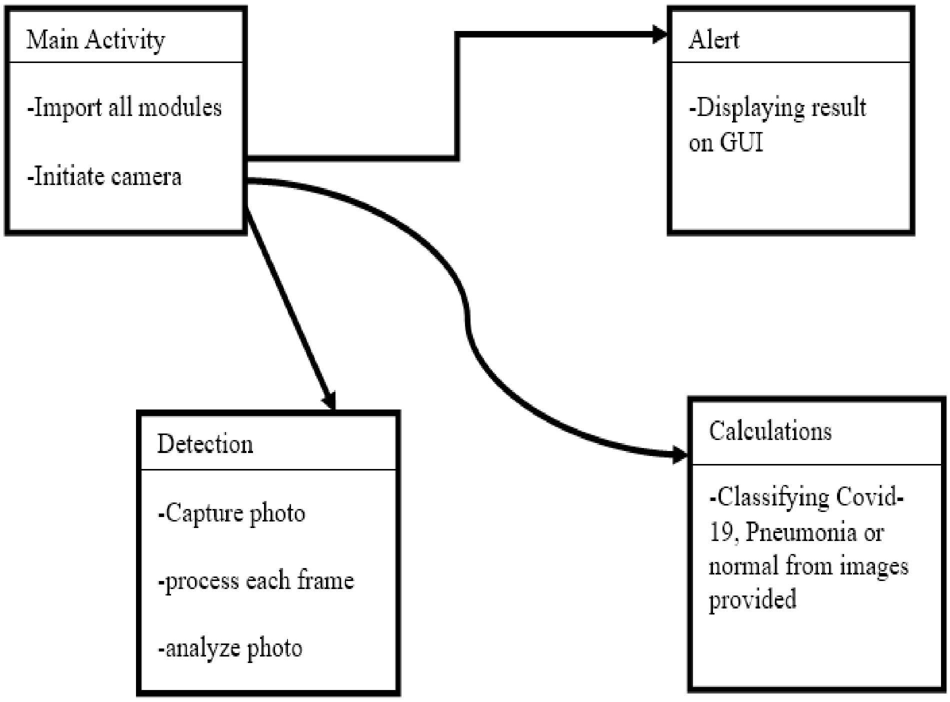

Figure 4. Class diagram of Disease detection

V.ALGORITHM

To categories lung related disease from the dataset, we will design a deep learning system. An X-ray image is fed into the system. It categorizes this data into one of several categories(normal, coivd19 and pneumonia). The system contains a collection of CNNs, image training processes, and neural networks that merge the CNNs' image options with the image. Unweighted averaging is employed to mix the NNs' outputs into a collection of prediction possibilities for the categories. The classification relies on the most probability.The image is provided as input is sent through a sequence of image feature detectors.

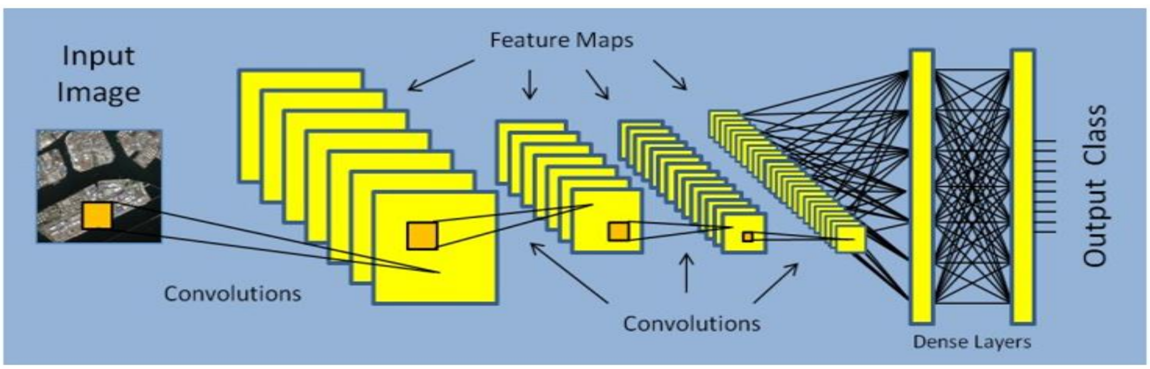

Fig 5. convolutional neural network's structure (CNN)

1. Convolutional Layer

Using feature detectors/kernels, we extract distinct features pixel by pixel in the convolution layer. Convert the source through a succession of convolutions, each with a particular filter. As a result, various feature maps appear. After that, all of the feature maps are combined to create the final output of the convolution layer.

2. Pooling

This cuts down on time required for training and eliminates the issue of overfitting. Max Pooling is a technique for extracting the maximum pixel value from a feature that needs to be extracted.

3. Flattening

The pooled features are arranged into one column as just an input for the following layer that is converting our 3D data into 1D during flattening.

4. Fully Connected Layer

Every neuron in one layer is coupled to every neuron in another layer in fully connected layers. It's equivalent to a multilayer perceptron. This layer applies weights to the data from the previous analysis stage to anticipate the proper label. As a result, the ultimate categorization decision is made.

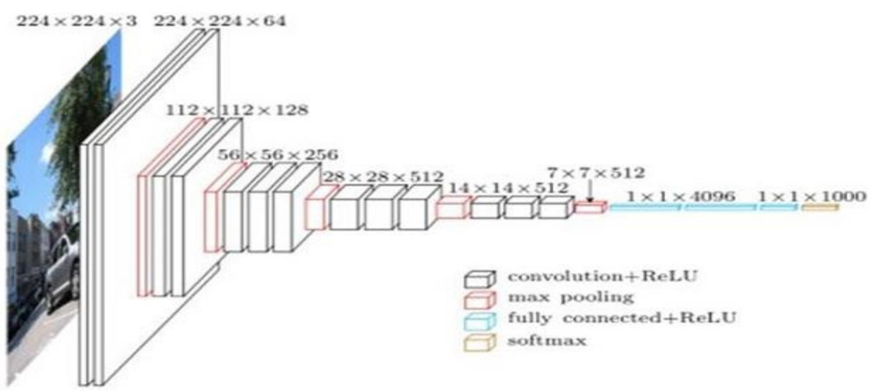

Fig 6 A visualization of the VGG architecture

Every level in CNN uses matrices-based filters that are set to random values at the start. While training, this technique will automatically gain a sense for all these filters. Our CNN will study to categorize x-ray data by: Our CNN will study to categorize x-ray data by:

recognizing edges in the initial layer.

• finding forms in the subsequent levels.

• detecting additional higher characteristics thereafter.

The final layer of CNN makes predictions about the image based on the features from the previous layer. This technique, is indeed an aspect linear combination of 2 matrice preceded by the add up value.

1. Take 2 identically sized matrices.
2. Multiply each ingredient separately.
3. Add up all of the elements.

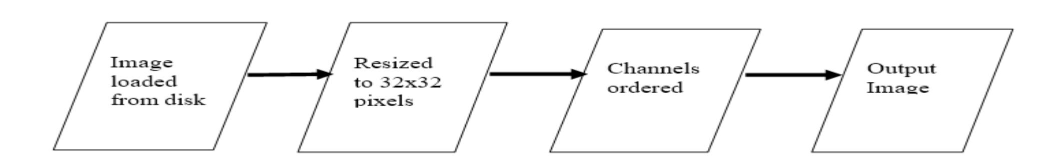

Fig 7 Pipeline for image pre-processing

An image is loaded from the disk. The image is resized to 32x32 pixels and channel dimensions are ordered finally, the final image is the output.

VI. Results and Discussion

Fig 8. Initial window

The first interface pops up when we run the application. The 1st button, choose image, which is being used to pick a x-ray, while the second button, quit, is used to exit the interface.

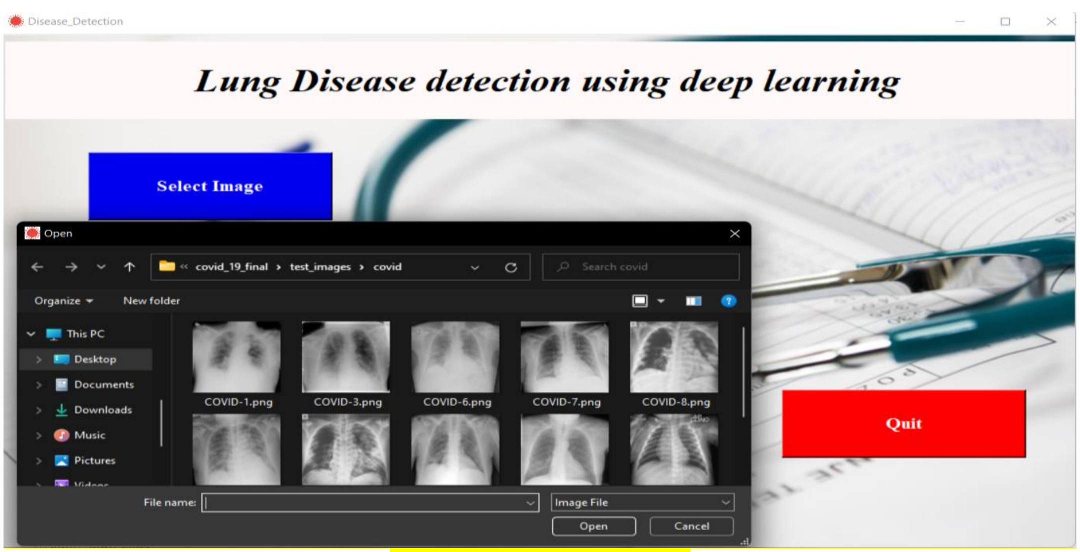

Fig 9. Image Selection

When the user selects the picture button on the selection interface, the photograph file appears, where the person can choose the image from which the outcome should be determined. The user selects the predict button after selecting the image which resulting in Covid-19 Positive, Pneumonia, lung opacity or Normal for the given X-ray.

Fig 10. Covid Resulted

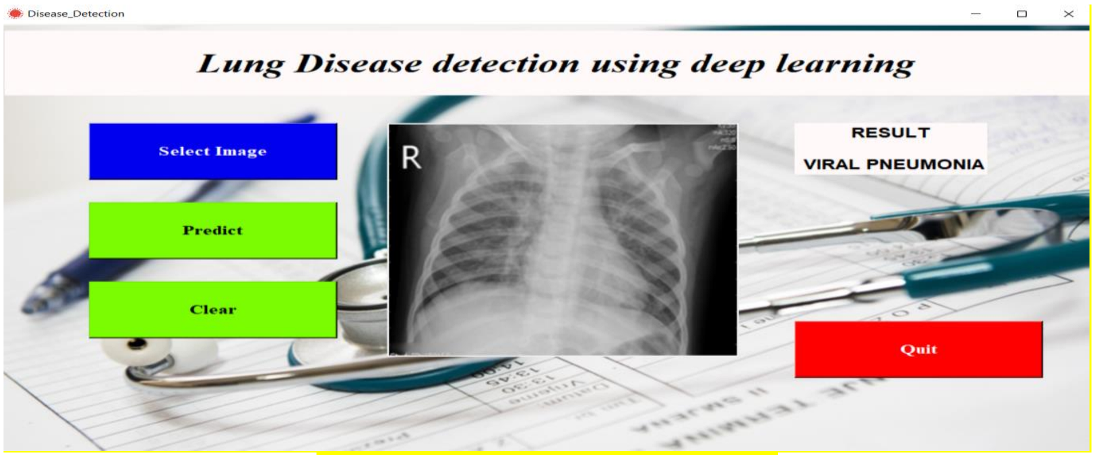

Fig 11. Viral Pneumonia Resulted

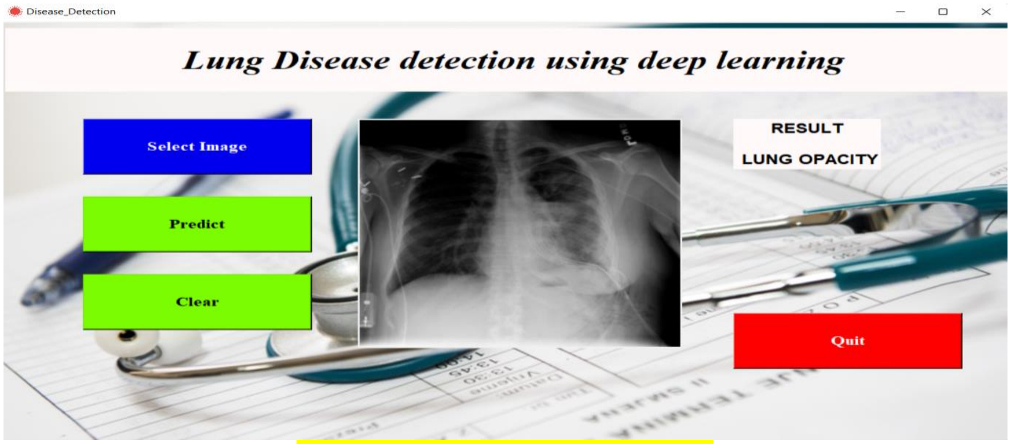

Fig 12. Lung Opacity Resulted

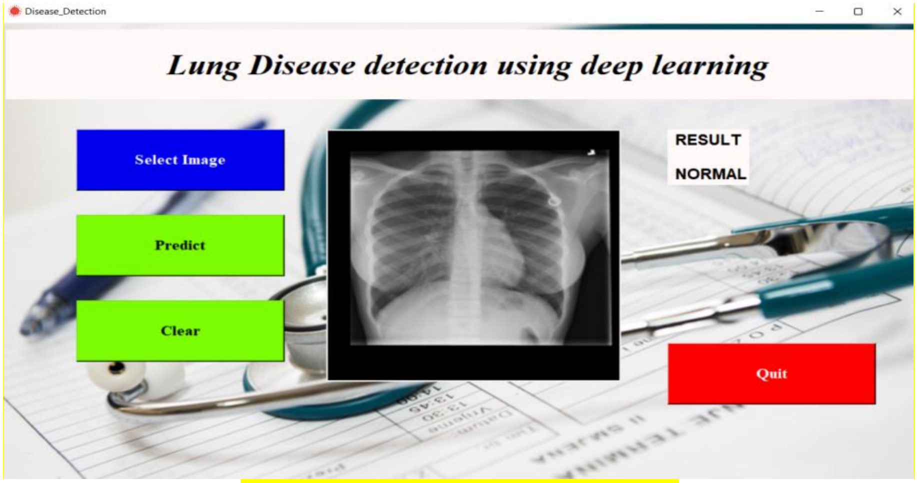

Fig 12. Healthy Person Resulted

This study shows how multiple training strategies may be used to create computationally efficient models. Training and testing with a larger dataset are required to make lung disease detection clinically relevant.

Cost of X-ray and the radiation emitted by X-ray is less which will not harm body or internal organ of a patient when is exposed to X-ray. Using chest radiographs, the recommended model may be utilized to detect lung disease. Because X-ray radiographs are easily available for illness diagnosis, they are recommended. Within seconds, the model can diagnose disease. It is suggested that X-ray images be used with a deep learning algorithm. When compared to CT, X-ray is more accessible due to its lower radiation dosage. Patients who have been identified as by lung disease by the model are referred to radical centers for validation and therapy as soon as possible.

REFERENCES

[1]. D. Harshita, M. Krishna Pranthi, M. Reethika, “COVID Detection from Chest X-ray with deeplerning: ChestXNet”,2020, IEEE.

[2]. Swati Mukherjee under the guidance of Prof. Bohra, “Lung Cancer Disease Diagnosis Using Machine Learning Approach”, 2020, IEEE.

[3]. Rajpurkar, P., Irvin, J., Zhu, K., Yang, B., Mehta, H., Duan, T., Ding, D., Bagul, A., Langlotz, C., Shpanskaya, K., Lungren, M.P., “Chexnet: Radiologist-level pneumonia detection on chest x-rays with deep learning”, 2017.

[4]. Mark Sandler, Andrew Howard, Menglong Zhu, Andrey Zhmoginov, and Liang- Chieh Chen, “Mobilenetv2: Inverted residuals and linear bottlenecks. In proceedings of the IEEE conference on computer vision and pattern recognition”, 2018.

[5]. Muhammad Farooq and Abdul Hafeez, “Covid-resnet: A deep learning framework forscreening of covid19 from radiographs”, 2020.

[6]. E. Maddah and B. Beigzadeh, “Use of a smartphone thermometer to monitor thermalconductivity changes in diabetic foot ulcers: a pilot study,” Journal of Wound Care, vol. 29, no. 1, pp. 61–66, 2020.

7]. Sreedhar Kumar, S., Ahmed, S. T., & NishaBhai, V. B. Type of Supervised Text Classification System for Unstructured Text Comments using Probability Theory Technique. *International Journal of Recent Technology and Engineering (IJRTE)*, *8*(10).

[8]. C. Roldan Jim ´ enez, P. Bennett, A. Ortiz Garc ´ ´ıa, and A. I. Cuesta Vargas, "Fatigue detection during sit-to stand test based on surface electromyography and acceleration: A case study," Sensors, vol. 19, no. 19, p. 4202, 2019

[9]. Ezz El-Din Hemdan, Marwa A Shouman, and Mohamed Esmail Karar, "Covidx- net: A framework of deep learning classifiers to diagnose covid19 in x-ray images", 2020.