1. Introduction :

a.overview:

Pneumonia is considered the greatest cause of children in all over the world. Approximately 1.4 million children die of pneumonia every year, which is 18% of the total children died at less than five years old [1]. Globally overall two billion people are suffering from pneumonia every year [1]Pneumonia is a lung infection, which can be caused by either bacteria or viruses. Luckily, this bacterial or viral infectious disease can be well treated by antibiotics and antivirals drugs. Nevertheless, faster diagnosis of viral or bacterial pneumonia and consequent application of correct medication can help significantly to prevent deterioration of the patient condition which eventually leads to death [2].

Currently many biomedical complications (e.g., brain tumor detection, breast cancer detection, etc.) are using Artificial Intelligence (AI) based solutions [7-10]. Among the deep learning techniques, convolutional neural networks (CNNs) have shown great promise in image classification and therefore widely adopted by the research community [11] Deep Learning Machine learning techniques on chest X-Rays are getting popularity as they can be easily used with low-cost imaging techniques and there is an abundance of data available for training different machine-learning models. Several research groups [1, 12-25] have reported the use of deep machine learning algorithms in the detection of pneumonia, however only an article [16] has reported the classification of bacterial and viral pneumonia.

b.purpose:

The main objective of this work was to develop a deep learning framework to automatically diagnose pneumonia using chest X-ray images and to classify the result as normal cases or pneumonia cases, which will help in quickly and easily diagnosing the disease.

2. Literature Survey:

a. Existing problem:

- Chest pain when you breathe or cough
- Confusion or changes in mental awareness (in adults age 65 and older)
- Cough, which may produce phlegm
- Fatigue

- Fever, sweating and shaking chills
- Lower than normal body temperature (in adults older than age 65 and people with weak immune systems)
- Nausea, vomiting or diarrhea
- Shortness of breath

b.proposed solutions:

Generally, practicing personal hygiene, like regularly washing your hands, is the best way to prevent respiratory infections.

Vaccinations are also recommended for people who have an increased risk of pneumonia or its complications. For example, children can be vaccinated against the Haemophilus influenzae bacteria and pneumococci. Flu and pneumococci vaccinations are also suitable for people over 60 years of age.

Herbal medicines and dietary supplements such as vitamin products are often said to strengthen the immune system. But there are, no studies that prove that such substances are worth it – except for people who have a diagnosed vitamin deficiency. That usually only occurs in Germany or similar countries as a result of a very imbalanced diet.

Go to:

Treatment

Because the infection is usually bacterial, pneumonia is typically treated with antibiotics. The appropriate antibiotic depends on the type of bacteria.

Treatment lasts about 5 to 7 days. The antibiotic can be taken as a tablet or syrup. Depending on the severity of the illness and the risk of complications, treatment in a hospital may sometimes be needed. The antibiotic is usually given as an infusion there.

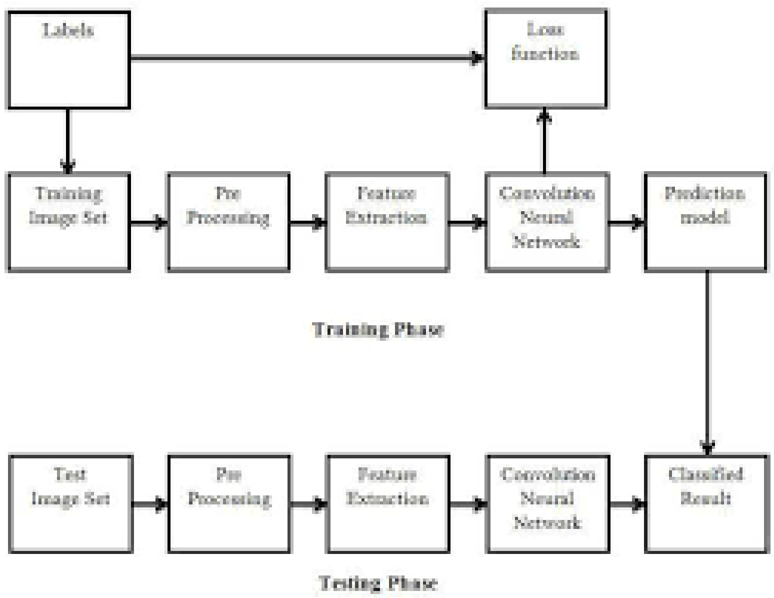
Some people with severe pneumonia are also given a steroid injection. Inhalation of oxygen using a mask is sometimes necessary; artificial respiration is less commonly needed.

If the pneumonia was caused by viruses, other drugs are needed, like a virostatic against flu viruses.

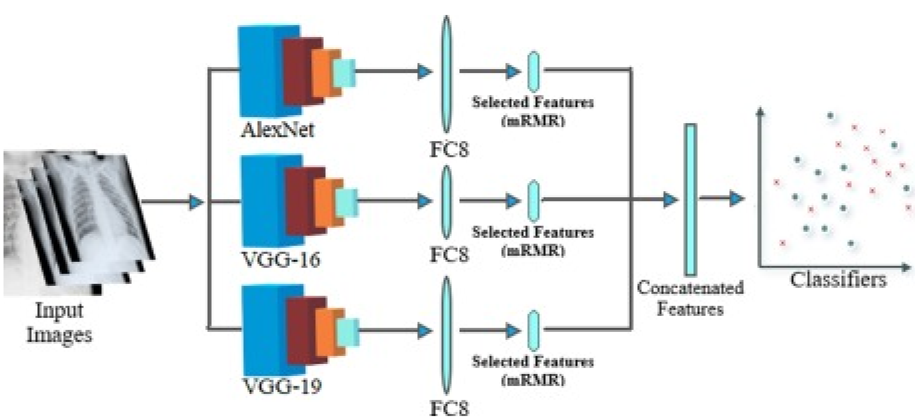
Cough medicines from the pharmacy, special breathing exercises or physiotherapy aren't recommended for treating pneumonia.

3. Theoretical Analysis:

a. Block diagram :



b.Hardware/software designing:



4. Experimental Investigations:

Three different forms of performance evaluations and comparisons were carried out in this study: two classes (normal and pneumonia), three classes (normal, bacterial pneumonia and viral pneumonia), and two classes (bacterial pneumonia and viral pneumonia) classification using four different deep learning algorithms through transfer learning. The experiment carried out in this study consists of three steps. In the first step, the dataset divided into normal and pneumonia. Second step, the dataset divided into normal, bacterial and viral pneumonia. Last step, the dataset divided into bacterial and viral pneumonia. An end-to-end training approach was adopted to classify normal, bacterial and viral pneumonia images.

Performance Matrix for Classification:

Four CNNs were trained and evaluated using five fold cross-validation in this work. The performance of different networks for testing dataset is evaluated after the completion of training phase and was compared using six performances metrics such as- accuracy, sensitivity or recall, Specificity, Precision (PPV), Area under curve (AUC), F1 score.

Accuracy =(TP+TN)/(TP+FN)+($FFFF$+$TTTT$)

Sensitivity =(TP)/(TP+FN)

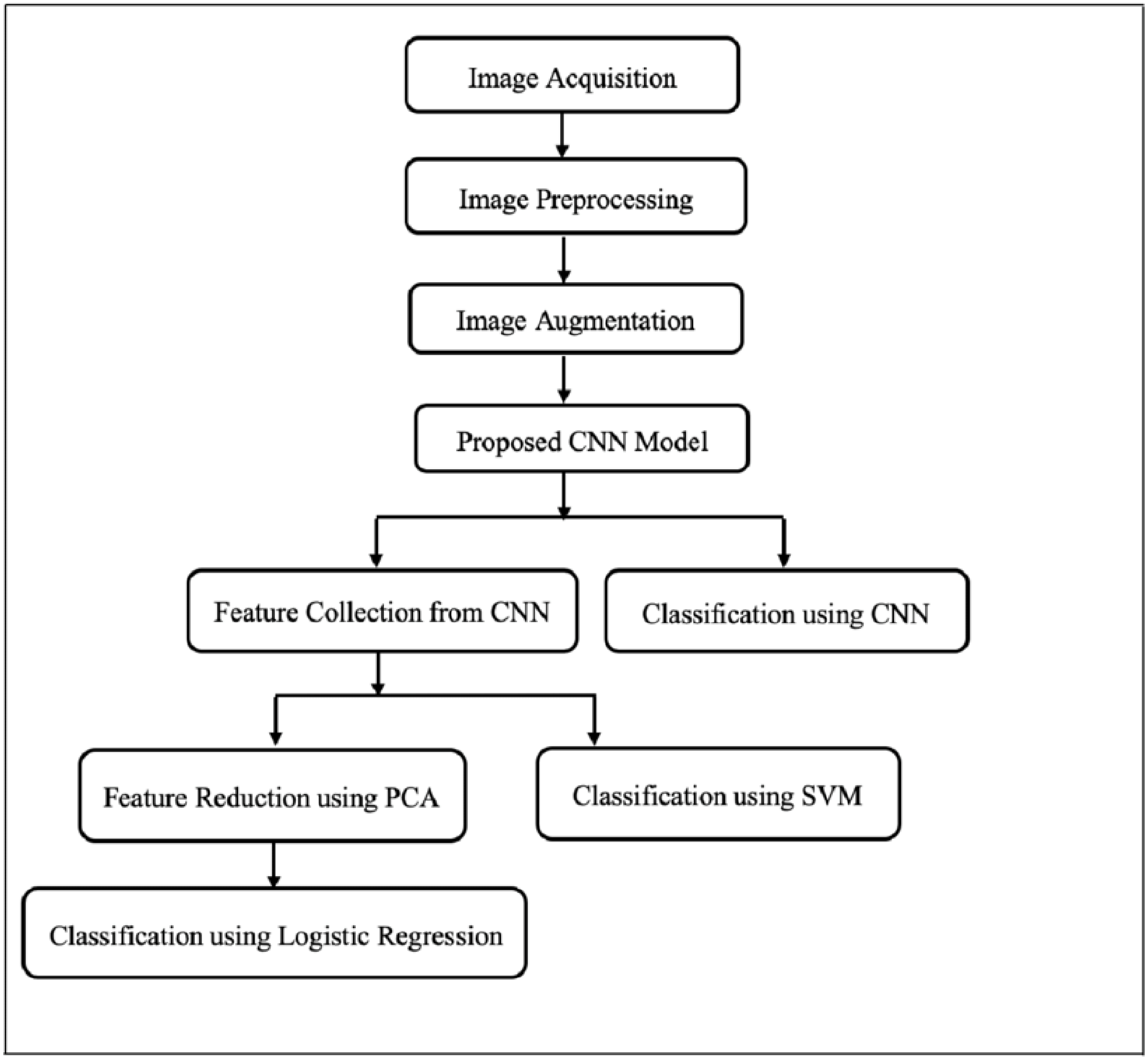
Specificity =(TN)/(FP+TN)

Precision =(TP)/(TN+FP)

F1 score =(2*TP)/(2*TP+FN+FP)

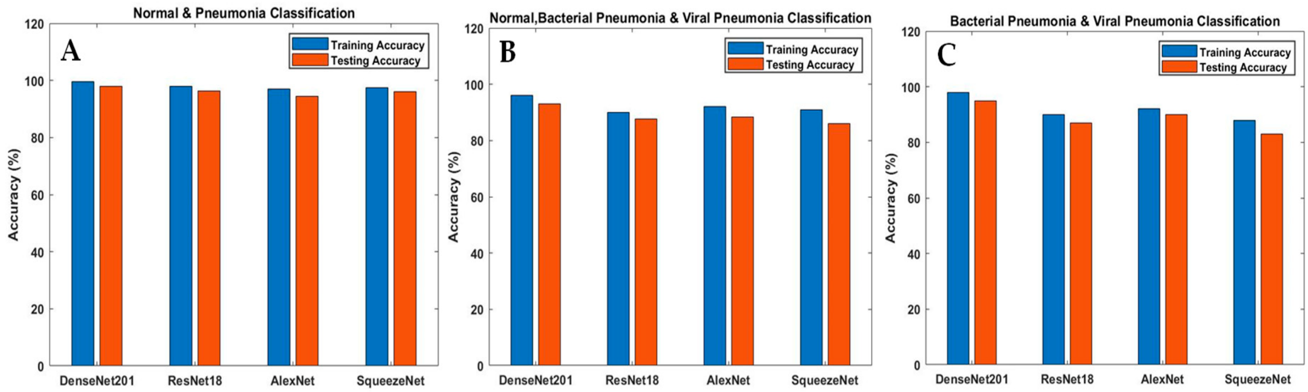
In the above equations, while classifying normal and pneumonia patients, true positive (TP), true negative (TN), false positive (FP) and false negative (FN) were used to denote number of pneumonia images identified as pneumonia, number of normal images identified as normal, number normal images incorrectly identified as pneumonia images and number of pneumonia images incorrectly identified as normal, respectively. On the other hand, while classifying viral and bacterial pneumonia, TP, TN, FP, and FN were used to denote number of viral pneumonia images identified as viral pneumonia, number of bacterial pneumonia images identified as bacterial pneumonia, number bacterial pneumonia images incorrectly identified as viral pneumonia images and number of viral pneumonia images incorrectly identified as bacterial pneumonia, respectively

5. Flowchart:



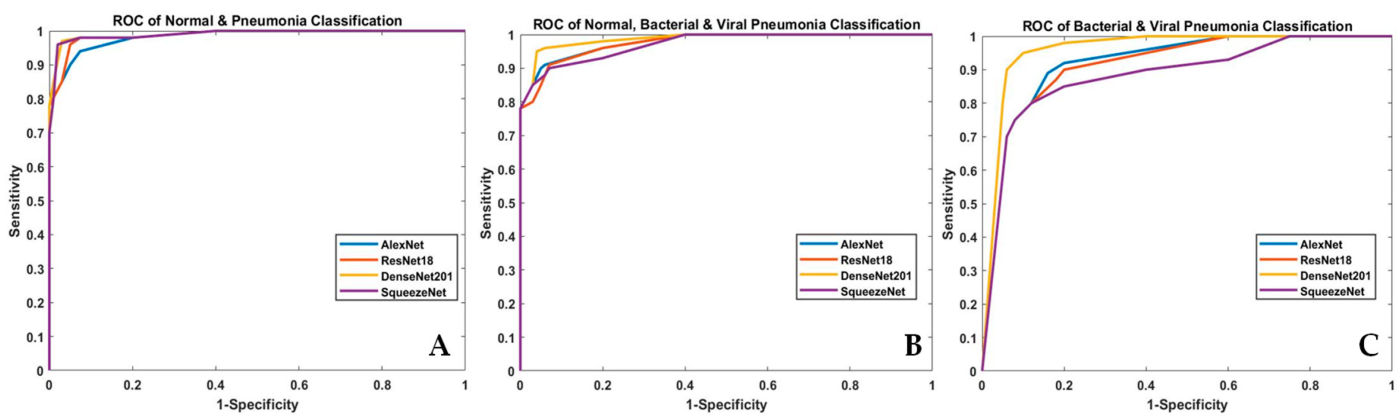
6.result:

The comparative performance of training and testing accuracy for different CNNs for classification schemes were shown in Figure(a). It can be noted that for three classification schemes DenseNet201 is producing the highest accuracy for both training and testing. For normal and pneumonia classification, the test accuracy was 98%, while for normal, bacterial and viral pneumonia classification, it was 93.3%, and for bacterial and viral pneumonia classification, it was found to be 95%. Figur(b)shows the area under the curve (AUC) /receiver-operating characteristics (ROC) curve (also known as AUROC (area under the receiver operating characteristics)) for different classification schemes, which is one of the most important evaluation metrics for checking any classification model's performance. This is also evident from Figure(b) that DenseNet201 outperforms the other algorithms.



figure(a)

Figure (a): Comparison of training and testing accuracy for Normal and Pneumonia (A), Normal, bacterial and viral Pneumonia (B), Bacterial and viral Pneumonia (C) classification for different models.



figure(b)

Figure (b): Comparison of the ROC curve for Normal and Pneumonia (A), Normal, bacterial and viral Pneumonia (B), and Bacterial and viral Pneumonia classification using CNN based models.

7. Advantages & Disadvantages:

	Advantages	Disadvantages
	Easy to implement	Produce rough solutions
	Sets sequential steps	Generally used as initialization of robust approaches
	Lower computational complexity	Poor generalization capability
		Based on low-level features
		Lack of shape constraints
	Provides shape flexibility	Do not perform well at widely varying shapes
	Combines both low-level features and general shape of the lung	Require proper initialization for a successful converge
		The possibility of trapping at local minimum due to bone intensity
	Best part of the schemes are combined	Might require long training process
	Similar accuracy as in inter-observer accuracy	
s	Similar accuracy as in inter-observer performance	Long training process
		Needs large set of annotated data
		Higher computational complexity

*

8. Applications:

- **Bacterial pneumonia.** This type is caused by various bacteria. The most common is *Streptococcus pneumoniae*. It usually occurs when the body is weakened in some way, such as by illness, poor nutrition, old age, or impaired immunity, and the bacteria are able to work their way into the lungs. Bacterial pneumonia can affect all ages, but you are at greater risk if you abuse alcohol, smoke cigarettes, are debilitated, have recently had surgery, have a respiratory disease or viral infection, or have a weakened immune system.

- **Viral pneumonia.** This type is caused by various viruses, including the flu (influenza), and is responsible for about one-third of all pneumonia cases.

You may be more likely to get bacterial pneumonia if you have viral pneumonia.

- **Mycoplasma pneumonia.** This type has somewhat different symptoms and physical signs and is referred to as atypical pneumonia. It is caused by the bacterium *Mycoplasma pneumoniae*. It generally causes a mild, widespread pneumonia that affects all age groups.

- **Other pneumonias.** There are other less common pneumonias that may be caused by other infections including fungi.

9.Conclusion:

This work presents deep CNN based transfer learning approach for automatic detection of pneumonia and its' classes. Four different popular CNN based deep learning algorithms were trained and tested for classifying normal and pneumonia patients using chest x-ray images. It was observed that DenseNet201 outperforms other three different deep CNN networks. The classification accuracy, precision and recall of normal and pneumonia images, bacterial and viral pneumonia images, and normal, bacterial and viral pneumonia were (98%, 97%, and 99%); (95%, 95% and 96%) and (93.3%, 93.7% and 93.2%) respectively. There are millions of children who die each year due to this potentially fatal disease. Timely intervention with proper treatment plan through correct diagnosis of the disease can save a significant number of lives. Due to the huge number of patients attending out-door or emergency specifically in the third world countries, medical doctor's time is limited and computer-aided-diagnosis (CAD) can save lives. Moreover, there is a large degree of variability in the input images from the X-ray machines due to the variations of expertise of the radiologist. DenseNet201 exhibits an excellent performance in classifying pneumonia by effectively training itself from a comparatively lower collection of complex data such as images, with reduced bias and higher generalization. We believe that this computer aided diagnostic tool can significantly help the radiologist to take clinically more useful images and to identify pneumonia with its type immediately after acquisition. This fast classification will open up other avenues of application for this CAD tool, more particularly in the airport screening of pneumonia patients.

10. Future Scope:

Pneumonia constitutes a significant cause of morbidity and mortality. It accounts for a considerable number of adult hospital admissions, and a significant number of those patients ultimately die (with a mortality rate of 24.8% for patients over 75 years) [61]. According to the WHO, pneumonia can be prevented with a simple intervention and early diagnosis and treatment [4]. Nevertheless, the majority of the global population lacks access to radiology diagnostics [62]. Even when there is the availability of imaging equipment, there is a shortage of experts who can examine X-rays. Through this paper, the automatic detection of pneumonia in chest X-ray images using deep transfer learning techniques was proposed. The deep networks, which were used in our methodology, had more complex structures, but fewer parameters and, hence, required less computation power, but achieved higher accuracy. Transfer learning and data augmentation were used to solve the problem of overfitting, which is seen when there is insufficient training data, as in the case of medical image processing. Further, to combine different architectures efficiently, a weighted classifier was proposed. The experiments were performed, and the different scores obtained, such as the accuracy, recall, precision, and AUC score, proved the robustness of the model. The proposed model was able to achieve an accuracy of 98.857%, and further, a high F1 score of 99.002 and AUC score of 99.809 affirmed the efficacy of the proposed model. Though many methods have been developed to work on this dataset, the proposed methodology achieved better results. In the future, it would be interesting to see approaches in which the weights corresponding to different models can be estimated more efficiently and a model that takes into account the patient’s history while making predictions.

11. Bibliography :

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12.Appendix:

source code:

```
# -*- coding: utf-8 -*-
"""Flask.ipynb

Automatically generated by Colaboratory.

Original file is located at
    https://colab.research.google.com/drive/1nbyIORe4vXLKhWx90aZkxUbK1DM-Fjrp
"""

pip install flask-ngrok

from google.colab import drive
drive.mount('/content/drive')

cd /content/drive/MyDrive/Flask-Google\ Colab

cd Flask

from __future__ import division, print_function
import sys
import os
import glob
import numpy as np
from tensorflow.keras.preprocessing import image
from tensorflow.keras.applications.imagenet_utils import preprocess_input, decode_predictions
from tensorflow.keras.models import load_model
from tensorflow.keras import backend
import tensorflow as tf
from resizeimage import resizeimage
from skimage.transform import resize
from PIL import Image
# Flask utils
from flask import Flask, redirect, url_for, request, render_template
from werkzeug.utils import secure_filename
from gevent.pywsgi import WSGIServer
```

```
from flask_ngrok import run_with_ngrok
# Define a flask app
app = Flask(__name__)
run_with_ngrok(app)
# Load your trained model
model = load_model("/content/drive/MyDrive/Flask-Google Colab/Flask/pneumonia.h5")

UPLOAD_FOLDER='/content/drive/MyDrive/Flask-Google Colab/Flask/uploads'
app.config['UPLOAD_FOLDER']=UPLOAD_FOLDER

@app.route('/', methods=['GET'])
def index():
   # Main page
   return render_template('base.html')

@app.route('/predict', methods=['GET', 'POST'])
def upload():
   if request.method == 'POST':
      # Get the file from post request
      file = request.files['image']
      # Save the file to ./uploads
      name=file.filename
      file.save(os.path.join(app.config['UPLOAD_FOLDER'], name))
      image_file = Image.open("/content/drive/MyDrive/Flask-Google
Colab/Flask/uploads/{}".format(name))
      #image_file = image_file.convert('3')
      image_file.save('uploads/{}'.format(name))

      with open('uploads/{}'.format(name), 'r+b') as f:
         with Image.open(f) as image:
            cover = resizeimage.resize_cover(image, [150, 150])
            cover.save('uploads/{}'.format(name), image.format)

      img = Image.open('uploads/{}'.format(name))
      array = np.array(img)
      array=np.expand_dims(array,axis=0)
      pred = np.argmax(model.predict(array),axis=1)
      '''x = image.img_to_array(img)
      x = np.expand_dims(x, axis=0)
      preds = np.argmax(model.predict(x))'''
      if pred[[0]]==0:
```

```
        text = "You are perfectly fine"
    else:
        text = "You are infected! Please Consult Doctor"
    text = text
        # ImageNet Decode
    return text

if __name__ == '__main__':
    app.run()
```