

PNEUMONIA DETECTION USING MACHINE LEARNING

This project report is submitted to

Rashtrasant Tukadoji Maharaj Nagpur University

*In the partial fulfillment of the requirement for the award
of the degree
of*

Bachelor of Engineering in Computer Technology

by

Mr.Somesh Maslekar(CTD1910)

Mr.Vaibhav Mehar(CTD19101)

Ms.Tejaswini Dahare(CTD19111)

Mr.Latesh Ghangal (CTD19105)

Under the guidance of

Mr. Gaurav Divtelwar

Assistant Professor



2022-2023

**DEPARTMENT OF COMPUTER TECHNOLOGY KAVIKULGURU INSTITUTE
OF TECHNOLOGY AND SCIENCE,**

RAMTEK – 441106

CONTENT	Page No.
1. Abstract	1
2. Aims and Objective	2
3. Introduction	3-4
4. Literature Review	5
5. Proposed Approach and system Architecture	6-8
6. Plan of Implementation	9-10
7. Tools/Technologies used	11-14
8. References	15

ABSTRACT

In the world of healthcare, one of the major issues that medical professionals face is the correct diagnosis of conditions and diseases of patients. Not being able to correctly diagnose a condition is a problem for both the patient and the doctor. Prediction of respiratory diseases at their earlier stages can be very useful especially to improve the survival rate of that patient. Pneumonia is one of the most threatening diseases due to which many people die and the main reason behind it is that many people don't get to know about it in the early stages, due to some reasons and when they know it, it's too late. But, if these diseases are detected at the early stages, the probability of them being cured increases. But in numerous parts of the world far-reaching screening by CT, MRI or X-ray is not pragmatic, so midsection radiology stays in starting and most basic system. This model could help mitigate the reliability and interpretability challenges often faced when dealing with medical imagery. Unlike other deep learning classification tasks with sufficient image repository, it is difficult to obtain a large amount of pneumonia dataset for this classification task; therefore, we deployed several data augmentation algorithms to improve the validation and classification accuracy of the CNN model and achieved remarkable validation accuracy. Our classification method uses convolutional neural networks (CNNs) for classifying the images and early diagnosis of pneumonia.

KEYWORDS – Pneumonia detection, Respiratory disease, Convolutional neural network, Image processing, Chest X-ray, Machine learning, deep learning.

AIMS AND OBJECTIVES

Aim: The project aims to detect pneumonia at an early stage to provide proper treatment so that it will improve the survival rate of the patients.

Objectives: The key objective of the current model are given below:

- The main objective of the model is to take a chest X-ray image as an input and classify the image.
- To achieve this some image preprocessing techniques like resizing, grayscaling, and thresholding will be performed before feeding it to the CNN model.
- We will use transfer learning to train the model after which the model will be deployed on a website.
- The website will have a login prompt as security.

INTRODUCTION

Pneumonia is an acute pulmonary infection that can be caused by bacteria, viruses, or fungi and infect the lungs, causing inflammation of the air sacs and pleural effusion, a condition in which the lung is filled with fluid, causing cough with phlegm or pus, fever, chills, and difficulty breathing. Pneumonia is most common in underdeveloped and developing countries, where overpopulation, pollution, and unhygienic environmental conditions exacerbate the situation, and medical resources are scanty. Therefore, early diagnosis and management can play a pivotal role in preventing the disease from becoming fatal. Radiological examination of the lungs using computed tomography (CT), magnetic resonance imaging (MRI), or radiology (X-rays) is frequently used for diagnosis. X-ray imaging constitutes a non-invasive and relatively inexpensive examination of the lungs. A variety of organisms, including bacteria, viruses, and fungi, can cause pneumonia. Many people die of this disease because they are not detected in the early stages. If these diseases are detected in the early stages then there may be a chance to save people. Due to these diseases, the air sacks of our lungs may be filled with fluid or pus(purulent material). By using image processing in conjunction with machine learning algorithms we can build a model which will detect these diseases in their early stages and then generate a report based on the result. If the disease is detected in its early stages then by proper treatment, we can save many lives.

Deep learning is an important artificial intelligence tool, which plays a crucial role in solving many complex computer vision problems. Deep learning models, especially convolutional neural networks (CNNs), are used extensively for various image classification problems. However, such models perform optimally only when they are provided with a large amount of data. For biomedical image classification problems, such a vast amount of labeled data is difficult to acquire because it requires that expert doctors classify each image, which is an expensive and time-consuming task. Transfer learning is a work-around to surmount this obstacle. In this technique, to solve a problem that involves a small dataset, a model trained on a large dataset is re-used and the network weights determined in this model are applied. CNN models trained on a large dataset such as ImageNet. The proposed methodology uses a deep transfer learning algorithm that extracts the features from the x-ray image that describes the presence of disease automatically and reports whether it is a case of pneumonia.

A convolutional neural network (CNN) is a type of feed-forward network. The main advantage of CNN compared to its predecessors is that it is capable of detecting the relevant features without any human supervision. A series of convolution and pooling operations are performed on the input image, which is followed by a single or multiple fully connected layers. The output layer depends on the operations being performed. For multiclass classification, the output layer is a softmax layer. The strength of convolutional neural networks comes from a particular kind of layer called the convolutional layer. It can run directly on an underdone image and does not need any preprocessing. CNN is very satisfactory at picking up on design in the input image, such as lines, gradients, circles, or even eyes and faces. This characteristic makes a convolutional neural network so robust for computer vision. A typical neural network will have an input layer, hidden layers, and an output layer. CNN's are inspired by the architecture of the brain. Just like a neuron in the brain processes and transmits information throughout the body, artificial neurons or nodes in CNNs take inputs, process them, and send the result as output.

LITERATURE REVIEW

Lee et al. (2018) proposed DetNet, which was designed specifically for target detection and achieved better detection results with fewer layers. To avoid the large computational complexity and memory consumption caused by the high-resolution features map, the network adopts a low-complexity dilated bottleneck structure; a higher resolution of the feature map is ensured while obtaining a higher subtractive field. This paper draws on the idea of DetNet and the framework of faster R-CNN to study the detection of pneumonia.

Hashmi et al. (2019) proposed a weighted classifier-based approach that combines the prediction weights obtained from ResNet18, InceptionV3, Xception, MobileNetV3, and DenseNet-121 models. The authors stated that the final weighted classifier model achieved an accuracy of 80% on the test set. However, developing a lightweight and effective pneumonia detection approach for energy-efficient medical systems is still a challenging task that needs to be improved. The current deep learning-based pneumonia detection approaches have limitations in choosing suitable hyperparameter values for constructing a lightweight and accurate model.

Rajpurkar et al.(2017) proposed a classical deep learning network named DenseNet-121, which was a 121-layer CNN model to accelerate the diagnosis of pneumonia. In contrast to experienced doctors, the framework obtained a higher F1 score. Besides, to alleviate the effect of imbalanced classes, the team introduced Weighted Binary Cross-Entropy loss, whose difference between the Binary Cross Entropy loss was the different weights of imbalanced classes according to the number of each class. However, the proposed loss did account for the different training difficulty levels of classes. To solve the problem of poor generalization ability caused by over-fitting and the problem of spatial sparseness caused by ordinary convolution operation, residual connection network and dilated convolution was used by Liang in the backbone network model.

Proposed approach and System architecture

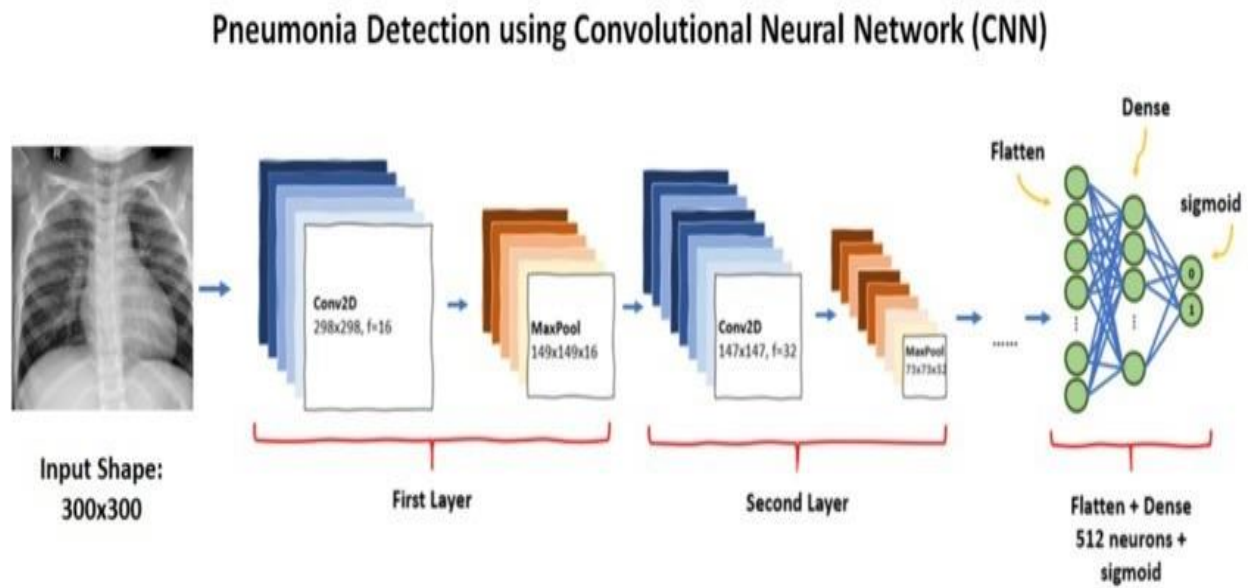


Fig 1.1: System architecture for Pneumonia detection using convolutional neural network

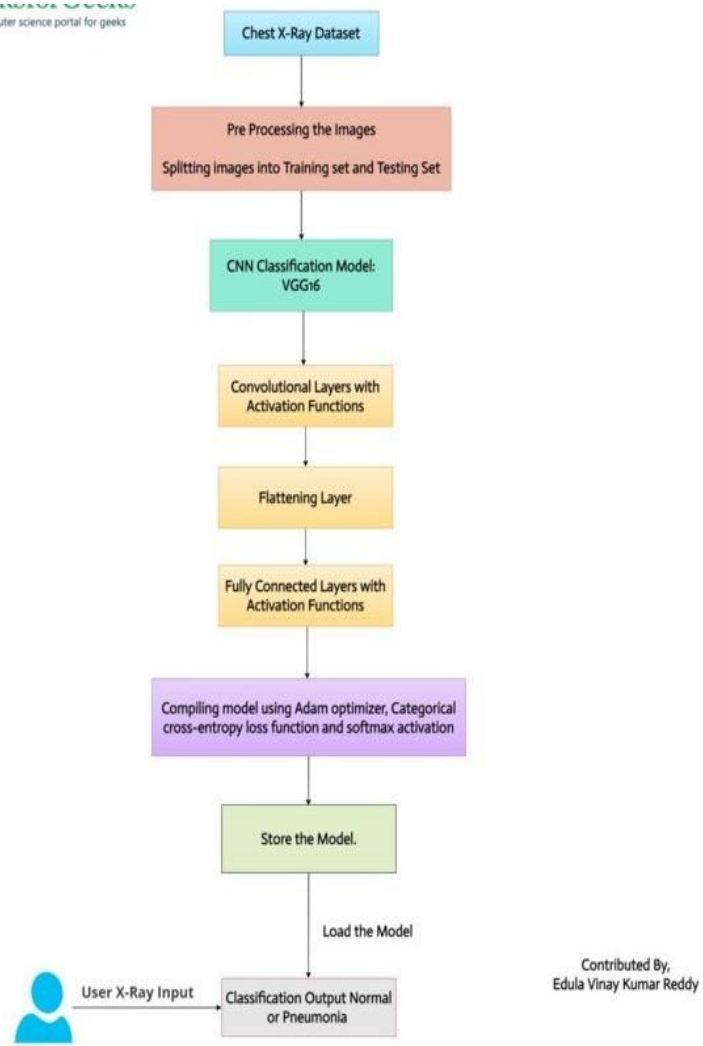


Fig 1.2: UML diagram for pneumonia detection

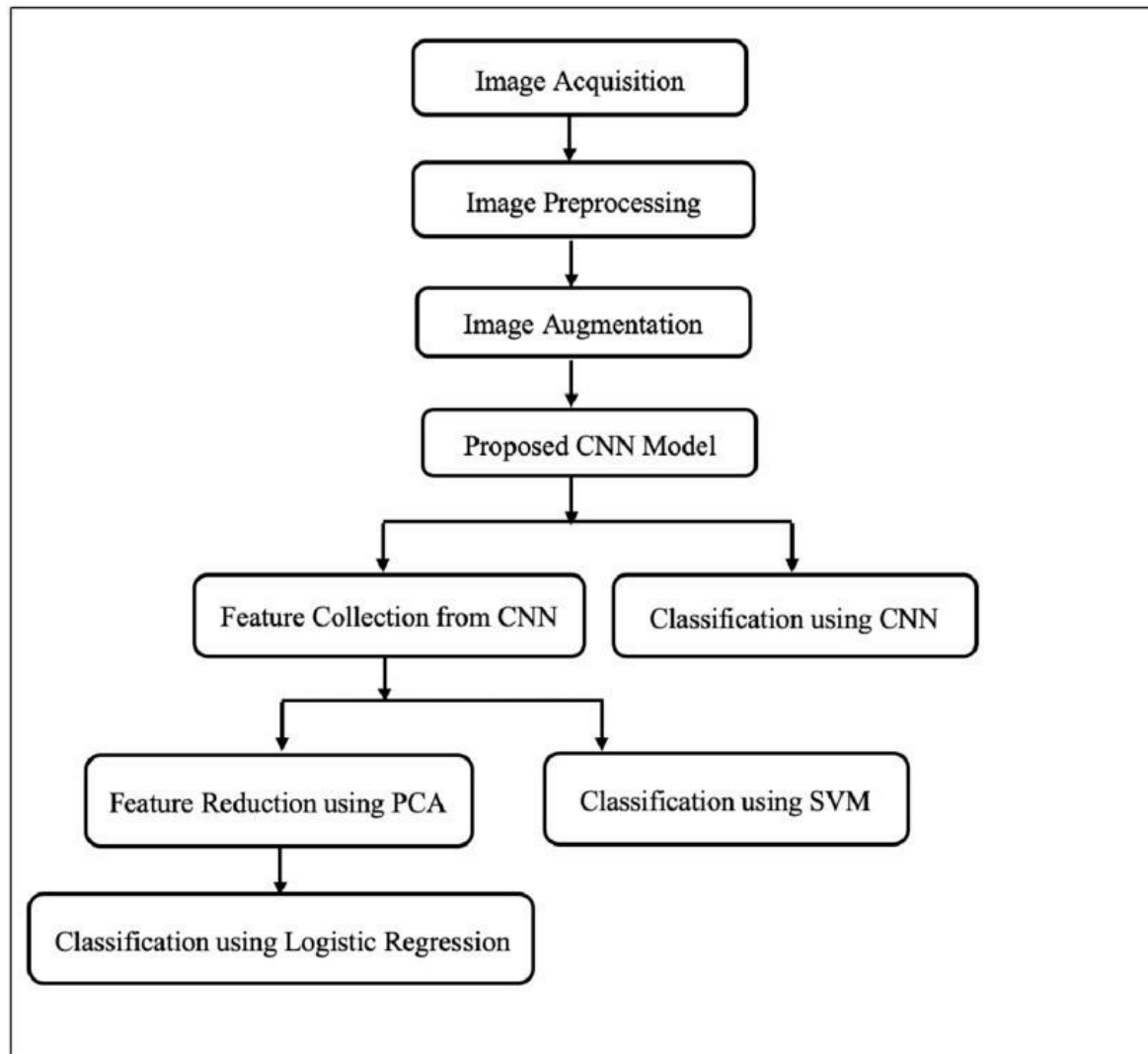


Fig1.3: Block diagram for pneumonia detection

PLAN OF IMPLEMENTATION

Gathering and preprocessing data

All transformations performed on raw data before feeding it to the machine learning algorithm are referred to as pre-processing. Technically data preprocessing is a technique in which the main aim is to transform the data into that form that is compatible for the model to understand before data can be used, it must be preprocessed.

Training the model with different algorithms

In this proposed model, firstly the dataset is imported and split into three parts train, test and validation. Now each train, test, and validation set is been initialized. After that now this set will need to transform into the proper form of images using ImageDataGenerator. The ImageDataGenerator will automatically label all the data inside the folder as pneumonia which images are of positive patients and vis-a-vis for negative patients. By this function, the model is the stage where the object of the class ImageDataGenerator is been created now for creating data-frames of train-data, pass each train-data to the data-frame attribute in the function which will convert the images into the array. So now as the data frame has been generated that will be passed into the model training. Convolutional neural networks are algorithms that detect patterns in data. In general, neural networks are composed of layers of neurons, each with its own set of learnable weights and biases.

Testing and evaluating model using F1 score as metric

The model is being tested on the test dataset after the completion of the training phase. Their performance was validated using the accuracy, recall, precision, F1, and area under the curve (AUC) score. The performance metrics include accuracy, precision, recall, and F1 score. Because it helps us understand the strengths and limitations of these models when making predictions in new situations, model performance is essential for machine learning.

Building frontend of the model

The front of the model is designed using HTML for giving eye-catching look, CSS is a cascading style sheet it gives a designer look to HTML, PHP which is a widely used general scripting language, and SQL (structure query language).

Work on the backend by implementing a login module as a security

In programming, a useful necessity characterizes an element of a product framework or its part. A capacity is portrayed as a bunch of data sources, conduct, and yields. Utilitarian prerequisites might be counts, specialized subtleties, information control, preparation, and other explicit usefulness that characterize what a framework should achieve. Social necessities depicting all the situations where the framework utilizes the useful prerequisites are caught being used cases. If a new user, then registers by giving personal details like name, age, address, phone number, email, and password.

Deploying the model

Deploying the model into an existing production environment to make practical business decisions based on data. To start using a model for practical decision-making, it needs to be effectively deployed into production.

Testing the model

Selenium is an open-source tool primarily used for automating tasks in a web browser. Selenium testing has become crucial in the web development profession. It is also possible to perform multiple tests with selenium.

TOOLS/TECHNOLOGIES USED

- **Python**

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built-in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components. Python's simple, easy-to-learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms and can be freely distributed. Python is commonly used for developing websites and software, task automation, data analysis, and data visualization. Since it's relatively easy to learn, Python has been adopted by many non-programmers such as accountants and scientists, for a variety of everyday tasks, like organizing finances.

- **Jupyter notebook**

The Jupyter Notebook is an open-source web application that you can use to create and share documents that contain live code, equations, visualizations, and text. Jupyter Notebook is maintained by the people at project jupyter. It is the latest web-based interactive development environment for notebooks, code, and data. Its flexible interface allows users to configure and arrange workflows in data science, scientific computing, computational journalism, and machine learning. A modular design invites extensions to expand and enrich functionality. A notebook integrates code and its output into a single document that combines visualizations, narrative text, mathematical equations, and other rich media. In other words: it's a single document where you can run code, display the output, and also add explanations, formulas, and charts, and make your work more transparent, understandable, repeatable, and shareable.

- **OpenCV**

OpenCV is a cross-stage library that is utilized to grow ongoing pc vision applications. OpenCV centers principally around picture preparing video catch and investigation which incorporates highlights like face identification and item location.

Computer vision is one of these fields that explains the procedure to reconstruct, interrupt, and understand a 3D scene from its 2D images, based on the properties of the structure present in the image. Computer vision deals with replicating human vision using hardware and software technologies. There are many such fields with which computer vision overlaps such as image processing, pattern recognition, and photogrammetric.

- **TensorFlow**

TensorFlow is an open-source library for numerical computation and large-scale machine learning. TensorFlow bundles together a slew of machine learning and deep learning models and algorithms (*aka* neural networks) and makes them useful by way of common programmatic metaphors. It uses Python or JavaScript to provide a convenient front-end API for building applications while executing those applications in high-performance C++. TensorFlow was developed by the google brain team for internal google use in research and production.

- **Keras**

Keras is one of the most powerful and easy-to-use python libraries, which is built on top of popular deep learning libraries like TensorFlow, Theano, etc., for creating deep learning models. Keras runs on top of open source machine libraries like TensorFlow, Theano, or Cognitive Toolkit (CNTK). Keras was created to be user-friendly, modular, easy to extend and to work with Python. The API was "designed for human beings, not machines," and "follows best practices for reducing cognitive load."

- **HTML**

HTML stands for Hyper Text Mark-up language which is used for creating web pages and web pages and web applications. Let's see what is meant by hypertext mark-up language, and web page. Hypertext: Hypertext simply means "Text within Text." A text has a link within it, which is a hypertext. Whenever you click on a link that brings you to a new webpage, you have clicked on a hypertext. Hypertext is a way to link two or more web pages (HTML documents) with each other.

Mark-up language: A mark-up language is a computer language that is used to apply layout and formatting conventions to a text document. Mark-up language makes the text more interactive and dynamic. It can turn text into images, tables, links, etc. Web page: A web page is a document that is commonly written in HTML and translated by a web browser. A web page can be identified by entering an URL. A web page can be of the static or dynamic type. With the help of HTML only, we can create static web pages.

- **CSS**

Cascading Style Sheets (CSS) is a stylesheet language used to describe the presentation of a document written in HTML or XML. CSS describes how elements should be rendered on screen, on paper, in speech, or on other media. It is generally used with HTML to change the style of web pages and user interfaces. It can also be used with any kind of XML document including plain XML, SVG, and XUL. CSS is used along with HTML and javascript in most websites to create a user interface for web applications and a user interface for many mobile applications. Before CSS, tags like font, color, background style, element alignments, border, and size had to be repeated on every web page. This was a very long process.

- **Javascript**

JavaScript (js) is a lightweight object-oriented programming language that is used by several websites for scripting webpages. It is an interpreted, full-fledged programming language that enables dynamic interactivity on websites when applied to an HTML document. With JavaScript, users can build modern web applications to interact directly without reloading the page every time. The traditional website uses js to provide several forms of interactivity and simplicity. The traditional website uses js to provide several forms of interactivity and simplicity.

- **PHP**

The PHP Hypertext preprocessor (PHP) is a programming language that allows web developers to create dynamic content that interacts with databases. PHP is used for developing web-based software applications. This tutorial helps you to build your base with PHP. It is a server-side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, and even build entire e-commerce sites. It is integrated with many popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server. PHP is used for control statements, functions, array, string, file handling, form handling, regular expression, date and time, object-oriented programming in PHP, math, PHP MySQL, PHP with Ajax, PHP with jQuery, and PHP with XML.

PHP is an open-source, interpreted, and object-oriented scripting language that can be executed on the server-side. PHP is well suited for web development. Therefore, it is used to develop web applications (an application that executes on the server and generates the dynamic page.).

REFERENCES

1. Enes Ayan, Halil Murat Unver, "Diagnosis of Pneumonia from Chest X-ray Images using Deep Learning", 2019.
2. Abhishek Sharma, Daniel Raju, Sutapa Ranjan, "Detection of Pneumonia clouds in Chest X-ray using Image processing approach". 2017.
3. B. Li, G. Kang, K. Cheng, and N. Zhang, "Attention-guided convolutional neural network for detecting pneumonia on chest X-rays," in *proc. 441st Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC)*, Jul. 2019.
4. H.S. Omar and A. Babalik, "Detection of pneumonia from X-ray images using convolutional neural network," in *proc. Book*, 2019, p.183.
5. Xin Li, Fan Chen, Haijiang Hao, Mengting Li "A pneumonia Detection Method Based on Improved Convolutional Neural Network" 2020 IEEE 4th Information Technology, Networking, Electronic and Automation Control Conference (ITNEC 2020)

