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Pneumonia Disease Detection using CNN

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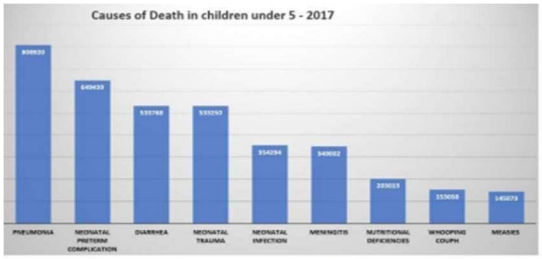
Abstract: *Pneumonia is a potentially fatal lung disease brought on by an infection that is bacterial or viral. It may be life- threatening if not treated promptly, thus early detection of pneumonia is critical.*
The article emphasizes the need of early identification of pneumonia, a potentially fatal lung condition resulting from a viral or bacterial illness. It suggests an automated approach for diagnosing digital x-ray images for diagnosing bacterial and viral pneumonia, as well as a thorough report on the methods employed. The scientists trained a dataset 5247 chest x-ray images, including bacterial, viral, and regular chest x- ray images using four pre-trained Convolutional Neural Networks (CNNs). The study provides three categorization systems with good learning accuracy rates. normal vs. pneumonia, bacterial vs. viral pneumonia, and normal, bacterial, and viral pneumonia, respectively, of 98%, 95%, and 93.3%. The findings of this study have important implications for faster and more accurate pneumonia diagnosis by radiologists, as well as for swift pneumonia sufferers are screened at airports

Keywords: chest X-ray, viral and pneumonia caused by bacteria, deep learning.

I. INTRODUCTION

Pneumonia is a prevalent disease worldwide, affecting over 450 million individuals annually, which accounts for 7% of the global population [1]. Pneumonia kills almost four million people each year. [2], with young children under the age of 5 being particularly susceptible [3] According to a "Our World in Data" [4] study, pneumonia is responsible for the highest death rate among children under five, as shown in Figure 1. In 2017, 808,920 children died as a result of pneumonia., which is 16 times higher cancer related deaths and ten times higher than HIV-related deaths. Figure 1 illustrates this data.



This figure shows the number for causes of death in the Children under the age of during 2017. It shows the pneumonia has the highest number of deaths in contrast o other common diseases[2]

According to a research presented on World Pneumonia Day, by 2030, over Millions of young people under the age of five may perish. from pneumonia [5]. Pneumonia has been a significant cause of death among people since the early 19th century.

II RELATED WORK

Recently, the use In the realm of medical image grouping, the use of algorithms based on machine learning (ML) for identifying thoracic disorders has garnered interest. Sundaram and Lakhani utilized two different deep convolutional neural networks (DCNNs), Alex Net and Google Net, for detecting pulmonary tuberculosis. Huang et al. suggested a deep learning-based technique for classifying nodules in the lungs. to diagnose lung cancer. Islam et al. explored the performance of several convolutional neural network (CNN) versions in identifying anomalies in chest X- rays using the Open dataset. To further enhance the application Wang et al. published a larger frontal chest X-ray dataset for their investigation into machine learning in chest screening.

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III LITERATURE REVIEW

Machine learning methods have been used to identify a number of medical disorders., including pneumonia. Several studies have explored different methods of using artificial intelligence to diagnose diseases. The previous paragraph highlights some of the research work in the medical image categorization field using machine learning algorithms. We have examined research on medical image detection, including the use of various datasets to develop effective models and the strengths and limitations of these aproaches.

Deep learning is a useful technique for training medical image datasets, including for the detection of pneumonia. A research employed deep learning models of restnet-101 and restnet50 to identify pneumonia, although the outcomes varied depending on individual variables. To compensate for this discrepancy, a successful deep learner method including the combination of both strategies was presented. The study included a dataset of 14,863 x-ray scans, and the accuracy obtained was impressive. for detecting several Regions of Interest (ROIs) in an input was 96%. However, when bigger datasets are examined in a realtime situation, the difficulty of merging the Rest Net models may restrict the precision.

An artificial neural network (ANN) has been found to be effective in detecting and diagnosing breast cancer, TB, and pneumonia are all examples of chest disorders.

The study used different pre processing techniques to eliminate irrelevant data and enhance the imaging process, such as histogram equalization and image filtering. Lung segmentation was a critical interest in identifying pneumonia infection, as well as various diagnostic features were extracted to classify images obtained for detecting pneumonia. The feedforward The neural network assisted in achieving 92% accuracy. with a dataset obtained from 80 patients. However, Changes in the position and size of chest x- ray pictures reduced accuracy considerably. Although pattern recognition algorithms are effective in detecting medical pictures, including chest ailments, this technology has drawbacks, including the inability to identify changes in image size and structure. It is crucial to develop a neural network model that can detect changes in image size and structure as a result. to overcome this flaw. [4]

Medical image classification requires a powerful machine learning model due to the complex nature of pattern recognition involved. Convolutional neural network (CNN) is a widely used approach for this purpose, owing to its layered structure. CNN is composed of stacked layers with varying heights, widths, and depths, and its dense structure allows for weight sharing. During training, the CNN is fed input data, and the parameters are learned to generate the desired output. The use of CNN is a popular and effective approach for medical image classification.

CNN is an effective technique for medical picture categorization because to its thick stacking topology. The CNN structure is made up of a stack of layers with different depths, widths, and heights. that permit weight sharing. CNNs are taught by feeding them data and learning different parameters to determine individual output. The primary purpose of employing the CNN technique is to Reduce the disparities between projected and actual outcomes.

CNN is divided into two stages: region suggestions and object categorization. The object detector picks regions in an image that are likely to contain items of interest during the region proposal stage.. In the second stage, the most promising ROIs are selected, and objects within them are classified. However, CNNs have limitations, such as ignoring feature dependencies, which can result in feature selection issues and noise exclusion.

To address these limitations, a two-step model was used to examine high-resolution medical images and Exploit statistical dependencies between labels, which are critical in boosting illness diagnosis accuracy. The figure depicts the CNN architecture. [3]

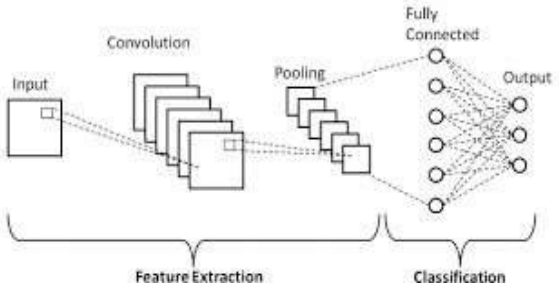

Figure 1: CNN Model Architecture[3].

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IV OBJECTIVE

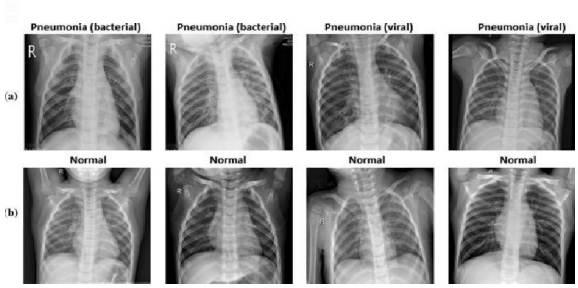
The primary goal of this initiative is to establish if someone has pneumonia or not., If yes then to determine whether it is caused by the bacteria or viruses

.Several x-ray image in the data set are used in the project for the detection hence for the better result we need the better accuracy from these images, in order to solve this problem we will use CNN (Convolutional Neural Network). CNN provides an excellent ability to perform image classification with an accuracy of an about 90-95%.

V. DESIGN METHODOLOGY

The collection contains 5856 chest X-ray pictures, comprising 1574 4282 pneumonia cases and normal cases. Using a 70:15:15 ratio, the images were randomly split into three sets for training, validation, and testing. deep convolutional neural networks used in this study Inception-v3, ResNet-50, and DenseNet-121 are examples. The networks were fine-tuned on the dataset, and their performances were utilised to assess using F1- score, AUC-ROC, recall, accuracy, and precision metrics. Experimental results showed that all three models achieved good performance with accuracy above 95%. However, Dense Net- 121 outperformed the other models with the highest F1-score and AUC- ROC. study demonstrates the effectiveness of using deep Chest X-ray pictures using convolutional neural networks to identify pneumonia and highlights the importance of selecting appropriate models for the task. [5]

The study's dataset includes 5,856 chest X-ray pictures, including 5,232 624 photos made up the test subset and 624 images the training subset. 3,883 images in the training subgroup were classified as pneumonia, whereas 1,349 were classified as normal. In the test subset, 390 photographs are identified as pneumonia, whereas 234 images are identified as normal. The pneumonia patients in the dataset are classified as bacterial or viral. A table depicts the distribution of the collection's normal, bacterial, and viral samples. Figure3 also includes various examples of photographs labelled as pneumonia or normal.



Images from a chest X-ray dataset: a pneumonia labelled image, b normal labelled image

VI DATA AUGMENTATION AND TRANSFER LEARNINGFINE TUNING

Large volumes of data are necessary during the training phase to increase the generalisation capabilities of CNN models. Obtaining adequate data for some computer vision issues, however, can be difficult, particularly for medical concerns that need tedious and time-consuming procedures. labeling. To address this issue, different methods, such as data augmentation, have been developed. In this study, To increase the model's performance, data augmentation was applied. generalization ability, prevent overfitting, and increase accuracy. Specifically, techniques for processing images were used to process the regular chest X-ray pictures, and 2,534 new enhanced images were created. generated. Additionally, real-time data augmentation methods were To avoid overfitting, this is employed during the training phase. Transfer learning, which includes leveraging knowledge learnt from one task to tackle another comparable problem, is another way used to increase the performance of deep neural networks..

In recent years, many researchers have used pre-trained CNN filters on ImageNet data to train CNN networks for various computer vision problems, including medical image analysis. This approach significantly reduces the training time. Depending on the task and data, transfer learning may be applied in a variety of ways, including feature extraction, finetuning, and pre- trained models. similarity with ImageNet data. The general features learned in the first layers of a CNN may be used to many datasets and situations, while data-specific characteristics emerge in the following layers. In this work, a two-stage transfer learning technique was applied, with seven CNN models trained

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using various transfer learning and fine-tuning methods to categorise chest X-ray pictures as pneumonia or normal. The optimal hyperparameters were determined through a trial-and-error strategy, and the For the ensemble procedure, which required retraining CNN models, the most effective models were picked. previously trained to classify normal or pneumonia to classify either typical, bacterial, or viral pneumonia.

VII CONVOLUTIONAL NEURAL NETWORKS

Backpropagation is a technique used by Convolutional Neural Networks (CNNs) to learn spatial properties from data. They are made up of crucial components including convolution, pooling, and fully linked layers. The convolution layer extracts information from the input picture using a set size filter, generating an activation map for each filter. The pooling layer decreases picture size while preserving features, resulting in lower model parameters and processing costs. The FC layers classify information retrieved by convolutional layers and serve as the CNN's output. In order to identify pneumonia in chest X-ray pictures, seven well-known CNN models were trained. in this work, and the best three models were chosen for the ensemble technique based on their performance in testing.

VIII CONCLUSION

To summarize, the study presented a pneumonia detection in chest X-ray images using the CNN model was developed and tested. high accuracy and could be useful for medical professionals. Future work could involve increasing the dataset size, applying more data augmentation techniques, and exploring transfer learning techniques to further improve the model's performance. The proposed CNN model demonstrates potential for automated Using a chest X-ray to identify pneumonia images.

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