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Pneumonia Detection Using Deep Learning Methods

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Abstract: ***A lung infection known as pneumonia develops when the virus spreads to the lungs' air sacs or alveoli. By processing medical images, artificial intelligence and machine learning techniques have been used in the field of medicine to improve the accuracy of disease reporting.. This paper presents a new model for diagnosing pneumonia and primarily focuses on analysing and contrasting the diagnosis of lung illness using various deep learning methods like VGG16, VGG19, RESNET-50 and RESNET-101 . These methods are investigated on x-ray datasets. From the above models the best deep learning model is selected to create an application which determines whether the given x-ray is pneumonia effected or normal. In contrast to other current methods, the experimental study has demonstrated our suggested method's strong performance.***
Keywords: Pneumonia detection, deep learning, VGG16 , VGG19 ,RESNET-50 and RESNET-101.

I. INTRODUCTION

A dangerous illness that inflames the air sacs is pneumonia. It can affect either one lung or both. The World Health Organization reports that pneumonia has been connected to several fatalities in India. A radiotherapy expert is required to review the chest x-rays. Therefore, a computer-based algorithmic detector will be helpful for quickly identifying the pneumonia-affected x-ray even in remote locations. The work of performing medical analysis has become simple thanks to deep learning algorithms. Convolutional neural networks are commonly utilised in illness categorization. Additionally, pre-trained CNN models' feature extraction is more effective for classification. The software created classifies the images using several attributes taken from the data set of X-ray images.

The research of machine learning (ML) techniques for detecting lung disorders has recently attracted interest in the area of research for medical picture identification.

II. RELATED WORKS

R. Nijhawan, M. Rishi, A. Tiwari, and R. Dua's paper titled "A Novel Deep Learning Framework Approach for Natural Calamities Detection" was released in 2019. The authors suggest a unique deep learning architecture for exploiting satellite imagery to detect natural disasters including earthquakes, floods, and wildfires.[1]

The paper "Classification of Pneumonia in Chest Radiographs Using Deep Learning" by Omar Althomali, Mohammed A. Al-Zoube, and Fahad S. Alotaibi was published in 2019. The classification of pneumonia in chest radiographs might be done using a deep learning model, according to the authors. The algorithm used is SVM[2]

Omar Althomali, Mohammed A. Al-Zoube, and Fahad S. Alotaibi's research article titled "Classification of Pneumonia in Chest Radiographs Using Deep Learning" was released in 2019. The classification of pneumonia in chest radiographs might be done using a deep learning model, according to the authors.[3]

Al Mamlook R. E., Chen S., and Bzizi H. F. presented their article, "Investigation of the Performance of Machine Learning Classifiers for Pneumonia Detection in Chest X-ray Images.They evaluate the performance of several classifiers, such as support vector machines, decision trees, random forests, logistic regression, and k-nearest neighbours (KNN). (SVM).[4]

The paper "Pneumonia Classification Using Deep Learning from Chest X-Ray Images During COVID-19" With an emphasis on the COVID-19 environment, the authors suggest a deep learning-based method for classifying pneumonia in chest X-ray pictures.[5]

In 2020, Liang G. and Zheng L. released a paper titled "A Transfer Learning Method with Deep Residual Network for Pediatric Pneumonia Diagnosis."The authors suggest a deep residual network-based transfer learning method for diagnosing paediatric pneumonia. (ResNet). [6]

V. Sirish Kaushik and colleagues presented their paper titled "Pneumonia Detection Using Convolutional Neural Networks (CNNs)."Convolutional neural networks are suggested by the authors as a deep learning-based method for detecting pneumonia in chest X-ray pictures. (CNNs).[7]

Sajid Mahmood, Muhammad Afaq, and Muhammad Sharif's publication, "Pneumonia Detection using Deep Learning from Chest X-Ray Images," was released in 2019.The authors suggest using deep learning to identify pneumonia in chest X-ray pictures. The suggested method entails pre-processing the chest X-ray pictures, then training a convolutional neural network (CNN) to categorise the images as normal or pneumonia.[8]

2020 saw the publication of a study by Ehsan Hosseini-Asl, Kasra Saeb-Parsy, and Simon Graham titled "Deep Learning-Based Pneumonia Detection on Chest X-Ray Images."The authors suggest using deep learning to identify pneumonia in chest X-ray pictures. Pre-processing the chest X-ray pictures and training a convolutional neural network (CNN) to categorise the images into normal, bacterial pneumonia, and viral pneumonia categories are also part of the suggested method.[9]

The paper "Pneumonia detection on chest X-Ray using machine learning paradigm" by Chandra T. and Verma K. was published in 2020. [11]

A study by Janizek J., Erion G., DeGrave A., and Lee S. titled "An adversarial approach for the robust classification of pneumonia from chest radiographs" was released in 2020.The authors suggest an adversarial strategy for the accurate diagnosis of pneumonia based on chest radiographs.[12]

2020 saw the release of the publication "Deep learning for automatic pneumonia detection" by Gabruseva T., Poplavskiy D., and Kalinin A.The authors of this research suggest a deep learning-based method for automatic pneumonia detection utilising pictures from chest X-rays. They divided chest X-ray pictures into two categories—normal and pneumonia—using a convolutional neural network (CNN) model.[13]

2020 saw the publication of a study by Praveen Kulkarni, Ramakrishnan Swaminathan, and Jayaraman J. Thiagarajan titled "Deep Learning for Pneumonia Detection in Chest X-rays: A Comparative Study."In this work, the scientists compared various deep learning models for detecting pneumonia in chest X-rays.[14]

The proposed paper evaluates the accuracy values of different deep learning models using x-ray image dataset.

III. METHODOLOGY

A. Block diagram

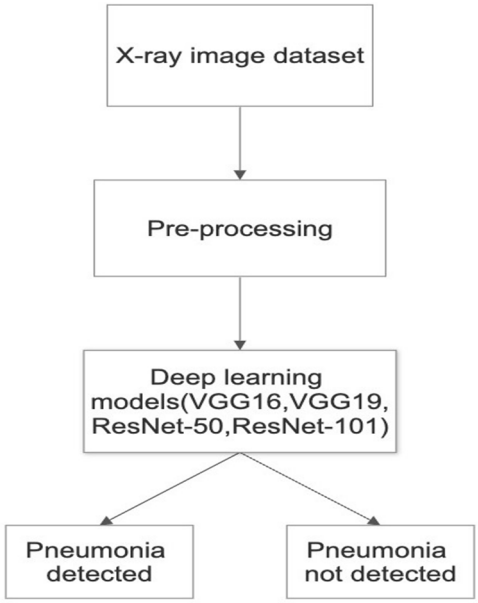

Figure.1. Block diagram of the proposed method

B. Pre-processing

Images need to be processed before they can be utilised for model training and inference. Changes in size, colour, and direction are only a few examples, but there are others as well. Pre-processing improves the image's quality so that we can analyse it more successfully. Through pre-processing, we may eliminate undesirable distortions and enhance specific properties that are crucial for the application we are developing. Those characteristics could change depending on the application. For software to work properly and deliver the required results, a picture must be pre-processed.

C. Deep learning models

We have used the following deep learning models and compare their accuracies.

1) *VGG16:* The ImageNet dataset, a sizable collection of images used for image classification and object recognition applications, served as the training ground for the convolutional neural network model VGG-16. There are 16 layers total in the VGG-16 architecture, including 3 fully linked layers and 13 convolutional layers. To categorise photos into one of 1000 different classes, the model was trained. In addition to being a popular feature extractor for other computer vision tasks including object identification, semantic segmentation, and transfer learning, VGG-16 is a very accurate model for picture classification**.**
2) *VGG19:* VGG19 processes the input image and extracts features from it using several convolutional and max-pooling layers. The fully connected layers then get these features and use them to generate the final forecast. The key advantage of the design is its ability to efficiently capture complicated characteristics in images due to the use of small convolutional filters (3x3) used repeatedly with a deep network topology. The design has 19 layers, including 3 fully linked levels and 13 convolutional layers. When it comes to picture classification jobs, VGG19 is renowned for both its excellent accuracy and its capacity for handling massive image inputs.
3) *RESNET-50:* The utilization of residual connections, which enable deeper networks without encountering the vanishing gradient problem, is what distinguishes the architecture. 50 layers make up ResNet-50, including fully connected, pooling, and convolutional layers. It is renowned for handling massive image inputs and for having a high level of accuracy in image classification jobs.
4) *RESNET-101:* ResNet-101 has more layers than ResNet-50 and is a deep convolutional neural network (CNN) architecture.Like ResNet-50, ResNet-101 makes advantage of residual connections to train extremely deep networks without running into the issue of vanishing gradients. ResNet-101's additional layers may offer more representational capacity, which could lead to better performance on picture classification tasks. The model can take longer to train since it needs more computational power and resources when there are more layer's present.

IV. RESULTS & DISCUSSION

On a dataset of X-ray images, the proposed approach is examined [10]. Figure 2 includes photos from the dataset. This technique divides images into two categories: normal and X-rays affected by pneumonia. Using the Xray image dataset deep learning models are created and their accuracy values are listed in the below table.

A. Dataset

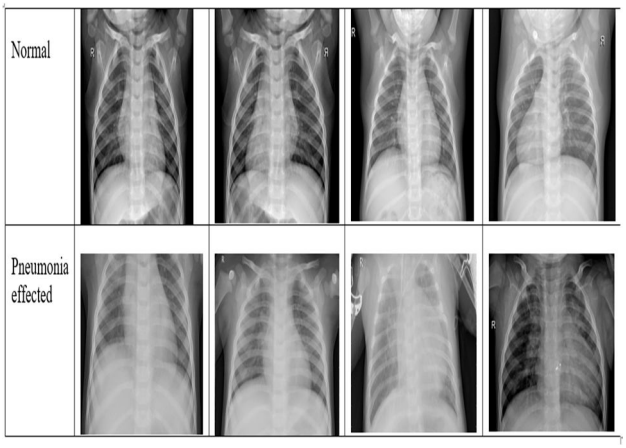

Figure.2. Refers the classification of the dataset

We used a Kaggle-available dataset [10] of lungs from X-ray scans for training and testing the model. This data collection is divided into two groups: pneumonia-affected and normal. 6565 x-ray images make up the training data set, while 624 x-ray images make up the testing data set. As a result, this dataset is divided into 505:48, with 91% of the data being used for training and the remaining data being utilised for testing.

Table 1 : Comparison of accuracy values of different deep learning model

Deep learning models	Accuracy (%)
VGG19	93.12
VGG16	92.2
ResNet-50	74.29
ResNet-101	74.21

From the table above, we can see that VGG-19 outperformed other available approaches since it has additional layers in its neural network.

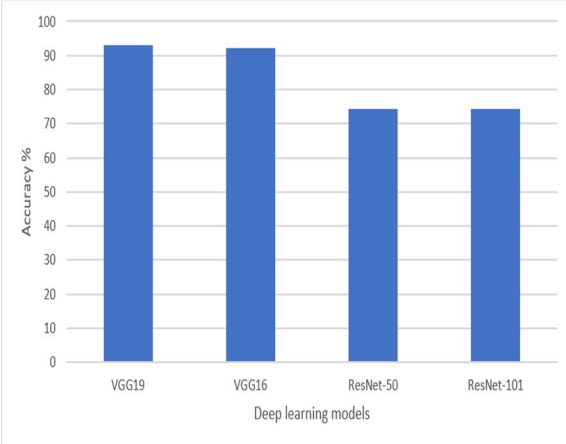

Figure.3. Refers to bar graph of the accuracy levels of executed methods

Table 2 : Comparison of accuracy values of existing methods

Author	Paper title	Accuracy %
Proposed method	Proposed method: "Pneumonia detection using deep learning methods"	93.12%
Jun Wang	"Automated chest radiograph interpretation using deep convolutional neural networks" (2016)	76.50%
Yufeng Peng	"A deep learning model for pneumonia detection in chest x-ray images" (2018)	78%
Arnab Kumar Roy	"Chest X-ray analysis using deep learning algorithms" (2018)	80%
Ahmed A	"Automated Detection of Pneumonia in Chest X-rays Using Machine Learning"	82%

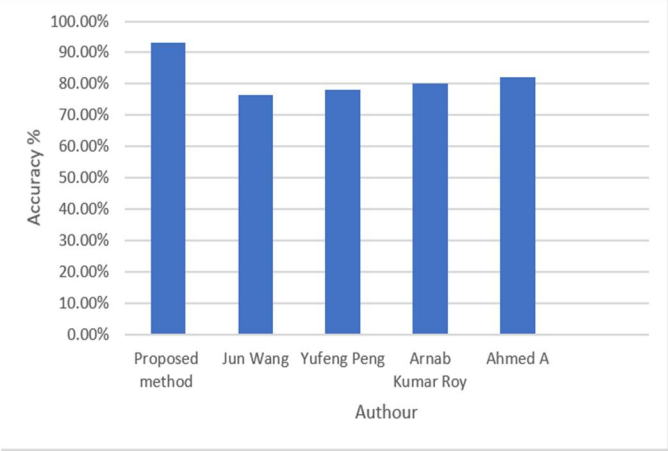

Figure.4. Refers to bar graph of the accuracy values of proposed methods and existing methods

V. CONCLUSION

It is interesting to see how deep learning has been applied to so many diverse real-world situations, even if this study is far from finished. We have shown you how to separate information about pneumonia into positive and negative categories using a set of X-ray pictures. The model was created entirely from scratch, which sets it apart from existing approaches that largely depend on transfer learning. After comparing various deep learning models, VGG19 outperformed them all with an accuracy of 93.12%.

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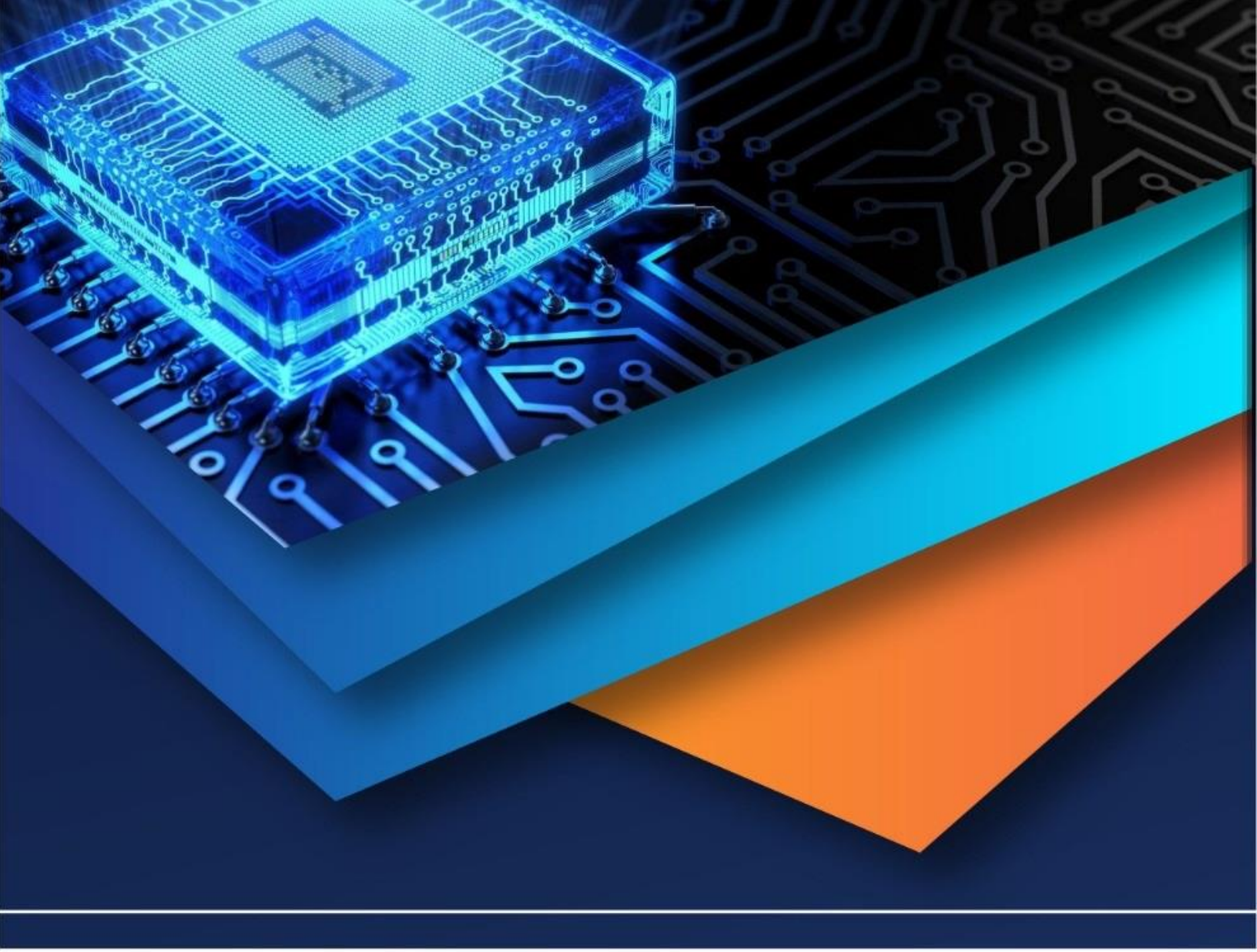

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