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PNEUMONIA DETECTION USING CHEST X-RAY

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Abstract: Lung disease can be considered as the serious health problem in people's life. Pneumonia is impulsive life-threatening crisis due to lung collapse. Normally it is detected on chest X-ray. The treatment is dependent on timely review of radiographs. Chest radiography (Chest X-ray) is thus far effective, low- cost and broadly used medical imaging trials. The radiologists primarily did the diagnoses manually over each scan, with no automated assistance. The proposed system would greatly improve the efficiency of radiologists, with their knowledge to analyse the chest Xray images. This method uses deep learning approach to predict the Pneumonia lung disease from chest X-ray images. Input is given as chest X-ray image and after pre-processing, it will be fed into Convolutional Neural Network model for disease prediction. The problem can be cast as binary classification problem, where the output is either Pneumonia or Normal. The training model is developed with chest X-rays dataset which contains 5856 chest X-ray images. Keras and TensorFlow are used as tools for implementation.

Keywords: Pneumonia, Chest X-ray, VGG16, ResNet-50, Inception-V3

I. INTRODUCTION

The chest is the most important part of the body as it contains the respiration organs, which are responsible for sustaining the important life functions of the body. The count of people being diagnosed with a chest disease globally is in millions. Chest X-rays are one of the most cost-effective medical image examinations available. The one who specialized in diagnosing diseases using X-rays is Radiologists. To discover possible diseases in the lungs the radiologists spend a lot of time while diagnosing chest X-ray images. The knowledge of anatomical principles, physiology and pathology, and keen analysis are needed for diagnosing X-rays. Developing a system for analyzing chest X-ray could make a huge impact on the radiologists.

A chest X-ray produces a black-and-white image of the organs in the chest. Tissues like lungs which consist of air appear as black and, bones like dense tissues absorb X-rays that appear white in images. The grey appears as tissues. Some of the diseases that are diagnosed using chest x-ray images are heart diseases, pneumonia, bronchitis, fractures, etc.

Fig. 1 (a) Pneumonia (b) Normal

Among them, Pneumonia is one such a critical condition that requires timely communication and immediate action. The presence of air in the pleural space causes pneumonia. The 3 clinical types are closed, open and tension pneumonia. Around 9% occur annually and most commonly in tall thin men aged between 20 and 40. One of the causes is smoking. The radiologists find the pneumonia from a chest X-ray by checking the sharp border of the collapsed lung. Fig 1 illustrates the Normal and Pneumonia images. The chest x-ray shows the visible lung edge and absent lung markings peripherally. While using radiographs, pneumonia can be misclassified with other diseases, because pneumonia is shown as curved- contour and the smooth regions as dark against the chest wall. If not diagnosed and treated at an exact time,

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then it will lead to the cause of death. Early detection is crucial, and it can happen because of injury or spontaneously or trauma to the chest wall.

According to National Institutes of Health (NIH), chest X ray is the best test for lung diseases. However, reading X ray images can be tricky and requires domain expertise and experience. An approach of deep learning is used to train an AI algorithm that analyses chest X ray images and detects the lung disease whether it is a pneumonia or Normal. Deep Learning techniques like Convolutional Neural Networks (CNNs), have been successfully employed for image classification in a broad range of medical applications (e.g., for pathology detection in X-ray images). CNN are very similar to normal Neural Networks (NNs). They are made up of neurons with their weights and biases. Each neuron receives inputs, which outperforms a dot product followed by non-linearity. The loss function (Sigmoid) is included in the last layer. These are done at image analysis which is designed to process 2D inputs. It is also used to learn, to detect spatial patterns in the training data and uses it to make predictions on testing data. A model which can predict diseases based on X-rays will provide a reasonable check to help achieve higher accurate diagnoses. The network is trained on a large- scale dataset of 5856 X-ray images to predict the pneumonia lung disease.

II. LITERATURE SURVEY

[1] In this work developed an image-based computer aided detection (CAD) algorithm by use of regions with CNN features (R-CNN) for detection of lung abnormalities. The performance of image-based CAD which is used by CNN and that of image-based CAD which is used by R-CNN for different varieties of lung abnormalities such as lung nodules and diffuse lung diseases. The pre-trained CNN model Alex Net which has been trained on the ImageNet dataset, which has 1000 object categories and 1.2 million training images. Here also data augmentation for supplementing a small number of images data. Randomization was performed to avoid biasing results. The CNN model processed the training sets and test sets. First, features of the training images were extracted using CNN. Then, these features were used to train a multiclass support vector machine (SVM). Finally, the multiclass SVM classifier evaluated validation set. For the classification of benign and malignant lung nodules, the mean accuracy was 95.2% without augmentation and 99.4% with data augmentation.

[2] To automate diagnostics from medical images has found its ways, which has continuously been one of the most interesting fields of software development. This has presented a systematic approach for the detection of the presence of pneumonia clouds in chest X-rays (CXR) with the use of only image processing techniques. For this, the work is done work on 40 analogy chest CXRs which is pertained to Normal and Pneumonia infected patients. Indigenous algorithm has been developed for cropping and for extracting of the lung region from the images. To detect pneumonia clouds, they used Otsu thresholding which will segregate the healthy part of lung from the pneumonia infected cloudy regions.

[3] The system is designed for Benign and Malignant lung disease detection. Interstitial Lung Disease (ILD) patterns are classified using Convolutional Neural Network (CNN). Here, a MVKBC model called Multi View Knowledge Based deep model is used for classification of Benign and Malignant. The X ray patches are classified into 7 classes. To capture the texture features of lung tissues a novel network architecture is designed. Their experiments shows that they employed scratched trained CNN or pretrained Alex net CNN as genetic feature extractor of 2D image which dimensions were reduced. Although the result is not so impressive but shows the probability score based on the classification. CNN features trained classifier gives better performance than CNN networks itself if the feature transformation, selection, and classification are done wisely.

[4] To aid pneumonia diagnosis in children, Wavelet and Scheme transforms are used as methods using chest radiograph images. This system presents a novel approach based on computer-aided diagnostic (CAD). The Pneumo-CAD system is designed for the classification of images into presence (PP) or Absence of pneumonia (PA). The knowledge database for the Pneumo- CAD comprised chest images confirmed as PP or AP by 2 radiologists trained for the interpretation of chest radiographs according to the WHO guidelines for the pneumonia diagnosis in children. The performance of this system was evaluated by subset of images randomly selected from the knowledge database. The feature extraction using wavelets transform coefficients of the image is done for the retrieval of similar images. The performance was measured by the ROC curve.

III. METHODOLOGY

The dataset used is amassed by the NIH (National Institutes of Health - Clinical Centre). It comprises chest X-ray images of 112,110 from 30,605 unique patients. The dataset is available from open source. 5856 of images are used here. Each image in the dataset is labelled with pneumonia and normal. The deep learning model uses 224x224 resolution and

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normalize the data subsequently. Each pixel has zero mean and approximately unit variance and down sampled in the neural net to predict disease as either pneumonia or normal. ResNet50, VGG16, and InceptionV3 are popular deep learning architectures commonly used in computer vision tasks, including medical image analysis. These models have been successfully applied to pneumonia detection from chest X-ray images.

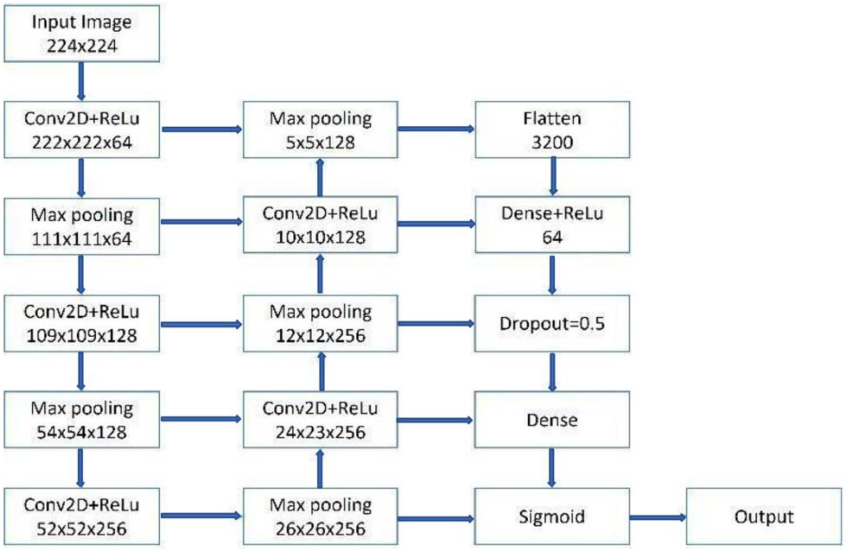

Fig. 2 Methodology

ResNet50

ResNet50 is a deep convolutional neural network (CNN) architecture that gained attention for its ability to train deep networks effectively. It consists of 50 layers and uses skip connections (or residual connections) to mitigate the vanishing gradient problem. ResNet50 has achieved impressive performance in various image classification tasks, including pneumonia detection.

VGG16

VGG16 is another well-known CNN architecture that stands for Visual Geometry Group 16. It consists of 16 layers, including convolutional layers, max-pooling layers, and fully connected layers. VGG16 has a simple and uniform architecture, making it easier to understand and implement. In pneumonia detection, VGG16 has been employed by training it on a large dataset of chest X-ray images. The model learns to extract relevant features from the X-ray images and classify them as pneumonia-positive or pneumonia-negative. VGG16's deep architecture helps capture intricate details in the X-ray images, enabling accurate detection of pneumonia.

InceptionV3

InceptionV3 is a deep learning model that introduced the concept of "inception modules." These modules are designed to efficiently capture features at different spatial scales by using filters of various sizes in parallel. InceptionV3 achieves excellent performance on image classification tasks while maintaining a relatively small model size. For pneumonia detection using chest X-ray images, InceptionV3 has been trained on a diverse dataset of X-ray images. By leveraging its advanced architecture, the model can identify relevant features related to pneumonia, such as opacities and lung infiltrates. InceptionV3's ability to capture multi-scale features contributes to accurate and robust pneumonia detection.

- ***Input Image:*** In this pixel are arranged in binary encoded matrix form.
- ***Pre-processing:*** The aim of pre-pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing.
- ***CNN – Architecture:*** CNN are a class of Deep Neural Networks that can recognize and classify features from images and are widely used for analyzing visual images.

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- ***Trained Model:*** It consist of sample output data and corresponding sets of input data that have an influence on the output.
- ***Test Image:*** Large collection of sample images designed for analysis and quality assessment of different kinds of displays.
- ***Prediction:*** the output of an algorithm after it has been trained on a historical dataset and applied to new data when forecasting the likelihood of a particular outcome, such as whether pneumonia is present or not.

IV. CONCLUSION

Pneumonia is a serious and potentially life-threatening disease characterized by the presence of gas in the pleural space. In this study, a Convolutional Neural Network (CNN) was developed to aid in the diagnosis of pneumonia based on chest X-ray images. The CNN was trained and tested using a large dataset consisting of 5856 chest X-ray images. The input to the CNN model is a chest X-ray image, which undergoes preprocessing steps before being fed into the network for disease prediction. The goal is to classify the X-ray image as either showing signs of pneumonia or being normal, making it a binary classification problem.

The trained CNN model achieved an accuracy of 85% on the test set, demonstrating its ability to accurately predict the presence of pneumonia in chest X-ray images. This performance indicates the potential of the model as a valuable tool in a hospital management environment. By incorporating the proposed CNN model into the existing workflow, it can serve as a means of verification for radiologists. The model can assist radiologists by providing an additional analysis of chest X-ray images and supporting their diagnosis of pneumonia. The model's high accuracy suggests that it can provide reliable insights and help improve the efficiency and accuracy of pneumonia diagnosis. It is important to note that while the model shows promise, it should not replace the expertise and judgment of trained medical professionals. Instead, it can serve as an aid in the decision-making process, offering a second opinion and reducing the likelihood of misdiagnosis. Further research and validation studies are recommended to assess the model's performance on different datasets and to evaluate its generalizability to diverse populations. Continuous refinement and improvement of the model, in collaboration with radiologists and medical experts, can enhance its usability and effectiveness in real-world clinical settings.

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