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CNN-Based Chest X-Ray Analysis for Disease Detection

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Abstract - The process of classifying; detecting and measuring the certainty of lung x-ray image's abnormality using enhanced complex and deep learning of techniques such as CNN has observed improvements betterment especially to enhance a working solution i.e. pneumonia ,tuberculosis ,COVID-19,lung cancer. With regard to the datasets, several have been applied in the testing of the model to the utmost extent of its ability as well as its accuracy was well received in passing on the message. Also an intuitive graphical user interface makes it possible for physicians/managers to evaluate x-ray pictures within a short span of time along with exact outcomes linked to CNN output. The goal is to incorporate brilliant algorithms of deep learning into clinical practice to develop a more efficient diagnostic criterion of ailments that affect the chest, early detection and treatment, various treatment plans tailored according to the patient's needs so as to enhance their quality of life.

Key Words: DeepLung Diagnosis, Convolutional neural network name as well as Mask CNN for classifying Lung Disease and for interpreting X-ray Images**.**

1.INTRODUCTION

Medical imaging is beginning to open up some interesting possibilities of deep learning algorithms that may help in the identification of issues and classification of diseases. As for the practice of catching issues in this paper, the deep learning plays a significant role particularly CNN for catching issues and also convolutional neural networks to classify the lung diseases from x-rays. Observing peculiarities at early stages when it comes to lung x-rays contributes to a lot combating illnesses at the right time. We used the public datasets to train our proposed detection since they enable proper and accurate detection of the abnormal regions in the lung images. However, another factor comes into picture is the proper categorization of the disease as this significantly impacts the treatment. Aiming at the detection of abnormalities that is one of the most profound tasks in the forecast of diseases through image analysis, using CNN's, one of the most efficient deep learning architectures capable of learning paramount features from image data, we train the model using different datasets such as pneumonia, tuberculosis, COVID-19, and lung cancer. The above goal we want to achieve is to develop an accurate 'Classification Model' to classify images of lung X-rays in the right disease category tasks for disease classification and detection. The CNN model here is used for the disease classification and for detection. In order to satisfy the needs of health care persons and clinical procedures, we suggest to use modular structure which will be manageable and customizable while keeping the clear differentiation of roles. In the paper, every technique is implemented and tested on various number of datasets to ensure the accuracy and the sensitivity of the models in detection as well as disease classification. Both malaria and pneumonia are rigorous, occasionally deadly illnesses that affect hundreds of thousands of people ecumenical in areas with limited resources.

Malaria is an ominous disease, which becomes fatal in the absence of treatment timely. It is passed through infected mosquitoes and it is conveyed on through the Plasmodium

parasite. On the different hand, pneumonia is defined by the irritation in one or both of the lung's air sacs, more often caused by bacteria, viruses or fungi and so on. Pneumonia takes the top spot of sickness and death among the two phases in life; the older individuals and the onset of puberty.

Thus, for the purposes of correct and prompt management and treatment, pneumonia and malaria should be correctly differentiated. It is noteworthy that even conventional diagnostic approaches that can be considered accurate but which include laboratory assessments, physical and clinical examinations, and analysis by specialists may require time and personnel resources. These are more troublesome in the healthcare facilities that have tight budgets since they are labor-intensive, costly, and time-consuming compared to the modern techniques. But, in the recent past, the deep learning technology which is a subcategory of the ML shows the promising future. Applications that predict diseases tend to advance significantly since the use of Convolutional Neural Networks' (CNN's). It's virtually unimaginable to design an reliable algorithm that may analyze a chest X-ray of an individual affected person and decide whether or not the affected person is affected by pneumonia. The accuracy of the algorithm remains critical since the outcomes are implemented in people

In this case, to enhance the processing of lung images, advanced deep learning techniques, specifically CNN for health problem classification and for identification, will be used. Furthermore, through a modular structure, it is effective in the early diagnosis of diseases that relate to chest disorders and can categorize them differently from others. This is done in a rather fabulous manner by virtue of the fact that detection and illness classification have been done wonderfully.

2. Related Works

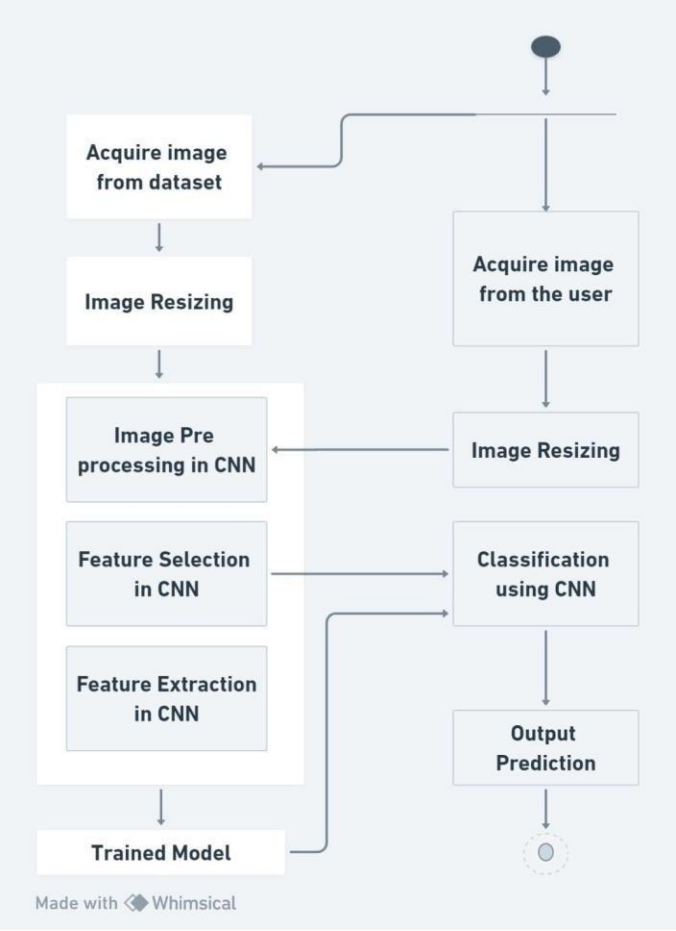
Shabana Urooj concentrated on enhancing successful tuberculosis diagnosis and identification. Nevertheless, one more modification in the proposed method is the use of a random function that can be added to the neural network directly or the use of stocastic weight of the network. As shown in the results below, the present study's result on the proposed method was higher than the Ensemble Deep Learning and Automatic Frontal Chest Radiograph Screening System. The estimated method, therefore, displays an enhanced efficiency seen with the sensitivity rate of 96. 2% for detecting the disease with sensitivity of 86. 01%, Accuracy 98. 45%, and F-Score 95. 88% respectively.[1]

T. Rajasenbagam et al. introduced a research paper by sharing a study on the detection of Pneumonia infection in the lungs using Deep Convolutional Neural Network on Chest X-ray images. The research paper used the dataset of pneumonia chest X-ray images to train the proposed Deep CNN models. A Content-based image retrieval is used to annotate the images in the dataset for the proposed solution. They develop a diagnosis model for Pneumonia infection using the VGG19 Net architecture. A GPU system was used to be trained with our data. This blows the authors' claim that their proposed model is superior to the existing one backed by the common measures of accuracy, precision, recall and F1 score out of the water.[2]

Sirish Kaushik and colleagues have shared a research paper with own new convolutional neural network tested well for the identification of pneumonic lungs in the chest X-ray. Since it can be utilized as a working tool of specialists in the medical field that contribute to the identification and treatment of pneumonia with high concerning the efficiency, this model is of paramount importance. The writer of the current paper aimed at creating a new CNN model, which contains four convolutional layers; From the background, to create a model from scratch and design a CNN model that classifies and detects pneumonia from the chest X-Ray. Closely related to the first drawback, a lower accuracy of the model is equal to 92%. In the group 2, with the level of difficulty 31%, the model has achieved the

recall rate of 98%. It is a highly important part since the high recall assumes a small number of false-negative cases that could endanger the patient's life. [3]

Khairul Munadi shared a paper with the main objective of evaluating and comparing the effects of the UM and HEF pre-processing techniques on the performance of the pre-trained CNN models for tuberculosis detection. The research combines UM and HEF image enhancement and use EfficientNet-B4, ResNet50, and ResNet-18 models to train the TB images in order to increase the detection rate. The employment of an image enhancement system is optimal for



preparing TB images for a pre-trained network to learn hence coming up with a better network. The results of the experiments prove that the proposed approach provides accuracy levels that are higher than the corresponding levels in related unresolved problems. [4]

L. Priya shared a paper where the former proposed a novel approach for adult asthma classification with the CNN model. Applying neuron-wise and layer wise visualization techniques the CNN obtains the accuracy of 83.it was found to have a 61% accuracy in diagnosing adult asthma solely by respiratory symptoms. The main purpose of this study is to reveal factors concerning asthma, to contribute to the therapy and give people over twenty adult years threshold to prevent possible stimulating factors. [5]

3.Proposed Model

The Convolutional Neural Network CNN is one of the deep learning neural networks that has more than one layers it has a max pooling layer. They play a role of aiding in the automatic picture recognition of X-rays. The Rectified Linear Unit (ReLU) layer enhances nonlinearity as it outlines the input that is non-negative. It looks like the fixed network of a trial and error system. The research set out to analyze some features in patients and seeks to categorize them into Disease and no Disease. The Fig. One block diagram is used to illustrate how the system has been organized. The user at first gives an image as an input and then forwards this image to the system. The system takes the image and inputs it to be process and passed on to the trained Model.

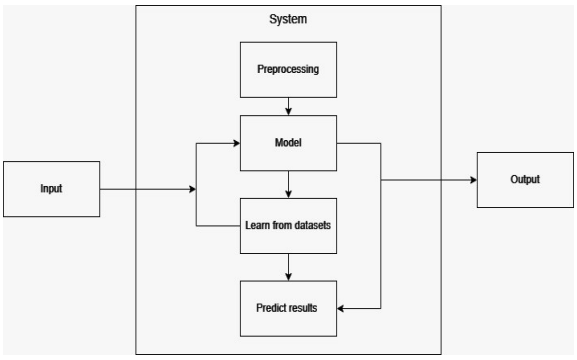


Figure 1: Block Diagram.

Figure 2: Process Flow Diagram.

The designed model is operated by taking the whole set of data which has been classified and also predicting the particular type of illness. After the result has been forecasted, The predicted output will be given to the user as well in the shape of text. i.e. to suggest what the training model looks at to partake of lung order or it is a normal image.

In case the picture shows of a lung disorder then it fills in the name of the illness.

In the context of the described task, the following can be noted: Fig 2 shows the process flow organization of the system for categorizing images using a CNN. The architecture of the CNN model is the first process of the technique. Common in classification is the use of several convolutional layers, after which the pooling and fully connected layers are used. The gathered Information reveals that the system can acquire images from either a dataset or the user. In any case, the obtained image is then prepared or preprocessed to fit the CNN architecture. The obtained preprocessed image input is passed later through the CNN Sect. 2.2 to extract features. These features are later chosen for the classification task. This image classification is carried out using a trained CNN model with the selected features. The final category is the output prediction, whereby it is classified to which of the groups the image belongs. In this work, a new architecture of the Convolutional Neural Network was proposed for pneumonia examination based on chest X-ray images. For feature extraction and classification, the number of convolutional layers followed by pooling layers and fully connected layers was initialized and the Image Data Generator along with data augmentation and other hyper parameters tuning were used. To check the training and validation accuracy between the epochs, the necessary training is performed with 5 epochs, and the accuracy is satisfactory.

CNN models used in malaria detection are assessed on several parameters such as accuracy, precision, recall, and the F1 score. From the given examples, it can be noted that the majority of the articles noted high levels of achievement on the identified metrics to the intended highest levels. It is necessary to understand the fact that high accuracy and high performance percentages are presented by the metrics shown by CNN models in malaria detection; these are invaluable skills for their further enhancement in the future.

4. *Five Classification*

A. *Data collection and Preprocessing:*

- Datasets of chest x-ray images are collected through a variety of sources like kaggle and our databases include public repositories and the photos are classified with five classes: And the outcomes of the groups are – cancer – class A, viral pneumonia –class B, covid-19 –class C, tuberculosis –class D, and normal –class E
- .First, prepare the data set; make sure that the dimensions of the photos are 50×50 pixels and assign the proper code to each photo. We also perform data augmentation in form of rotation, flipping, and zooming in order to diversify and therefore expand the training dataset.

B. Model Architecture:

- There exists the use of convolutional neural networks (CNN). The model includes three lay- ers of convolution and finally features are extracted by max pooling layers. The flattened output proceeeds through two fully connected layers. It is known that dropout frequently employed for the sake of preventing from overfitting. The output layer has 5 nodes with softmax activation for the multi-class classification problem. For training Through the course of the training process, categorical
- cross-entropy loss is used and the model is optimized with the help of an Adam optimizer. The training is carried out in 100 epochs with a batch of 64. The confusion matrix along with classification report is used to evaluate a model's performance. The example that concerns the application or representation of plots consists of values relating to accuracy, loss, precision, recall, and F1.

C. Malaria Detection

1) Data collection and Preprocessing:

- *The dataset used is the Malaria Cell Images Dataset; images of cells.*
- *Attached images are of the parasitized and uninfected cells which are cropped and then reshaped of size 50*50 and normalized.*

2) CNN model:

- To solve the problem of malaria detection, a Masked CNN architecture is suggested.
- The designing of the model includes Convolutional layers, max-pooling layers, fully connected layers with sigmoid phase output.
- Special training set like rotation, width shift, and shear are used during training.

C. Pneumonia Detection

- 1) Data collection and Preprocessing:

- Public data from the Kaggle platform 'Chest X-ray Images' are used.
- It is also important to note that all the images are first rescaled and recompressed to 128 x 128 pixels and normalized.

2) Custom CNN Model:

A new CNN architecture is proposed for detecting Pneumonia.

The model uses a combination of convolutional layers, max-pooling layers and fully connected layers with softmax output.

5.Results

A. These are Experimental result of Five Classification

- Cancer: precision :- 1 , recall :-0.96, F1-Score :-0.98
- Viral Pneumonia: precision :-0.95, recall :-0.95, F1- Score :-0.95
- Covid-19: precision :-0.95, recall :-1 , F1-Score :-0.97
- Tuberculosis: precision :-1.00, recall :-1, F1- Score :-1
- Normal: precision :-0.91, recall :- 0.91, F1- Score :-0.91

B. The confusion matrix displays details of the models performance with respect to different categories, refer to Figure 3. Figures 4 and 5 illustrate the training and validation accuracy/loss curves, respectively. The model demonstrates convergence without significant overfitting.

C. Detection Result

On the other hand, malaria detection system using CNN and Custom CNN model shows good result in which Malaria has an accuracy of 96% and pneumonia is detected at an accuracy close to 95% thus confirming its efficiency in diagnosing these diseases correctly. These findings are important in advancing disease diagnostic technologies and revealing how deep learning approaches can improve diagnostic capacity of a technique. Malaria Detection: 96% Pneumonia Detection:- 95%

6.Discussion

In short, our model was pretty successful with respect to analyzing X-ray images; as a suggested CNN model can be observed with great accuracy through the detection and classification of chest abnormalities such as pneumonia, TB, COVID-19, and lung cancer. Doctors can use this program easily to diagnose these diseases quickly and precisely. Our methodology could be called supple and resistant because it was able to identify and classify diverse pulmonary disorders. Nevertheless, more comprehensive research is needed in order to establish if these models are robust enough for application on bigger populations or datasets. Moreover, extra effort should be taken here to develop models that can be integrated into clinical workflows and residency programs for further use in medical trials of new medications.

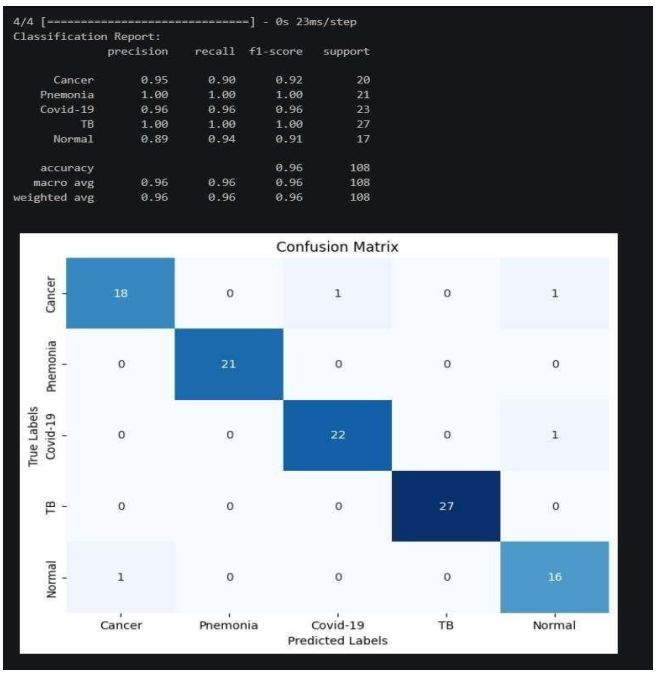


Figure 3: Confusion Matrix

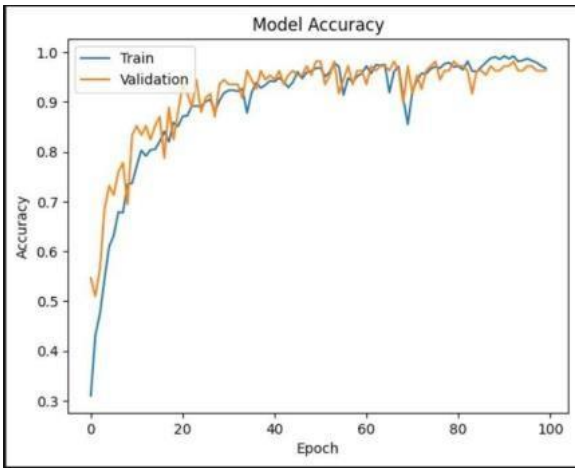


Figure 4: Model Accuracy

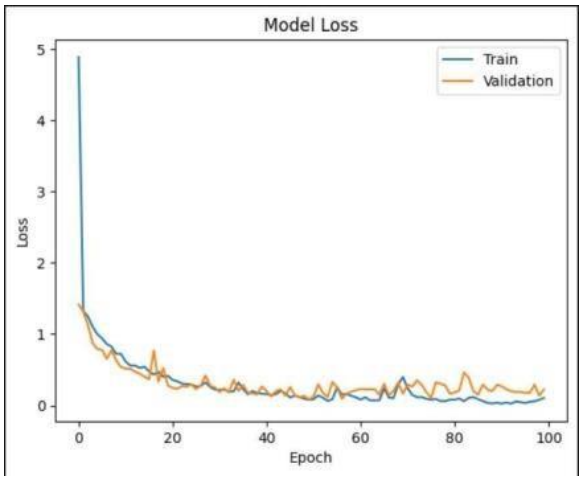


Figure 5: Model Loss

After summarizing the research, the article concludes by pointing out that deep learning has a great potential of revolutionizing diagnosis and provision of healthcare. We aim to utilize cognitive computing so as to improve global healthcare results as well as promote the advancement of medical technology.

7.Conclusion

It provides a CNN-based method for categorizing lung disease images into five groups: The diseases are Cancer, Viral pneumonia, Covid-19, Tuberculosis and Normal. The outcomes of this experiment plainly demonstrate that the suggested model can accurately differentiate between various types of lung diseases from the images of the chest X-ray. As our technique solution stated, one of our integrated approaches is more efficient in helping the healthcare provider diagnose lung disorders which is valuable for enhancing the patients' quality. Designing deep learning models for malaria and pneumonia recognitions indicate a significant advance in the uses of medical pictures to diagnose illnesses without a physician's help. The suggested CNN model for malaria and the modified CNN for pneumonia detection have shown promising results in terms of infected cells' identification and peculiarities of lung picture, respectively. The diagnosis of diseases can be done efficiently and quickly by healthcare practitioners utilizing the machine learning algorithms and convolution neural networks. These proved to be handy when screening massive volumes of medical pictures and especially in setting where qualified medical practitioners may be scarce. is limited.

8.References

[1] Shabana Urooj, S. Suchitra, Lalitha Krishnaswamy, "Stochastic LearningBased Artificial Neural Network Model for an Automatic Tuberculosis Detection System Using Chest X-Ray Images", (2022) - https://ieeexplore.ieee.org/stamp /stamp.jsparnumber=9900305

[2] T.Rajasenbagam, S.Jeyanthi, J.Arun Pandian ,"Detection of pneumonia infection in lungs from chest X-ray images using deep convolutional neural network and content-based image retrieval techniques" (2020). https://link.springer.com/article/10.1007/s12652-021- 03075-2

[3] V.Sirish Kaushik, Anand Nayyar, Gaurav Kataria "Pneumonia Detection Using Convolutional Neural Networks (CNNs)" (2020). https://rb.gy/5g2v8y

[4] Khairul Munadi, Kahlil Muchtar, Novi Maulina et.al,"Image Enhancement for Tuberculosis Detection Using Deep Learning". (2020)– https://opus.lib.uts.edu.au/bitstream/10453/ 146006/2/09277528.pdf

[5] Priya, B.Priyadharshini, " The Analysis of Adult Asthma using Convolutional Neural Network", April 2020 –https://irjet.com/archives/V7/i4/IRJET-V7I4565.pdf

[6] Organization for World Health, World Malaria Report.2019, The information was retrievedfromhttps://www.who.int/publicationsdetailredirect/9789241565721.

[7] Rajpurkar, P., Irvin, J., Zhu, K., Yang, B., Mehta, H., Duan, T., Ding, D., Bagul, A., Langlotz, C., Patel, B, Lungren, M. "Deep learning based pneumonia detection on chest x-rays with Chexnet. Preprint for arXiv is arXiv:1711.05225", 201

[8] Thoma, G., Kim, I., Rajaraman, S., Antani, S. visualization and analysis of convolutional neural network predictions in pediatric chest radiographs for pneumonia detection. 45–55 in Computerized Medical Imaging and Graphics, 68., 2018

[9] Roy, Kishor, Sharmin, Shayla Bintey, Rahma Mukta, Rahma Sen, Anik. (2018). Detection ofMalaria Parasite in Giemsa Blood Sample Using Image Processing. International Journal of Computer Science and Information Technology. 10. 55 - 65. 10.5121/ijcsit.2018.10105.