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Identification of Medical Diseases using Deep Learning

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Abstract **- The implementation of clinical-decision support algorithms for medical imaging faces challenges with reliability and interpretability. Here, we establish a diagnostic tool based on a deep-learning framework for the screening of patients with common treatable blinding retinal diseases. Our framework utilizes transfer learning, which trains a neural network with a fraction of the data of conventional approaches. Applying this approach to a dataset of optical coherence tomography images, we demonstrate performance comparable to that of human experts in classifying agerelated macular degeneration and diabetic macular edema. We also provide a more transparent and interpretable diagnosis by highlighting the regions recognized by the neural network. We further demonstrate the general applicability of our AI system for diagnosis of pediatric pneumonia using chest X-ray images. This tool may ultimately aid in expediting the diagnosis and referral of these treatable conditions, thereby facilitating earlier treatment, resulting in improved clinical outcomes.**

Keywords- **Pneumonia, Optical Coherence Tomography, Deep Learning.**

I. INTRODUCTION

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). The demand for advanced image analysis techniques stems from the recent proliferation of new biomedical imaging modalities. Medical imaging plays a vital role in patient healthcare. It aids in disease prevention, early detection, diagnosis, and treatment. It has become essential for virtually all major medical conditions and diseases. Medical imaging encompasses different imaging modalities and processes to image the human body for diagnostic and treatment purposes and therefore plays an important role in initiatives to improve public health for all population groups. Digital technology helps in improving patient care and provides efficient cost and workflow benefits to the hospitals and radiology department.

Deep Learning, as a branch of Machine Learning, employs algorithms to process data and imitate the thinking process, or to develop abstractions. Deep Learning (DL) uses layers of algorithms to process data, understand human speech, and visually recognize objects. Information is passed through each layer, with the output of the previous layer providing input for the next layer. The first layer in a network is called the input layer, while the last is called an output layer. All the layers between the two are referred to as hidden layers. Each layer is typically a simple, uniform algorithm containing one kind of activation function.

Pneumonia is inflammation of the tissues in one or both lungs that usually caused by a bacterial infection. In the USA annually more than 1 million people are hospitalized with the gripe of pneumonia. Unfortunately, 50.000 of these people die from this illness. Fortunately, pneumonia can be a manageable disease by using drugs like antibiotics and antivirals. However, early diagnosis and treatment of pneumonia is important to prevent some complications that lead to death. Chest X-ray images are the best-known and the common clinical method for diagnosing of pneumonia However, diagnosing pneumonia from chest X-ray images is a challenging task for even expert radiologists. The appearance of pneumonia in X-ray images is often unclear, can confuse with other diseases and can behave like many other benign abnormalities. These inconsistencies caused considerable subjective decisions and varieties among radiologists in the diagnosis of pneumonia . Therefore, there is a need for computerized support systems to help radiologists for diagnosing pneumonia from chest X-ray images. Recent developments in deep learning field, especially convolutional neural networks (CNNs) showed great success in image classification. The main idea behind the CNNs is creating an artificial model like a human brain visual cortex. The main advantage of CNNs, it has the capability to extract more significant features from the entire image rather than handcrafted features.

Image-based deep learning classifies macular degeneration and diabetic retinopathy using retinal optical coherence tomography images and has potential for generalized applications in biomedical image interpretation and medical decision making.

II. LITERATURE SURVEY

The product of this project has the potential for generalized impact application on biomedical imaging. The aid in expediting the diagnosis of pediatric pneumonia using chest X-ray images and classify macular denegration and diabetic retinopathy using tranfer learning techniques.

Table 1: Survey Table.

Paper Title	Publication and Year	Seed Idea	Pros	Cons
Diagnosis of Pneumonia from Chest X-Ray Images using Deep Learning.	2019 IEEE	This study proposed the prediction and classification of Pneumonia using two well-known convolutional neural network models Xception and Vgg16. It used transfer learning and fine tuning in the training stage. The test results showed that Vgg16 network exceed Xception network at the accuracy with 0.87%, 0.82% respectively.	The Xception network achieved a more successful result in detecting pneumonia cases. The network was trained by using a dataset consisting of 5856 frontal chest X-ray images of which are 1583 normal case & 4273 pneumonia case.	Xception network is more successful for detecting pneumonia cases than Vgg16 network. At the same time Vgg16 network is more successful at detecting normal cases.
Identifying pneumonia in chest X-rays: A deep learning approach	Amit Kumar Jaiswal, Prayag Tiwari, Sachin Kumar , Deepak Gupta , Ashish Khanna , Joel J.P.C. Rodrigues Year: 2019	This study proposed the prediction and classification of Pneumonia using Mask R-CNN a deep neural network. The network was trained by using a dataset consisting of 112000 frontal chest X-ray images and tested by 4500 images.	An algorithm that can detect the visual signal for pneumonia in medical chest radiographs, and output either pneumonia positive or negative, and if positive it also returns predicted bounding boxes around lung opacities.	With the usage of image augmentation, dropout and L2 regularization prevented the overfitting, but obtained something weaker results on the training set with respect to the test. The computation cost also burden exponentially when dealing with large image.
Identifying medical Diagnoses and Treatable Diseases by Image-Based Deep Learning.	Daniel S. Kermany, Michael Goldbaum, Wenjia Cai, M Anthony Lewis, Huimin Xia, Kang Zhang Year: 2018	This study proposed an artificial intelligence system using transfer learning techniques. It effectively classified images for macular degeneration and diabetic retinopathy. The system was trained and validated by 108,112 and 1,000 OCT scanned images.	It also accurately distinguished bacterial and viral pneumonia on chest X-rays . This has potential for generalized high-impact application in biomedical imaging.	The efficacy of the transfer learning technique for image analysis very likely extends beyond the realm of OCT images and ophthalmology.The performance of the model depends highly on the weights of the pre-trained model.
Pneumonia Radiograph Diagnosis Utilizing Deep Learning Network	ICEICT 2019 IEEE 2nd International Conference on Electronic Information and Communication Technology	The goal of this study is to develop an algorithm using Convolutional Neural Networks (CNNs) to detect visual signals for pneumonia in medical images and make a diagnosis. The deep learning network AlexNet was utilized through transfer learning.	Using a separate validation set the network was able to achieve an initial accuracy of 72%. This is significant because the images used for validation were different from the training images. This gives an accurate representation of how the network would function in real-world applications.	Accuracy lower tha expected. Images used for training were of low quality and irregular.
Prediction of Pneumonia using deep learning.	Reddy A. Raghavendra et al.; International Journal of Advance Research, Ideas and Innovations in Technology	It developed an algorithm which can most accurately predict on a validation set of chest Xrays. Convoluted neural networks are used to classify where each neuron is tightly connected to other neurons. Inception network was used in the development of CNN classifiers.	Inception network was heavily engineered. It used a lot of tricks to improve performance in terms of speed and accuracy. With much more robust and large dataset our project can intervene in all domains.	Classified the scan as positive or negative only.

III. OVERVIEW

With the rise in machine learning and deep learning approaches, we have the ability to find a solution of disease detection. In this project, we are going to develop an application system which takes an X-ray and a OCT scan of the user as an input, processes it, and predicts whether the user has the disease or not. It uses the chest X-ray to detect pneumonia and the OCT scan to detect diabetes. The final result is given to the user as an output in the form of medical report that the system generates. Also, the affected area in the X-ray (due to which pneumonia detected) and/or in the OCT scan is shown highlighted.

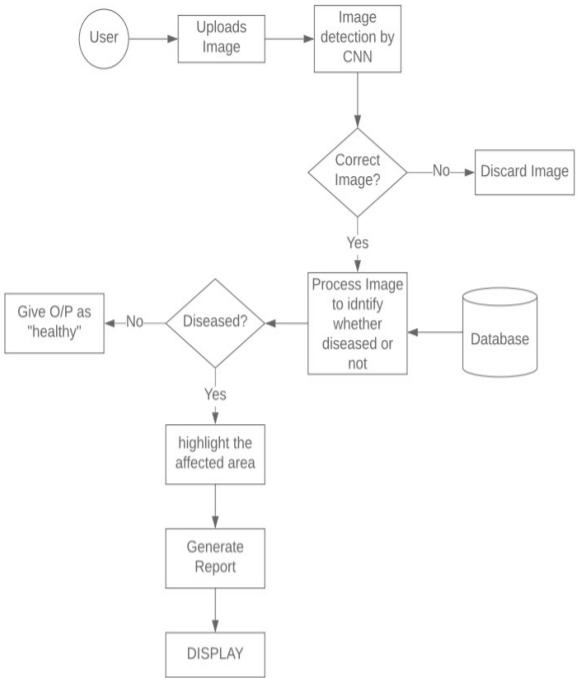

Fig. 1: System Overview Diagram

IV. CONCLUSION

Deep learnings methods have made this system, achieve a better accuracy of perdiction and diagnosis of diseases. The system will be designed as a generalized platform for diagnosis of medical diseases.

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