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Pneumonia Detection through X-Ray Using Deep Learning

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Abstract: *Pneumonia Detection through X-Ray Using Deep Learning is a web application which is used to detect the presence of Pneumonia from a collection of chest X-ray samples. Remarkable classification performance is achieved using methods that rely solely on transfer learning approaches or traditional handcrafted techniques. We constructed a convolutional neural network (CNN) model that extract features from a given chest X-ray image then it classifies it to determine if a person is infected with pneumonia. Reliability and interpretability challenges can be mitigated by this model that are often faced when dealing with medical imagery*

Key Word*: Pneumonia, Detection, X-ray, Convolutional Neural Network (CNN), infected, Deep Learning and medical*

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I. Introduction

The risk of pneumonia is immense for many, especially in developing nations where billions face energy poverty and rely on polluting forms of energy. The WHO estimates that over 4 million premature deaths occur annually from household air pollution-related diseases including pneumonia [10]. Over 150 million people get infected with pneumonia on an annual basis especially children under 5 years old [11]. In such regions, the problem can be further aggravated due to the dearth of medical resources and personnel. For example, in Africa's 57 nations, a gap of 2.3 million doctors and nurses exists [12, 13]. For these populations, accurate and fast diagnosis means everything. It can guarantee timely access to treatment and save much needed time and money for those already experiencing poverty.

Deep neural network models have conventionally been designed, and experiments were performed upon them by human experts in a continuing trial-and-error method. This process demands enormous time, know-how, and resources. To overcome this problem, a novel but simple model is introduced to automatically perform optimal classification tasks with deep neural network architecture. The neural network architecture was specifically designed for pneumonia image classification tasks. The proposed technique is based on the convolutional neural network algorithm, utilizing a set of neurons to convolve on a given image and extract relevant features from them. Demonstration of the efficacy of the proposed method with the minimization of the computational cost as the focal point was conducted and compared with the exiting state-of-the-art pneumonia classification networks.[14]

The proposed prediction model is implemented by Convolutional Deep Neural Networks (CNN) using Python programming language and the model is converted into a Website Application. Different machine learning algorithms are trained to measure the performance of CNN with popular and modern classifiers after pre-processing of data. Promising results are achieved, when the results of regular classifiers like SVM, random forest, adaboost, etc. are compared with the the suggested framework using different estimating metrics like accuracy, specificity, area under the curve, and sensitivity, etc.

II. Literature Survey

Over the last decade, several machine learning based automated methods for identifying different types of pneumonia have been widely studied [1]– [4]. Fiszman et al [1] used a natural language processing (NLP) tool to identify acute bacterial pneumonia-related disease in chest X-ray. Performance of this type of resource intensive application is very much comparable to that of the human expert. Chapman et al [2] demonstrated three computerized methods using a rule base, a probabilistic Bayesian network, and a decision tree to diagnose the chest X-ray report associated with acute bacterial pneumonia. In [3], a study of feasibility of an NLP-based monitoring system is done to identify healthcare-associated pneumonia in neonates. However, practical clinical applications of these types of methods are limited due to the dependency on the information extracted from the narrative reports of the patients. Parveen et al [5] reports an unsupervised fuzzy c-means classification learning algorithm to detect pneumonia infected X-ray images. This approach improves classification accuracy as fuzzy c-means allocate weights to all the pixels of the input X-ray images. Rajpurkar et al [4] demonstrated ChexNet, a 121-layer deep convolutional neural network (CNN), that provides the probability of detecting or identifying pneumonia using a heatmap to localize the area of the infection. Kermany et al. [6] introduced a transfer learning-based DL framework to diagnose paediatric pneumonia using chest X-ray images. However, none of the methods are exploited to classify X-ray images with pneumonia for the CS framework to meet the need of remote end analysis.

Researchers are utilizing the results of machine learning predictions for solving problems of life science. Large volume of information can be extracted and used for future prevention of dangerous diseases. For extracting information from the medical images Python language is used.

High dimensional data consists of the medical images which has sizable amount of feature descriptors. To extract the numerous feature descriptors, feature extraction techniques are applied on good quality X-ray images. Deep learning neural networks are trained with the extracted data to create the prediction model. Research is additionally carried for prediction of pneumonia using machine learning classifiers.

III. Working

To create an app that can detect whether the x-ray uploaded has symptoms of pneumonia. The pneumonia detection task is a binary classification problem, where the input is a frontal-view chest X-ray image X and the output is a binary label $y \in \{0, 1\}$ indicating the absence or presence of pneumonia respectively.

For one example within the training set, we optimize the weighted binary cross entropy loss $L(X, y) = -w_+ \cdot y \log p(Y = 1|X) - w_- \cdot (1 - y) \log p(Y = 0|X)$, where $p(Y = i|X)$ is that the probability that the network assigns to the label i, $w_+ = |N|/(|P|+|N|)$, and $w_- = |P|/(|P|+|N|)$ with |P| and |N| the amount of positive cases and negative cases of pneumonia within the training set respectively.

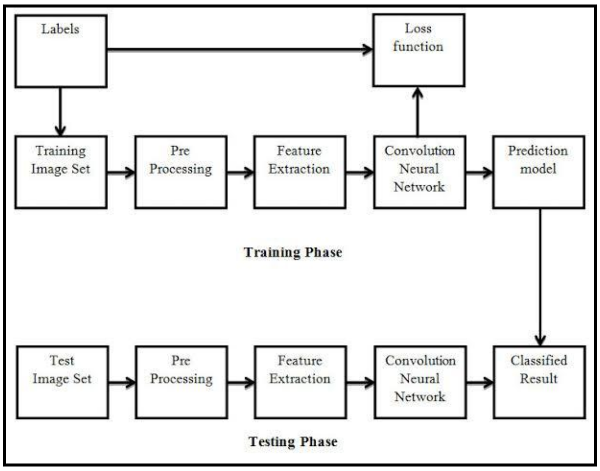

Fig. System Architecture Diagram

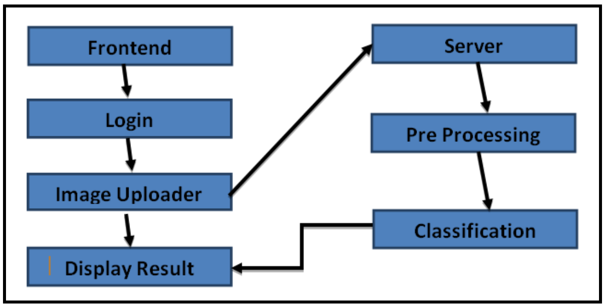

***Fig.** Block Diagram*

IV. Advantages

Machine learning algorithms were from the very beginning designed and analyze medical datasets. Today, machine learning provides indispensable tool for data analysis. Especially in the last few years, the digital revolution provided relatively inexpensive and available means to collect and store data. Modern hospitals are well equipped with monitoring and other data collection devices, and data is gathered and shared in large data system. Machine Learning technology is currently compatible for analyzing medical data, and especially there's tons of labor wiped out diagnosis in small specialized diagnostic problems.

Data about correct diagnosis are often available in the form of medical records in specialize hospitals or their departments. All that has to be done is to input the patient record with known correct diagnosis into a computer program to run a learning algorithm. This if in fact over simplification, but in theory, the medical diagnostic knowledge is often automatically derived from the outline of cases solved within the pasts. The derived classifier would then be able to be utilized either to help the doctor diagnosing the new patients or doctors' non-experts to embrace to analyze patients in exceptional symptomatic issue.

The proposed system is easy to use and is portable and can be used anywhere with an active internet connection. It can be used anywhere and there is no need to wait in queues. The results are accurate and are predicted very fast. The system can also predict different stages of pneumonia and which part may have pneumonia in future.

V. Limitation

First, only frontal radiographs were presented to the radiologists and model during diagnosis, but it has been shown that up to 15% of accurate diagnoses require the lateral view [7]; we thus expect that this setup provides a conservative estimate of performance. Third, neither the model nor the radiologists were not permitted to use patient history, which has been shown to decrease radiologist diagnostic performance in interpreting chest radiographs [8][9].

VI. Conclusion

We develop an algorithm which detects pneumonia from frontal-view chest X-ray images at a level exceeding practicing radiologist. We also show that an easy extension of our algorithm to detect multiple diseases outperforms previous state of the art on ChestX-ray14, the most important publicly available chest X-ray dataset. With automation at the extent of experts, we hope that this technology can improve health care delivery and increase access to medical imaging expertise in parts of the planet where access to skilled radiologists is limited.
An efficient model is made using deep learning algorithms in Python language which can help doctors to detect this deadly disease. The proposed framework is compared with state-of-the art methods of machine learning and found to be more efficient in prediction with an average accuracy of 84%, which is found to be better than all other classifiers.

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The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first ..."

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