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Lung Image Classification Using Convolutional Neural Network And Prediction of Different Diseases

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***Abstract*:** Usually, the people are not aware about a disease and the treatments pertaining to it. Also, the symptoms which leads to that disease is unclear and uncertain and if these symptoms are identified by the person, he must go through various steps for getting an appointment with the doctor like making a call to the healthcare facility. It is also a tedious job for the receptionist to manage all these telephonic calls and fix an appointment according to the availability of the doctor. After the diagnosis of a patient there could be a possibility that doctor couldn't diagnose the patient properly or there could be some inaccuracies in the diagnosis. In this paper we have come up with an exceptional solution to both of the above mentioned problems, that is we have used a medical chatbot under proper guidance for booking an appointment with the doctor and we have also have built an artificial intelligence based model that uses image classification technique to diagnose the reports of the patient which will state the results to which what the patient is suffering from. It uses CNN (convolutional neural networks) for the processing of the image. And this model can detect various respiratory related diseases.

Keywords: Medical chatbot, Artificial Intelligence, Model, Image classification, Convolutional neural networks

I. INTRODUCTION

Healthcare industry is a very vast industry and one of the fastest growing industry in the current scenario. But along with the growth of this industry, healthcare services face an enormous challenge of supply-and-demand and this can be fixed by employing a chatbot. An AI-enabled conversational UX can deliver personalized experiences to the users for scheduling doctor appointments which ease the work of the receptionist [1].

Next, a region of our project focusses on the doctor's perspective that they train for years to do diagnosing of assorted diseases and therefore the error rate is still relatively high. So this project of ours uses varied machine learning codes and convolution neural networks (CNN) which focuses on respiratory based images for detection of the lung based diseases. It takes reports such as MRI scans, CT scans as input for process and displaying the results. Presence of any respiratory based disease can often be diagnosed with the help of a CT, MRI image or X-ray of lungs. Doctor analyses the CT image and predicts the presence of any particular disease. Manual detection like these may have the possibilities for misdiagnosis. So it is always better to counter check and clear out any misdiagnosis or doubts.

So, the purpose of the project basically covers two aspects:

Enable users to book appointments hassle free without the use of telephonic calls and also it makes the job of the receptionist easy. The medical chat bot helps in arranging the appointments easily.

Doctors can double check their diagnosis and can clear any doubts or suspicions that they might have while diagnosis. The image classifier can train itself for new cases as well so that it can identify those cases in future.

The rest of the paper is organized as follows, Section I contains the introduction about the medical chat bot and the image classifier, Section II contains the related works wherein 4 paper have been described on the medical chat bot and the image classifier, Section III contains the methodology of the whole system which is been divided into 2 phases and each sub part of the system is described, Section IV contains the results and discussions where the final outputs of the system is displayed, Section V concludes the research work with the future scope.

II. RELATED WORK

In the year 2018, Mrs. Rashmi Dharwadkar, Dr.Mrs. Neeta A. Deshpande [1] developed a medical chatbot. This medical chat-bot operates on natural language processing that aids users to submit their problem regarding the health. The User can ask any personal doubts or questions related to their health conditions through the chat-Bot without physically being present in the hospital. By using Google API for text to speech and speech to text conversion. Query is sent to Chatbot and gets similar answers and display answers on android app.

In 2018, Zhaoqian Lan, Guopeng Zhou, Yichun Duan, Wei Yan [2] proposed an AI-assisted prediction system, which leverages data mining methods to reveal the relationship between the regular physical examination records and the potential health risk. It can predict users risk of physical status next year based on their physical examination reports presented this year. The system provides a user-friendly interface for users and doctors. Users can know their potential health risks while doctors can get a set of users with potential risk.

In 2018, Suren Makaju, P.W.C Prasad, Abeer Alsadoon, A.K.Singh, A.Elchouemi [3] came up with a research to analyze the multiple computer based techniques, analyzing the current best technique and finding out their limitation and finally proposing the new model with enhancements in the present best model. The strategy used was that lung cancer identification techniques were listed on the idea of their identification accuracies. The techniques were analyzed on each step and disadvantages were pointed out.

In 2018, Nima Tajbakhsh, Jae. Y Shin, Suryakanth R. Gurudu, R. Todd Hurst, Christopher B Kendall, Michael B. Gotway, Jianming Lang proposed a paper in which they considered four different medical imaging applications in three domains (radiology, cardiology, and gastroenterology) involving classification, detection, and segmentation from three various imaging models, and investigated how the performance of deep CNNs trained from start compared with the pre-trained CNNs fine-tuned in a layer-wise manner. Their experiments consistently showed that 1) The use of a pre-trained CNN with proper fine tuning performed better than a CNN trained from start. 2) Fine-tuned CNNs were more robust to the size of training sets than CNNs trained from start. 3) Their layer-wise fine-tuning process could offer a more prominent way to reach the best performance for the application at hand based on the amount of data available.

III. METHODOLOGY

The proposed system contains two phases:

PHASE 1: MEDICAL CHATBOT

The medical chatbot helps user to book an appointment. The user enters their personal details such as name, contact number and email ID. Then the user chooses which day and time the appointment should be scheduled according to the convenience. The user details and the appointment day and time is been recorded. And once a particular time slot is booked no other user can book the same time slot.

PHASE 2: LUNG BASED DISEASE DETECTION AND CLASSIFICATION

In our proposed system, the main core of our project is Convolutional Neural Networks. Deep Learning (DL) is a subset of Machine Learning (ML) which is a subset of Artificial Intelligence (AI) which plays a key role in developing human intelligible and independent systems also DL mimics the functionality of human brain which consists of enormous number of neurons controlled by a central nervous system and DL is also composed of several number of neural networks, where each neuron is represented as a single node and the entire activity is controlled by Central Processing Unit (CPU) or Graphics Processing Unit (GPU). Most of the models developed works with the principle of Convolutional Neural Network i.e., extracting appropriate and desired features automatically. Deep learning does not have to divide the feature extraction and the classification because the model automatically extracts the features while training the model. It is used in many research areas such as image processing, image restoration, speech recognition, natural language processing and bioinformatics. Each layer uses the output of the preceding layer as input.

Convolution Neural Networks

Convolution Neural Network makes use of the input consists of images and they constrain the architecture in a more sensible way than the regular Neural Network, the layers of a CNN have neurons arranged in 2 or 3 dimensions: width, height, depth [4].

Convolution Layer

CNN takes its name from the convolution layer. In this layer, mathematical operations are performed to detect the feature map of the input image. In Image processing, convolution is closely similar to another process called correlation. Correlation is the process of shifting a filter mask over the image and computing the sum of products at each location. Convolution differs a little as it uses an inverted filter. Using a filter the input image is reduced to a small size. The filter is shifted stepwise starting from the upper left corner of the scanned image. At each step, the values in the image are multiplied by the values of the filter and the result is summed.
The activation function provides a relationship between the input and output layers. Non-linear learning of the model occurs through the activation function. Several activation functions, such as linear, sigmoid, hyperbolic tangent, exist, but the nonlinear ReLU (Rectified Linear Unit) activation function is usually used in CNN.[5]

Pooling layer

Pooling layers are used to greatly scale down the size of the representation to reduce the number of parameters in the network, and also to control over fitting [6]. Pooling layer reduces the parameters of the feature, i.e., length and width is reduced but not the depth. This reduces the number of divisions and weights, reduces the training time and reduces the cost of processing too. This also deals with overfitting. Overfitting is a scenario where the model achieves 100% or 99% on the training set but on an average of 50% on the test information. This can be dealt by introducing dropout layers where a random set of activations are dropped out by setting the value to 0.

Dropout is a function that enhances generalization by learning many different representations of patterns.

Fully connected layer

This layer is the same as the way that the neurons are arranged in a traditional neural network. hence each node in a fully connected layer is directly connected to every node in the previous and in the next layer [7]. This layer identifies very big level features that highly correlate to an object or class.

Disease classifier model

CT (computed tomography) images of lungs represents a slice of the ribcage, where number of structures are located like blood vessels, arteries, blood vessels, parenchyma each pertaining its own specific information. Thus, for lung base disease analysis and diagnosis, it is important to segment lung structures. Segmentation is crucial step for an accurate respiratory disease diagnosis. A disease classifier model takes the reports such as X-ray images, CT scan images, MRI images as input for further processing for the diagnosis. These images are compared with the images present in the data set for further diagnosis. A data set is a collection of multiple data collected from various resources. Where all the information related to particular entity is collected like images, results, calculations etc. Likewise, in this system data set regarding the lung-based diseases are collected like x-ray images, CT scan images and reports. These data sets are enormous in quantity. So basically, an AI project depends upon the quality of the data set. So, following is the representation of the working of the disease classifier model.

INCEPTION V3 ALGORITHM

Inception V3 is the algorithm which is used by this system. This algorithm is an open source algorithm which was developed by Google which is used for classification of images. Inception-v3 is a network that is 48 layers deep. This model is in TensorFlow platform where transfer learning technology is used to retrain the lungs category datasets, which can drastically enhance the accuracy of lungs classification.

IV. RESULTS AND DISCUSSION

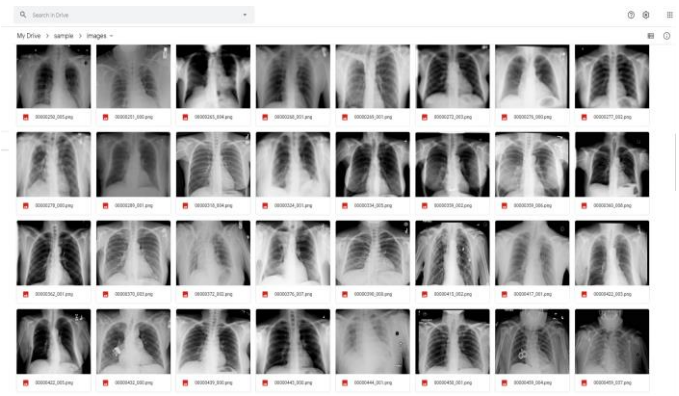

FIG 1: Dataset of different lung images

FIG 2: Sample scanned image of lungs

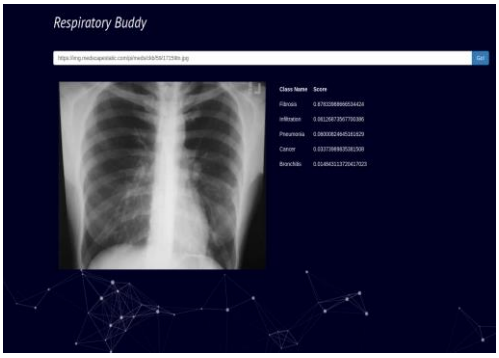

FIG 3: Output of the system

URL prediction is used to display the image. As the radiologists or doctors could use this on the go. They would not carry the reports of the patient with them every time. So, to overcome this, url is better where the doctor can fetch the records online itself.

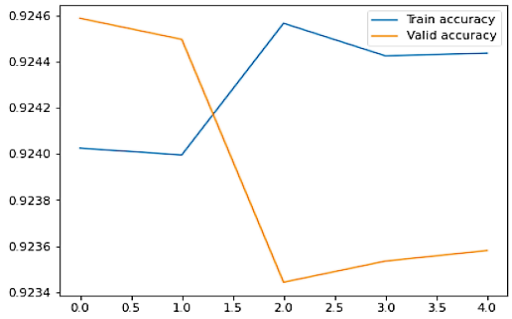

FIG 4: Comparison of training and validation accuracy.

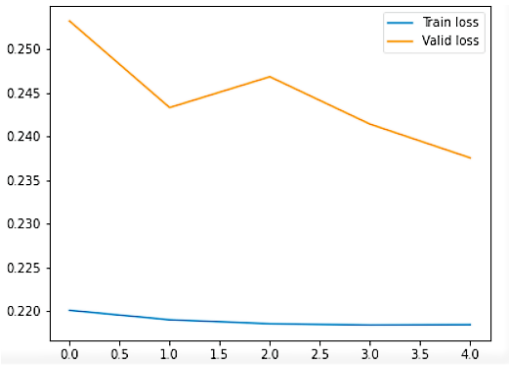

FIG 5: Comparison of training and validation loss.

V. CONCLUSION AND FUTURE SCOPE

In this paper, the proposed system contains a medical chatbot and a lung-based disease detection and classification system. The medical chatbot is used for booking an appointment with the doctor wherein the user enters their personal details and the desired date when the appointment is to be scheduled. So, it makes the process more convenient for the users and as well as for the receptionists. And the lung-based disease detection and classification system works on convolution neural network. Three various input matrices have been obtained for R, G and B channels to start convolution for very image in the data set. And it uses X-Ray, CT scan and MRI images to perform diagnosis. Each input image matrix has been convoluted. RLU activation function and max pooling have been implied to the output matrix. The experiments have been carried out on healthy and diseased lung images to perform classification. It is concluded that the proposed method effectively recognizes different types of lung diseases. To improve recognition rate in classification process different filters or different sizes of convolutions can also be used. The achieved accuracy is 92.30%. Creating and training a CNN model from scratch is a tedious process when compared to the usage of existing deep learning models for various applications to achieve maximum accuracy. Therefore in the future work, it is planned to utilize a model efficient than existing architectures, such that it gives higher accuracy with minimum size and complexity. It can be concluded that AI can diagnose a disease better than human if given the right amount of training. Everyone will win and its important to remember that AI won't replace doctors but it can be the most powerful tool they've ever used.

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