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Pulmonary Lobe Based Lung Diseases Detection Using Deep Learning Techniques

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Abstract- Coronavirus disease 2019 (COVID-19) is an infectious disease triggered by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since the disease has spread all over the globe in enormous numbers and is declared a pandemic. Although radiological imaging is not recommended for diagnostics as the patient arrives in the clinic, a chest X-ray is often useful to monitor treatment outcomes and comorbidities in seriously ill patients. The detection of COVID-19 from chest X-ray and its differentiation from lung diseases with identical opacities is a puzzling task that relies on the availability of expert radiologists. Recently, several researchers have reported the use of AI-based tools in solving image classification problems in healthcare, based on training with X-ray images, CT scans, histopathology images, etc. Deep learning is an extremely powerful tool for learning complex, cognitive problems, and the frequency of their use and evaluation in different problems is increasing. In the present study, we have made use of a deep learning algorithm using the convolutional neural network (CNN) that can efficiently detect COVID-19 from CT-scan images. And also implement Multi-class CNN to identify the multiple lung diseases such as Pneumonia, tuberculosis, and so on. Experimental results shows that the proposed system provides improved accuracy in disease prediction and also provide the diagnosis information about analyzed diseases.

Keywords- Deep learning, Feature Extraction, Image segmentation, CNN.

I. INTRODUCTION

Deep learning is an artificial intelligence (AI) function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also known as deep neural learning or deep neural network.

Deep learning is a modern variation which is concerned with an unbounded number of layers of bounded size, which permits practical application and optimized implementation, while retaining theoretical universality under mild conditions. In deep learning the layers are also permitted to be heterogeneous and to deviate widely from biologically informed connectionist models, for the sake of efficiency, trainability and understandability, whence the "structured" part. Deep Learning is a machine learning technique that constructs artificial

neural networks to mimic the structure and function of the human brain.

II. PROBLEM IDENTIFICATION

Access to accurate outbreak prediction models is essential to obtain insights into the likely spread and consequences of infectious diseases. Governments and other legislative bodies rely on insights from prediction models to suggest new policies and to assess the effectiveness of the enforced policies. The novel coronavirus disease (COVID-19) has been reported to have infected more than 2 million people, with more than 132,000 confirmed deaths worldwide. The recent global COVID-19 pandemic has exhibited a nonlinear and complex nature. In addition, the outbreak has differences with other recent outbreaks, which brings into question the ability of standard models to deliver accurate results. In addition to the numerous known and unknown variables involved in the spread, the complexity of population-wide behavior in various geopolitical areas and differences in containment strategies dramatically increased model uncertainty. Consequently, standard epidemiological models face new challenges to deliver more reliable results. To overcome this challenge, many novel models have emerged which introduce several assumptions to modeling. In this study, they propose to generate a more accurate diagnosis model of COVID-19 based on patient symptoms and routine test results by applying machine learning to reanalyzing COVID-19 data.

III. MATERIALS AND METHODS

The coronavirus disease 2019 (COVID-19) pandemic has caused health concerns worldwide since December 2019. From the beginning of infection, patients will progress through different symptom stages, such as fever, dyspnea or even death. Identifying disease progression and predicting patient outcome at an early stage helps target treatment and resource allocation. However, there is no clear COVID-19 stage definition, and few studies have addressed characterizing COVID-19 progression, making the need for this study evident. Lung abnormality is one of the common diseases in humans of all age group and this disease may arise due to various reasons. Recently, the lung infection due to SARS-CoV-2 has affected a larger human community globally, and due to its rapidity, the World-Health-Organisation (WHO) declared it as pandemic disease. The COVID-19 disease has adverse effects on the respiratory system, and the infection severity can be detected using a chosen imaging modality. The field of medical imaging introduced CAD (Computer-Aided Diagnostic) systems which help medical specialist to identify and categories the problem. The lesions are produced with different body parts which cause the cancer. Such lesions are referred to as nodule if they causes cancer, otherwise non-nodule. In the design of a CAD system, the main task is to segment the volume of particular body part, like lungs volume should be separated from the complete image so that they can keep our focus on the object of interests. These objects are unwanted lesions.

These unwanted lesions are potential nodules. The next step is to classify the potential nodules into nodules and non-nodule. Rapid and accurate detection of COVID-19 coronavirus is necessity of time to prevent and control of this pandemic by timely quarantine and medical treatment in absence of any vaccine. Daily increase in cases of COVID-19 patient's worldwide and limited number of available detection kits pose difficulty in identifying the presence of disease. Therefore, at this point of time, necessity arises to look for other alternatives. Among already existing, widely available and low-cost resources, X-ray is frequently used imaging modality and on the other hand, deep learning techniques have achieved state-of-the-art performances in computer-aided medical diagnosis. Therefore, an alternative diagnostic tool to detect COVID-19 cases utilizing available resources and advanced deep learning techniques is proposed in this work. The proposed method is implemented in four phases, viz., data augmentation, preprocessing, stage-I and stage-II deep network model designing.

Deep network implementation in two stages is designed to differentiate COVID-19 induced pneumonia from healthy cases, bacterial and other virus induced pneumonia on X-ray images of chest. They employed MIL, a deep learning method, using quantitative CT data to accurately predict the disease severity of COVID-19. By utilizing an inexpensive and widely available test, our model can be used to identify patients at high risk of disease progression in the early phase of the disease, which has important practical implications for conducting early intervention, preventing disease progression, and reducing mortality. They recommend that confirmed COVID-19 patients should undergo CT screening as soon as they are admitted to the hospital, so that physicians can use our model to determine the risk of severe disease. If the result indicates a potential worsening of the condition of the patient, closer monitoring and early intervention should be considered before the disease severity increases.

In proposed methodology, so can train the medical images related to lung diseases in terms of CT scan images. In testing side, input the CT scan image, apply preprocessing to eliminate the noises in image using median filter algorithm. And extract the features using contour model. Finally classify the multiple lung diseases using CNN algorithm and to provide diagnosis details with improved accuracy rate.

System Architecture

This architecture has five parts such as preprocessing, features extraction, segmentation and classification. User can be input Lung CT image as input and preprocessing steps to convert the image into gray scale and filter the noise using median filter algorithm. Then perform features extraction steps to extract the color, shape and other features and constructed as sparse matrix. After that perform active contour method to segment the lung boundaries. Finally classify the features whether is affected or not using CNN algorithm and provide the multiple lung diseases. Over all block diagram is represented in fig 3.1

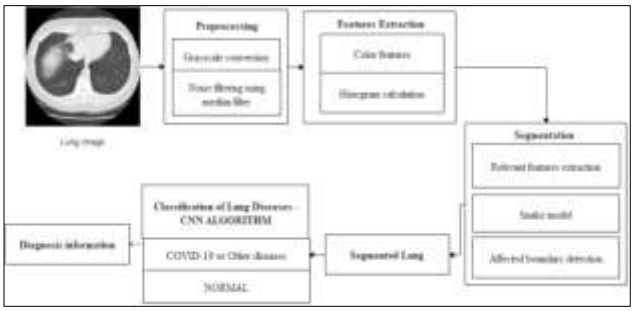

Figure 1: Proposed Architecture

Image Acquisition

Computed Tomography (CT) is taken into account in concert of the simplest strategies to diagnose the pneumonic nodules. It uses x-rays to get structural and practical info concerning the physical body. However, the CT image quality is influenced lots by the radiation dose. The standard of image will increase with the many quantities of radiation dose, however within the same time, this will increase the amount of x-rays being absorbed by the lungs. To forestall the physical body from all reasonably risk, radiologist's area unit obligated to cut back the radiation dose that affects the standard of image and is answerable for noises in respiratory organ CT pictures.

Pre-Processing

Here, CT image can input to the system. The user has to select the required lung frame image for further processing. Then each image is resized to 256*256. Then implement median filter to remove noises from lung images. The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing. Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of

neighboring pixels. The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image pixel, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

Feature Extraction

Feature learning comprises a set of algorithms to transform labeled or unlabeled data to a new space, where it can capture the parameters and patterns of variation by disentangling the hidden features. Numerous unlabeled data is available in each domain, e.g. images, text data, speech, which contain several patterns of variation that can easily be collected for feature extraction, e.g. from preprocessed image. The task of feature extraction from unlabeled data is known as unsupervised feature learning. In linear sparse coding, the goal is to find a decomposition in which the hidden components are sparse, meaning that they have probability densities which are highly peaked at zero and have heavy tails. This basically means that any given input vector can be well represented using only a few significantly non-zero hidden coefficients.

Lung Classification

The classification is the final step of the system. After analyzing the structure, each section individually evaluated for the probability of true positives. Lung diseases are classified using Convolutional neural network algorithm. CNNs represent feed-forward neural networks which encompass diverse combos of the convolutional layers, max pooling layers, and completely related layers and Take advantage of spatially neighborhood correlation by way of way of imposing a nearby connectivity pattern among neurons of adjacent layers. Convolutional layers alternate with max pooling layers mimicking the individual of complex and clean cells in mammalian seen cortex. A CNN includes one or extra pairs of convolution and max pooling layers and ultimately ends with completely related neural networks. The hyper-spectral data with hundreds of spectral channels can be illustrated as 2D curves. The hierarchical structure of CNNs is steadily proved to be the most efficient and successful manner to analyze visible representations. The fundamental challenge in such visual tasks is to model the intra-class appearance and shape variation of objects. The hyper-spectral data with hundreds of spectral channels can be illustrated as 2D curves. They know that CNNs can accomplish competitive and even better performance than human being in some visual problems, and its capability inspires us to study the possibility of applying CNNs for classify the disease features. The CNN varies in how the convolutional and max pooling layers are realized and how the nets are trained. This network varies affording to the spectral channel size and the number of output classes of input lung data. So our proposed work overcomes irregular boundaries separation in Lung image classification with features extraction.

Disease Prediction

Covid-19 is a rapidly spreading viral disease that infects not only humans, but animals are also infected because of this disease. The daily life of human beings, their health, and the economy of a country are affected due to this deadly viral disease. Covid-19 is a common spreading disease, and till now, not a single country can prepare a vaccine for COVID-19. A clinical study of COVID-19 infected patients has shown that these types of patients are mostly infected from a lung infection after coming in contact with this disease. Chest x-ray (i.e., radiography) and chest CT are a more effective imaging technique for diagnosing lunge related problems. Still, a substantial chest x-ray is a lower cost process in comparison to chest CT. In this module, we can identify the COVID and other diseases. And also provide prescription for affected diseases.

IV. RESULT & DISCUSSION

The Graphical User Interface (GUI) where generated after the execution of the main function the. The first GUI image consists of the uploading of CT lung images. This process of the Disease detection is Image acquisition. And the CT image of lung is

acquired from the image data set where all the images are in digital form.

In this uploading part, there are two set process will be done. One is training and another one is testing. Training consists in learning a relation between data and attributes from a fraction of the training dataset. Testing consists in testing predictions of this relation on another part of the dataset.

In training mode, it will give the Grayscale converted image, Invert image, Noise removal image of the uploaded lung image. In the Grayscale image, every shade of black and white colour will be obtained. So, we can easily remove the noise. In the invert image, the colour in image will be inverted for better accuracy. And then the noise will be removed using the median filter.

In testing mode, the noise removal image is segmented using Active Contour algorithm, the method used in Active Contour algorithm is snake model. The snake model helps in object tracking. So that we can easily identify the affected regions. These affected boundaries are in the matrix form. Using the matrix comparison, the classification of the image is going to be detected.

The diseases are PNEUMONIA, COVID, TUBERCLOSIS, INFLUENZA. If the given input is not placed under these diseases, then it will be denoted as NORMAL and the prescription will be added as per the type of disease.

Figure 2: Original Image-Pneumonia

Figure 3: Gray Image-Pneumonia

Figure 4: Invert Image- Pneumonia

Figure 5: Noise Removal Image-Pneumonia

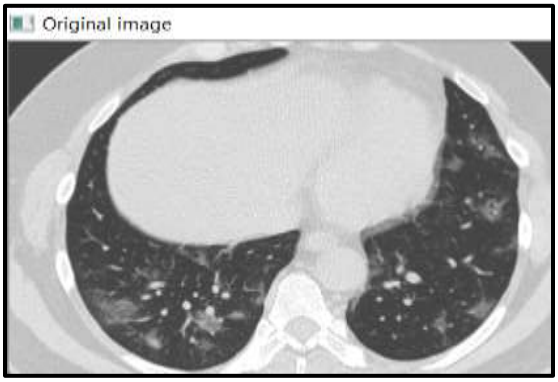

Figure 6: Original Image-COVID

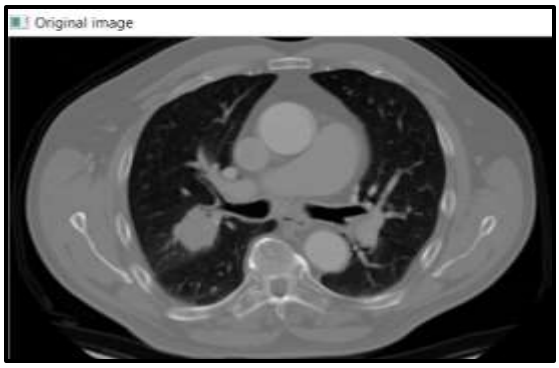

Figure 7: Original Image- Tuberculosis

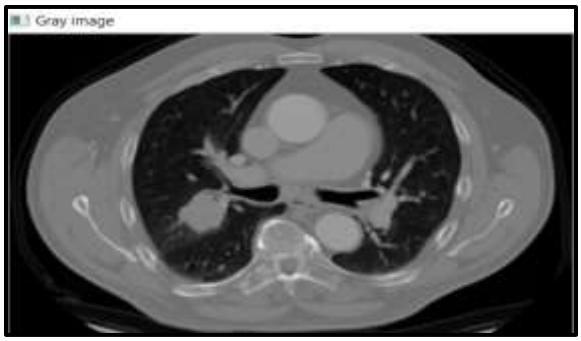

Figure 8: Gray Image- Tuberculosis

Figure 9: Noise Removal Image- Tuberculosis

V. CONCLUSION

The confirmatory diagnosis of COVID-19 is mainly dependent on clinical symptoms, epidemiological history, nucleic acid detection, immune identification technology, etc. All the methods mentioned above have some limitations such as time required, costs, equipment dependence, shortage of testing kits, availability of trained healthcare workers, inter operator variability's, especially in a pandemic like this, making them cumbersome diagnostic procedures. Timely diagnosis of the COVID-19 patients can enable help in the optimization of available resources, including trained human resources, for all the supportive measures required for confirmed patients. Automated AI-based intelligent chest X-ray classification has such untapped potential for this unmet need, as evident from recent researches. Rapid screening to diagnose such patients is also essential for controlling outbreaks. In conclusion, an AI system derived from heterogeneous multinational training data delivers acceptable performance metrics for the classification of chest CT for COVID-19 infection. We can conclude that the proposed system provided multiple lung disease classification using CNN algorithm. Our system implemented contour method to segment the lung lesions and with multi-class classification with multiple lung related diseases with improved accuracy rate.

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