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A Novel Architecture to Classify Coronavirus (Covid-19) using Convolutional Neural Network

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Abstract: - Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. Under such circumstances, 3D volumetric imaging has become a valuable tool for diagnosis and prognosis of COVID-19 patients. In this study, we propose new method for detecting and classifying COVID-19 infection from 3D volumetric lung images. For the detection and classification process, we have used 3D volumetric image processing and deep learning techniques respectively.

Keywords: - 3D Volumetric Image Processing, Classification, Coronavirus Disease (COVID-19), Deep Learning Techniques, Detection.

1 Introduction

The infectious disease induced by the recently identified coronaviruses is Coronavirus disease (COVID-19). Many patients with COVID-19 are affected with mild to moderate respiratory disease and recover without specific therapy. The more likely elderly and the more likely to acquire major diseases are individuals with underlying medical issues such as cardiovascular disease, diabetes, chronic respiratory illnesses and cancer.

It is best to be fully informed about the COVID-19 virus, its cause, and its growth, as a method to avoid and reduce transmission. Cleanse your hands or use an alcohol-based rub regularly, and do not contact your face, to protect yourself and others of infection. The COVID-19 virus transmits mostly by saliva gout or nasal discharge when the person who is sick in sneezing, thus the practice of breathing hygiene is particularly crucial (for example, by coughing into a flexed elbow).

A new respiration virus, termed the new Coronavirus in 2019, or COVID-19, headlines worldwide for an epidemic of breathing diseases. The outbreak started in China's Wuhan, Hubei Province and rapidly spread to the US and beyond. There are thousands of ill and officials of public health are watching the spread of the virus closely. Coronaviruses are a wide family of viruses found in people and animals that can trigger respiratory diseases around the world. Many known coronaviruses infect individuals, generally causing very minor respiratory diseases such as the common cold.

The illness can be verified with the RT-PCR test for polymerase reverse transcription chain reactions. As a gold standard for diagnosis, it is time consuming to confirm COVID-19 patients using the RT-PCR, and high misleading rates as well as low sensitivities could put obstacles in the way of early identification and treatment of the presumptive patients.

2 Related Works

For the diagnosis, evaluation and staging of COVID-19 infection, CT imagery is critical. For disease development, follow-up scans every 3-5 days are usually advisable. Bilateral and peripheral ground glass of opacification (GGO) with or without consolidation have been found to be predominantly CT results for COVID-19 patients. However, only qualitative print and crude descriptions of the diseased regions are currently utilized in radiological reports due to the shortage of automated quantification techniques. This study develops a DL segmentation method to quantify the areas of infection of interest and their volumetric ratios w.r.t. of the lung automatically [1]. In 300 chest CT images of 300 patients of COVID-19, automated segmented and manually defined infection zones were compared. the performance of the technology. A human-in-the-loop (HITL) strategy to assist infection region segmentation radiologist has been adopted in order to quickly delineate training samples and to achieve manual intervention with automatic results, which has dramatically reduced the total segmentation time to four minutes after 3 iterations.

The approach of the analysis of medical pictures has rapidly become deep learning algorithms, particularly convolutionary networks. This article examines the main deep learning principles relevant to the analytics of medical picture and summarizes over 300 inputs, most of them last year. They examined the use of extensive training to classify the image, recognize objects, segment them, register and other tasks. Concise investigations by application area are provided: neuro-, retinal-, pulmonary-, digital-, breast-, cardiac-, abdominal- and musculoskeletal pathologies. They concluded by an overview of the present state of the art and critical discussion of future research challenges and directions [2].

They discovered that in the early years, a relatively low positive rate of detection of viral RNA from the sputum or nasopharyngeal swab in real time was seen in the reverse transcription-polymerase chain reaction (RT-PCR) (named by the World Health Organization). The symptoms of COVID-19 computed tomography (CT) imaging differ from other forms of viral pneumonia, such as viral influenza-A pneumonia. For this reason, clinicians are urging this new pneumonia to be diagnosed with a new early stage. The purpose of this work was to develop an early screening model to differentiate pneumonia COVID-19 from viral influenza-A-pneumonia and healthy patients with deep-learning CT images. First, the potential areas of infection were segregated by a three-dimensional profound pulmonary CT model set. These distinct pictures were classified into COVID-19, viral influenza A and unrelated to infection groups, and the relevant confidence values were calculated using a location attention model. Finally, Noisy or Bayesian function estimated the kind of infection and overall trust in this CT instance [3].

3 Methodology

In this article we propose to discover COVID-19 areas that are totally automatically infected by chest CT data collected from different centers and scanners with controlled deep learning architecture. Based on the findings of the detection of COVID-19 patients can also be diagnosed. We further test the hypothesis that, on the basis of CT radiological characteristics, the deep neural networks that we have created allow us to distinguish COVID-19 cases from community acquired pneumonia (CAP) and non-pneumonia (NP) scans.

This study involved COVID-19, CAP and NP patients in the 3D volumetric chest of the CT. The clinical categorization of COVID-19 patients can be categorized as mild, moderate, severe and critical in accordance with diagnostic and treatment program COVID-19 released by the National Health Commission in China. All the patients at the COVID-19 were in serious or critical phases, and all of our CT scans were conducted within three days. Patients who were randomly selected from collaborating hospitals were CAP and other NPs (no lung disease, lung nodules, chronic inflammation and chronic obstructive lung disease); CAP patients are included according to recommendations for therapy of acquired pneumonia in adults issued by the American Thoracic Society of the Infectious Diseases.

The Diagnosis of CAP focuses on the identification of clinical features (e.g., cold, fever, developing sputum and pleuritic chest discomfort) and is followed by a pulmonary examination, usually with X-rays in the chest, and with CT in our case. A chest radiograph is required to establish the diagnosis and differentiate CAP better from other specific causes of cough and fever such as acute bronchitis when individuals with CAP are regularly examined. No lung or lungs illness, e.g., lung nodules, chronic inflammatory diseases, chronic obstructive pulmonary disease and others have been diagnosed in NP patients. It should be noted that, in the context of normal CT, there were no apparent abnormalities in both lungs from CT exams.

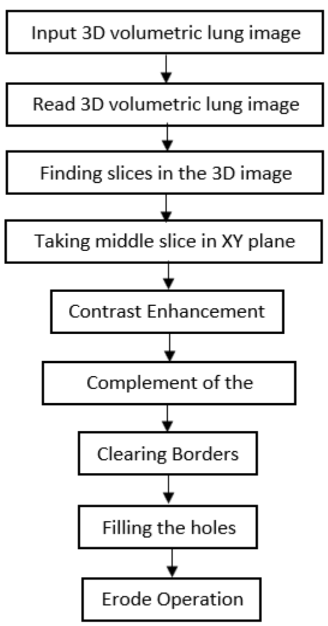

Fig 1: Lung Segmentation

The image intensity modification remains throughout the entire scope of the data type. An excellent contrast image has a clear black-and-white distinction. The high contrast image shows stronger highlights and darker shadows appear. Zeros becomes zero in the complement of a binary image. The white and the black have been reversed. Each pixel value is extracted to the class' maximum value of the pixel in addition to a grayscale or color picture (or 1.0 for double-precision images). The pixel value in the output frame is the difference. Dark regions become brighter in the output image and darker in light areas. Reds become cyan, greens magenta, blues yellow, and vice versa for color images. Morphology is a wide range of image processing activities that handle shape-based images. Every pixel in the image is modified according to the value in the neighborhood for a morphological procedure. You may build a morphological operation that is sensitive to certain forms in the input picture by selecting the size and shape of the neighborhood.

As far as machine learning is concerned, the artificial neural network works quite effectively. In different classifying tasks such as image, audio and word, artificial neural networks are employed. Various Neural network types are applied to different objectives, such as predicting the sequence of words that we use more precise LSTM recurrent neural networks, and similarly using Convolution Neural Network for the image categorization. In this we will create a fundamental CNN building piece. One or more convolutionary layers can be used as a convolutionary neural network. The number and complexity of the data relies on the number of convolutionary layers.

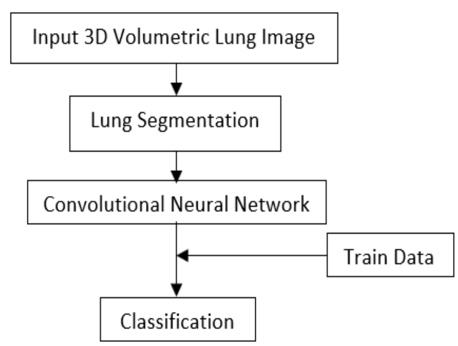

Fig 2: Flow of Proposed Method

An artificial neural network works extremely well when it comes to Machine Learning (ML). Images, video, and words are classified using artificial neural networks (ANNs). Recurrent Neural Networks (LSTM) are used to predict word sequences. Convolutional neural networks are used to classify images. In this project, we're going to lay the foundation for CNN's development. One or more convolutional layers can be used in a neural network with convolutional layers. How many layers there are in a convolution depends on the amount and complexity of the data being processed.

Similar to previous work is the major goal of this project. We shall propose a new CNN model due to the poor accuracy rate of the existing model. The data collection consists of over 30 images. Stochastic gradient descent (SGDM) optimizer will be the solver of the training network. The number of epochs is going to be 30. The initial training rate will be 0.1. Every epoch will be the option to shuffle data. Network validation frequency will be 10 in number of iterations (positive integer).

S. No	Layer Name	Filter Size, No. of Filters	Stride, Padding
1	Image Input Layer [28 28 1]	-	-
2	Convolutional 2D Layer	3, 8	1, Same
3	Batch Normalization	-	-
4	ReLU Layer	-	-
5	Max Pooling Layer	2	2
6	Convolutional 2D Layer	3, 16	1, Same
7	Batch Normalization	-	-
8	ReLU Layer	-	-
9	Max Pooling Layer	2	2
10	Convolutional 2D Layer	3, 32	1, Same
11	Batch Normalization	-	-
12	ReLU Layer	-	-
13	Fully Connected Layer (3)	-	-
14	Softmax Layer	-	-
15	Classification Layer	-	-

Table 1: Description about layers

Model accuracy will be high (nearly 85%), low in misclassifications and applications are diagnosis and prognosis of COVID-19.

4 Experimental Results

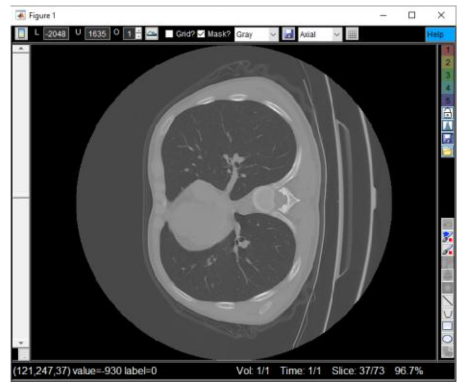

Fig 3: 3D Volumetric Lung Image

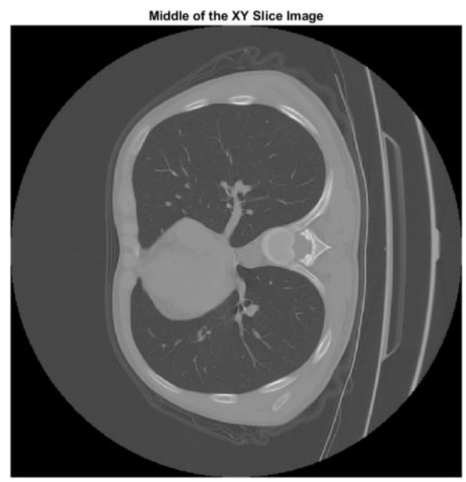

Fig 4: Middle Slice Image

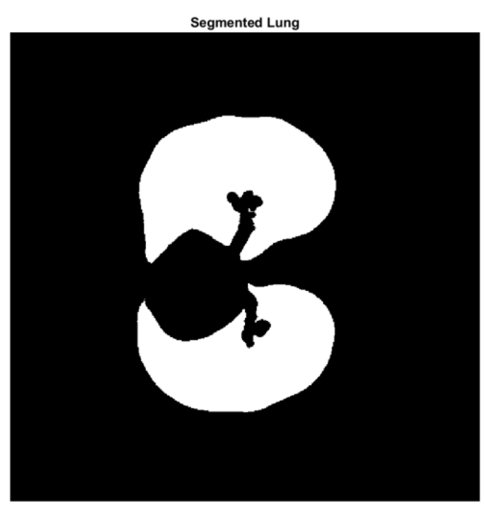

Fig 5: Lung Segmentation

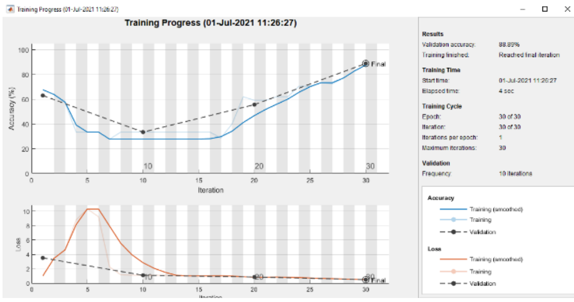

Fig 6: Training Progress

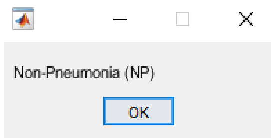

Fig 7: Output Message Box

S. No	Existing Method in %	Proposed Method in %
1	48.15	74.07
2	37.04	74.07
3	33.33	92.59
4	33.33	70.37
5	48.15	92.59
6	40.74	88.89

Table: Accuracy Comparison

5 Conclusion

Most individuals infected with COVID-19 will develop mild to moderate respiratory failure and will recover without special care being needed. Aged individuals are most likely to experience serious diseases, as are those with ongoing medical conditions such as cardiovascular disease, asthma, chronic respiratory disease and cancer. In certain conditions, 3D volumetric imaging has been a valuable technique for COVID-19 patients' diagnosis and prognosis. We suggested a new approach for the diagnosis and classification of COVID-19 infection from 3D volumetric lung images in this report. We used 3D volumetric image processing and deep learning approaches for the detection and classification process respectively. Experimental results show that our model performs better when compared to existing models.

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