<u>REPORT</u>

<u>Project Topic-</u> A Deep Learning based Approach for Detection and Classification of COVID-19 on CT-scans using U-Net model and Convolutional Neural Network

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(1) *Reason to perform this for COVID-19.*

COVID-19 has been declared as a pandemic that is, an epidemic spread across various countries and continents. 75% of the population all around the world is under the lockdown situation to overcome its widespread. Researchers are working hard to find a solution to diagnose the corona virus at an early stage and its cure. Though its fatality rate is low, still the chances of death are high for people with lower immunity especially elderly and infants. Hence, early detection of virus in their body is important. It is known as a droplet infection, spreads by the droplets of an infected person's cough, sneeze or mouth. One of the major symptoms of COVID-19 is breathlessness and pain in the chest. The corona virus affects the lung region largely, causing an inflammation in the lungs and making it tougher for the person to breathe. The corona virus has been observed to attack the healthy cells present in the lungs and damages the alveoli (tiny air sacs) which transfers the oxygen to the blood vessels. These blood vessels carry the oxygen to the RBCs. RBC in turn; deliver the oxygen to all the internal organs in the body. But this functionality gets affected by the virus and the first response of the body is to destroy the virus and prevent its replication, but if the individual has weaker immunity then the body is unable to stop the virus and this aggravates the crisis.

Doctors can see signs of respiratory inflammation on a chest X-ray or CT-scan. On a chest CT image, they may see something they call "ground-class opacity" because it looks like a frosted image. The opaque spots in your lungs look like they start to connect each other in cases of severity. But these conclusions are not specific for COVID-19 (can be possible for flu as well). Considering that CT imaging could aid in screening and accelerating the speed of the diagnosis of COVID-19 especially with shortage of RT-PCR which is quite an expensive instrument that most of them cannot afford, we can say CT scans are useful but accuracy should be ensured.

To ensure accuracy, we train the convolutional model using CT-scans of both COVID and non-COVID patients in our proposed work. Using this, it will support in the clinical decision making with considered accuracy rate.

(2) *Elaborate the usefulness of this data for minimizing the pandemic effects.*

The disease is typically confirmed by reverse-transcription polymerase chain reaction (RT-PCR). However, it has been reported that the sensitivity of RT-PCR might not be high enough for the purpose of early detection and treatment of the presumptive patients. Computed tomography (CT), as a non-invasive imaging approach, can detect certain characteristic manifestations in the lung associated with COVID-19. Hence, the CT scans could serve as an effective way for early screening and diagnosis of COVID-19. The sensitivity of chest CT to diagnose COVID-19 has been reported as high and hence, increases the value of our proposed work.

(3) *Explain the existing work on this domain and differentiate it from your proposed work.*

Even though ***real-time reverse transcriptase polymerase chain reaction (RT-PCR)*** has been considered as the gold standard for SARS-CoV-2 diagnosis, the very limited supply and strict requirements for laboratory environment would greatly delay accurate diagnosis of suspected patients, which has posed unprecedented challenges to prevent the spread of the infection, particularly at the nucleus of the epidemic area. In contrast with it, ***chest computed tomography (CT)*** is a faster and easier method for clinical diagnosis of COVID-19 by combining the patient's clinical symptoms and signs with their recent close contact, travel history, and laboratory findings, which can make it possible for quick diagnosis as early as possible in the clinical practice. It is also effectively helpful to isolate infected patients timely and control the epidemic. Chest CT is a key component of the diagnostic procedure for suspected patients and its CT manifestations have been emphasized in several recent reports.

Deep learning, as the core technology of the rising artificial intelligence (AI) in recent years, has been reported with significantly diagnostic accuracy in medical imaging for automatic detection of lung diseases. It surpassed human-level performance on the ImageNet image classification task with one million images for training in 2015, showed dermatologist-level performance on classifying skin lesions in 2017 and obtained very impressive results for lung cancer screening in 2019. However, most deep learning based methods for disease diagnosis requires to annotate the lesions, especially for disease detection in CT volumes. In the current, annotating lesions of COVID-19 costs a huge amount of efforts for

radiologists, which is not acceptable when COVID-19 is spreading fastly and there are great shortages for radiologists.

Specifically, deep learning was applied to detect and differentiate bacterial and viral pneumonia in **_paediatric chest radiographs_**. Attempts have also been made to detect various imaging features of chest CT.

In this report, we proposed a Deep Learning based Approach for Detection and Classification of COVID-19 on CT-scans using U-Net model and Convolutional Neural Network. The proposed work is different from the existing work in such a way that we first perform the segmentation operation on the CT scans to filter out the lung region using the pre trained U-Net model. The output of this U-Net model is then fed into the Convolutional Neural Network for the training of the classification and detection process. U-Net model is very appropriate to run on a large dataset for processing and segmentation operation.

(4) **_Why deep learning was chosen to achieve the objective of the proposed work?_**

Deep learning has been used for extracting COVID-19's graphical features from Computerised Tomography (CT) scans (images) using U-Net model in order to provide a clinical diagnosis ahead of the pathogenic test, thus saving critical time disease control.

The U-Net model accurately estimates and segments the shape and volume of the lung region. This segmented lung region from the CT scan is then fed to the CNN model. The study used a Convolutional Neural Network (CNN) on 746 CT scans to train the model using the classification of the CT-scans of COVID and non-COVID patients, and

then detect the infection in CT scans of COVID-19 patients. The training and validation accuracy of the model was recorded at around 91.5% and 70%, respectively.

(5) How is it useful for the wellbeing of the human beings and in what percentage?

The proposed work has great potential to be applied in clinical application for accurate and rapid COVID19 diagnosis, which is of great help for the front line medical staff and is also vital to control this epidemic worldwide. Accurate and fast diagnosis of infection results in treating a large number of patients in a short period of time. Manual read of a CT scan can take up to 15 minutes, the proposed model would be able to analyse the images in 10 seconds. It will support clinical decision making and improve workflow efficiency. We can say that it is at least 75% useful towards the human wellbeing during this time of crisis as it is rightly said, early detection leads to early treatment and cure resulting in less number of deaths.