

Coronavirus Detection and Analysis on Chest CT Using Machine Learning

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Abstract.

Coronavirus is still the leading cause of death worldwide. There are a set number of COVID-19 test units accessible in emergency clinics because of the expanding cases daily. Medical images analysis is one of the most promising research areas, it provides facilities for diagnosis and making decisions of a number of diseases such as Coronavirus. This research detect the different opacities in the CT-scan of infected patients viz. Ground-Glass Opacity, Consolidation Opacity and Crazy Paving Opacity, which in turn will help the clinical doctors all over the world, to do a quick diagnose in the detection of Corona Virus with Deep Learning. This model has overcome the results of Reverse transcription polymerase chain reaction (RT-PCR) which is not very efficient in the early diagnosis of the symptoms in the affected patients because its results are

not stable for the first two weeks and it can detect some of the symptoms only after the level of infection is increased gradually up to a certain level. As the model works on early detection, at the same time it saves the cost as the cost of CT-scan is least and it also saves the ample amount of time so that maximum patients can be diagnosed at the same time.

Keywords. Machine Learning; Deep Learning; RT-PCR,

CT-scan

1. Introduction

Whenever thought about mass deaths of people, it was either from a flood, drought, or an explosion caused by a missile or bomb, but these days the significant risk to the human lives from the virus named “Corona”. Coronavirus is the most quickly spreading infectious virus in the twenty-first century that presents epidemic threats to global health worldwide. It is a lethal contagious virus that spread rapidly from one person to another and causes death sometimes. The infected person is found with the symptom of the common cold, cough, fever, nausea, body pain, and difficulty of breathing, sore throat. Originally called SARS-CoV-2 abbreviated as COVID-19, Corona virus disease 2019 (COVID-19) is a respiratory illness that is spreading from person to person. The virus that causes COVID-19 is a novel corona virus that was first identified during an investigation into an outbreak in Wuhan, China. At

the end of 2019, the novel coronavirus disease 2019 pneumonia (COVID-19) occurred in the city of Wuhan, China [1-4]. Figure 1 represents contagious disease is effected by death percentage from (<https://www.who.int/>). Common signs of infection include respiratory symptoms, fever, and cough, shortness of breath and breathing difficulties, pneumonia, severe acute respiratory syndrome, kidney failure and even death. With the rapid development of computer technology, digital image processing technology has been widely applied in the medical field, including organ segmentation and image enhancement and repair, providing support for subsequent medical diagnosis [5-6]. Deep learning technologies, such as convolutional neural network (CNN) with the strong ability of nonlinear modeling, have extensive applications in medical image processing as well [7-10]. In order to fight against this epidemic, we designed a Image Classification with Localization model that will help the doctors all over the world to detect the early symptoms in the affected humans. COVID-19 model predicted ground-glass opacities, consolidations, and crazy paving (fluid) patterns in the Chest CT (Computed Tomography) of the affected patients, which is the first aid even before the Reverse transcription polymerase chain reaction (RT-PCR) test. This automatic prediction based method will help the medical department to work accordingly by reducing cost and time simultaneously. This AI based Covid-19 algorithm achieved an accuracy of 97.4%.

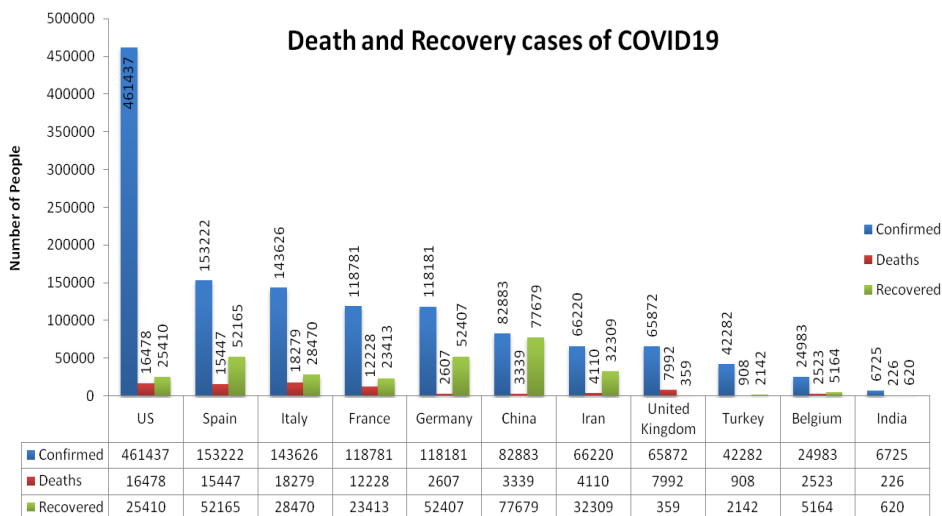


Figure 1: Graphical representation the rate of fatality and an infected person from COVID-19 up to 2020

2. Problem Formulation

Corona viruses (CoV) are a large family of viruses that are causing illness ranging from the common cold to much more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV).

Proposed work is to identify various points as given below:

1. Classify whether image is of CT-Scan or not
2. Check whether person is having Covid-19 or not based on opacities.
3. Localization of abnormalities within CT-SCAN

Covid-19 Image.

a. Equations

1.	$n_K = [nH_{prev} - f + 2 \times \text{padstride}] + 1n_H$ $= [nH_{prev} - f + 2 \times \text{padstride}] + 1$
2.	$n_M = [nW_{prev} - f + 2 \times \text{padstride}] + 1n_w$ $= [nW_{prev} - f + 2 \times \text{padstride}] + 1$
3.	$n_M = [nW_{prev} - f \times \text{fstride}] + 1$
4.	$dA + = \sum_{h=0}^{nH} \sum_{w=0}^{nW} W \times dZ$ <p style="text-align: center;"> $\begin{matrix} c & h & w \end{matrix}$ </p>

Step 1: We checked whether the input image is of CT-scan or not?

Chest CT has a potential role in the diagnosis, detection of complications, and prognostication of coronavirus disease 2019 (COVID-19). Implementation of appropriate precautionary safety measures, chest CT protocol optimization, and a standardized reporting system based on the pulmonary findings in this disease will enhance the clinical utility of chest CT. However, chest CT examinations may lead to both false-negative and false-positive results. Figure 2 represents the flow chart, whether the input image is of CT-scan or not.

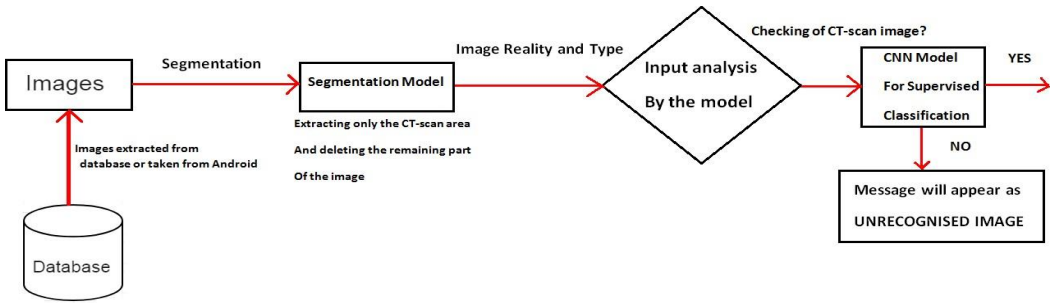


Figure 2: Classification of CT-Scan Image

Step 2: Once we are sure that we have the correct image as input, now we will extract the features of the image

Process Flowchart

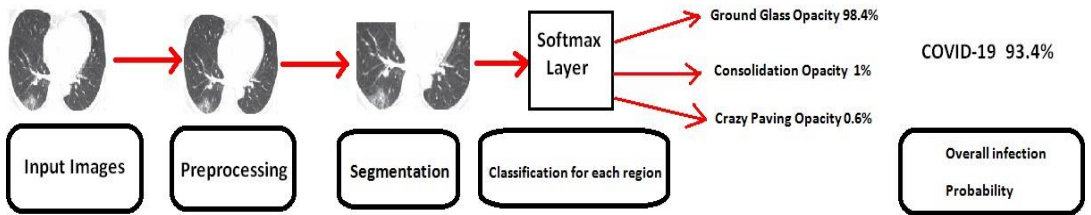
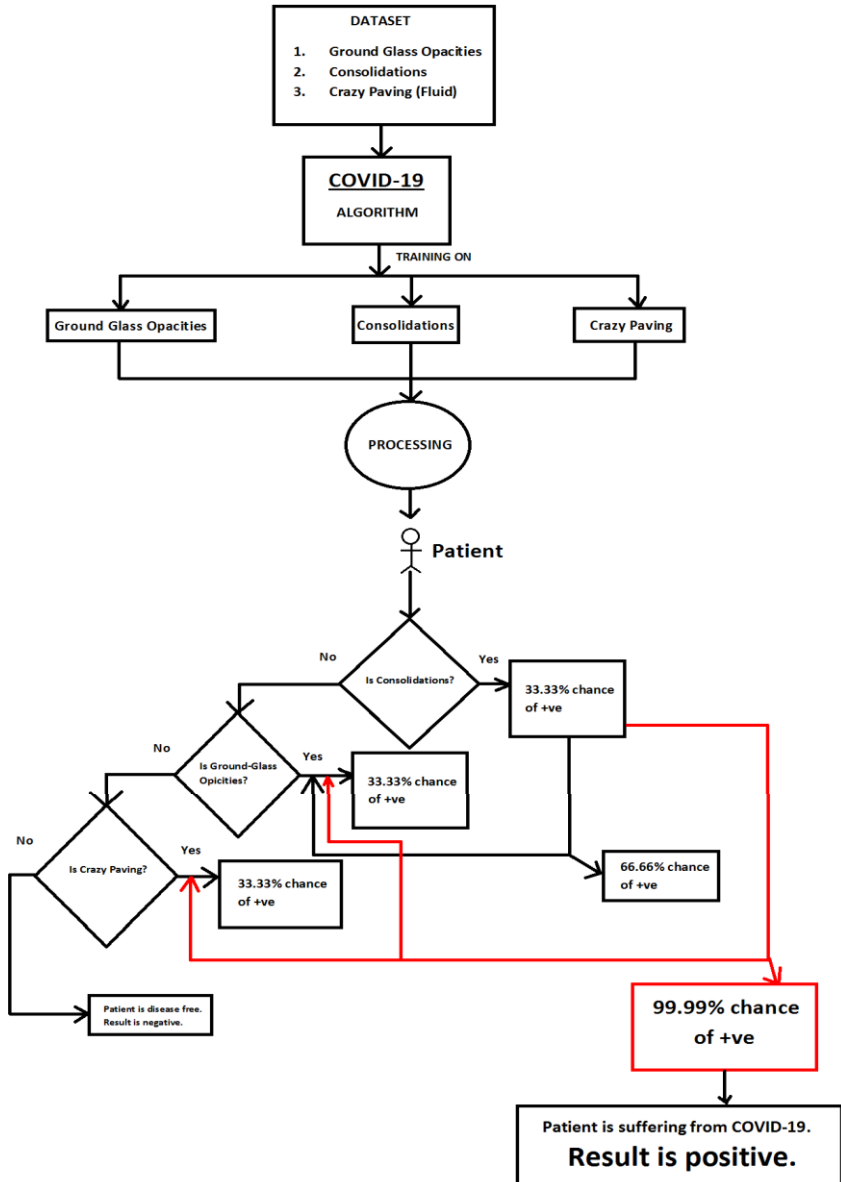


Figure 3: Classification of Covid-19 Opacities

3. Architecture Solution

Figure 4 represents Overall flow of the algorithm for



Covid-19 AI Detection

Figure 4: Architecture Solution of Covid-19

AI

4. **Detection Flow Chart Process:** 3 types of detections are to be done in Humans CT-scan images round glass opacities, consolidations, crazy paving. We have collected the dataset for the same.
 1. Applied the COVID-19 algorithm and detected the different opacities in the human CT-scan images.
 2. Localized the infected area inside the CT-scan image to determine if the patient is infected or safe.
 3. Trained the model and applied testing on live CT-scans of fresh cases and the model predicted with localization i.e. bounding boxes if any opacities are present else the model output the CT-scan as clean.
 4. Output is thrown in the form of Negative (clean) and Positive (infected) for different CT-scan images.

5. **Novelty and significance of the proposed model**
 - The prime objective of this paper is to design an intelligent model for early detection and prevention of coronavirus in the very first stage.
 - As the model works on early detection, at the same time it saves the cost as the cost of CT-scan is least

and it also saves the ample amount of time so that maximum patients can be diagnosed at the same time.

- **Objectives**

1. To detect the infected person within no time.
2. To help clinical doctors around the globe.
3. To implement AI in this epidemic.
4. To save the world with our model.

6. Results Analysis and Discussions

Stage 1: Classification of Positive and Negative Results

The Trained the model and applied testing on live CT-scans of fresh cases and the model predicted with localization i.e. bounding boxes, as seen in figure 5 and figure 6, Negative (clean) and Positive (infected) for different CT-scan images.

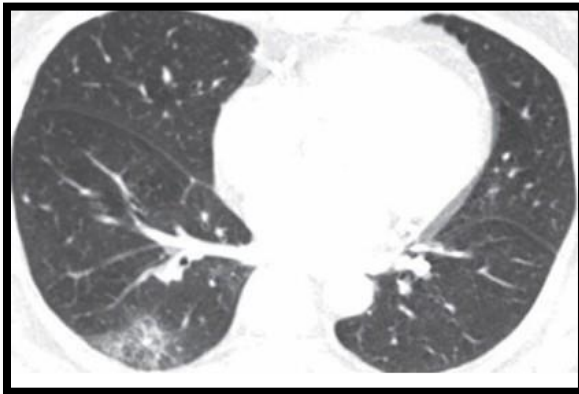


Figure 5: Result Analysis on COVID-19 is Positive



Figure 6: Result Analysis on COVID-19 is Negative

Stage 2: Localization of abnormalities in Positive Results

Based on figure 7, the diagnosis clearly indicates that ground glass opacity is 98.4% and consolidation opacity is 99.1%. As seen in figure 8, the abnormality localization of covid-19 with crazy paving opacity is 98.7%.

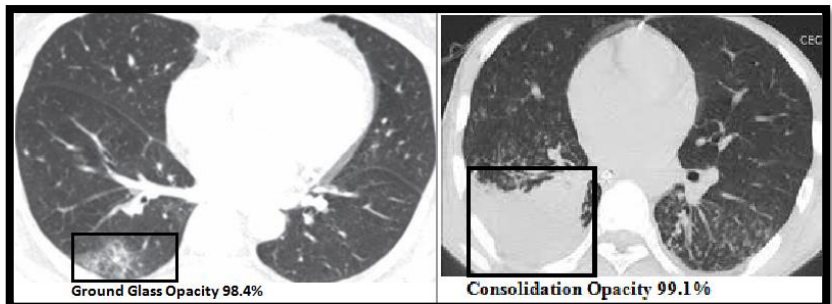


Figure 7: Abnormality Localization of Covid-19 with Ground Glass and Consolidation



Figure 8: Abnormality Localization of Covid-19 with Crazy Paving

7. Conclusions

In this AI based model, Convolutional Neural Network model is used for prediction. It is not based on any hit and trial system. It is directly based on Convolutional Neural Network Algorithm. Corona Virus is predicted based on CT-scan report. So we get to know about what kind of opacities are present in it. Getting exact picture of how much opacities are present so that doctors can diagnose the infected patients accordingly.

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