COVIDETECT: A TKINTER DESKTOP APPLICATION TO DETECT CORONAVIRUS USING CHEST CT-SCAN

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ABSTRACT

We are currently facing the threat of the Coronavirus Pandemic. The daily lives of people have come to a standstill. Tests to find out whether a person has contracted the virus are being conducted on a large scale. Due to this, the results are taking a long time to be released to the general people. This report proposes a desktop application built using the tkinter library which will help to detect COVID by checking for abnormalities in CT-Scan. This system tries to give a somewhat accurate prediction of whether the user is infected by coronavirus or not. This system basically tries to help the user to make use of his/her CT-SCAN images to predict corona virus in minimum time as compared to traditional tests. This system can be used as a primary or an intermediary step in the detection of the virus.

Keywords: Neural Networks, Deep Learning, Convolutional Neural Network, Computer Vision, ResNet, Tkinter, Tensor flow. Image Data Generator.

INTRODUCTION

COVID-19 is a very infectious and deadly pneumonia type disease of recent time. Novel coronavirus or SARS-COV-2 strain is a new respiratory disease that is highly infectious. Some of the initial and most common symptoms of this disease includes dry cough, muscle pain, headache, fever, sore throat and mild to moderate respiratory illness. Researchers are suggesting that there might be some long-term effects if infected by this virus. Initially, when there were no methods to test for COVID-19 the lung was a prominent internal organ to diagnose the gravity of COVID-19 infection using X-Ray and CT scan images of chest. Later on, a method to test COVID-19 was developed called the RT-PCR and is still currently the method used to detect it. Sometimes a person having some symptoms tests negative for COVID-19 in the RT-PCR test and hence the doctor then relies on X-Rays or CT-Scans to confirm whether that is actually the case. A lot of times, it has been found out that the person indeed is infected with COVID-19 after checking the X-Ray or CT-Scan. This project is a system helping a person to detect COVID infection using CT-Scan Images.

RELATED WORK

Since, this is a relatively new Virus, referring to existing papers was necessary. Since the discovery of the virus, a lot of systems, either similar or completely different have been developed to detect whether a person is infected or not, as accurately as possible. Some use CT-Scans while some use X-rays. The authors of [1] built a system based on the thoracic CT images that identifies cases suspected with COVID-19 features and along with classifying it as positive the system also gives a lung abnormality localization map and measurements. They were able to achieve a 98.2% sensitivity. The authors of [2] built a system that takes a series of CT slices as input and generates features for each of them which are then combined by max-pooling operation. It predicts for three classes with a sensitivity of 90%. The authors of [3] describe their findings for abnormalities in Chest CT-Scans after studying for more than 120 patients which was vital for this project as it is necessary to understand what abnormalities to look for in CT-Scans of infected patients. The authors of [4] propose a system that segments the abnormalities or infections from the CT images and quantifies it as a degree of infection. The authors of [5] have proposed specifically tailored Deep Convolutional Neural Network to be trained on Covid X-Rays. The authors of [6] use transfer learning to train an existing model as per their requirements. The authors of [7] describe the Chest CT findings and their correlation with RT-PCR results. The authors of [8] implemented three different model architectures and tested each of them against CT-Scans. The authors of [9] again propose a method to quantify the severity of the infection for the patient. The authors of [10] propose to extract the pulmonary regions followed by segmentation using 3D Convolutional Neural Network. Finally, it uses the extracted regions to predict the image into three classes.

DATASET AND PRE-PROCESSING

The dataset consists of 4,171 images and is divided into 3 directories. Each directory contains images corresponding to one of the three classes. The split used on the dataset is 20 %
i.e.: 80 % images will be used for training and 20 % images will be used for validation. Hence, the training set consists of 3338 images belonging to 3 classes. The training set is not balanced. This is because the number of images for each class are not the same. The validation set contains 833 images belonging to the same classes. which will be used to determine the validation accuracy and loss of the model. As seen above, the training set is not balanced. This is a problem because a bias will be created when the model is trained. This bias will cause the model to perform poorly on new data and hence it will lead to a lower accuracy for the detection of facial expression. This problem can be fixed to some extent using Data Augmentation that can be done in Tensorflow using the ImageDataGenerator which will load all the images from the training directory and apply transformations such as rotation, scaling etc. to generate new images from the existing ones. The images are zoomed in or out randomly by ± 10%. The images will be horizontally flipped randomly.

ANALYSIS

The ResNet model was giving decent results, hence it was finalized. To finalize, parameters such as training loss, validation loss, training accuracy and validation accuracy were considered. It trained for a maximum 37 epochs before stopping due to the possibility of overfitting. Out of all the epochs the model has been given the parameter to store the weights for the epoch with the lowest validation loss. So, the lowest validation loss is 0.921 as seen in the above image. Whatever the weights were finalized after that epoch will be used in the final model. The architecture implemented before ResNet was a Regular Deep Neural Network. It trained for a maximum 13 epochs before stopping due to the possibility of overfitting. Out of all the epochs the model has been given the parameter to store the weights for the epoch with the lowest validation loss. So, the lowest validation loss is 1.254 as seen in the above image. Whatever the weights were finalized after that epoch will be used in the final model. Aside from this, both the models were tested against 30 scan images (10 images from each class) collected from multiple datasets.

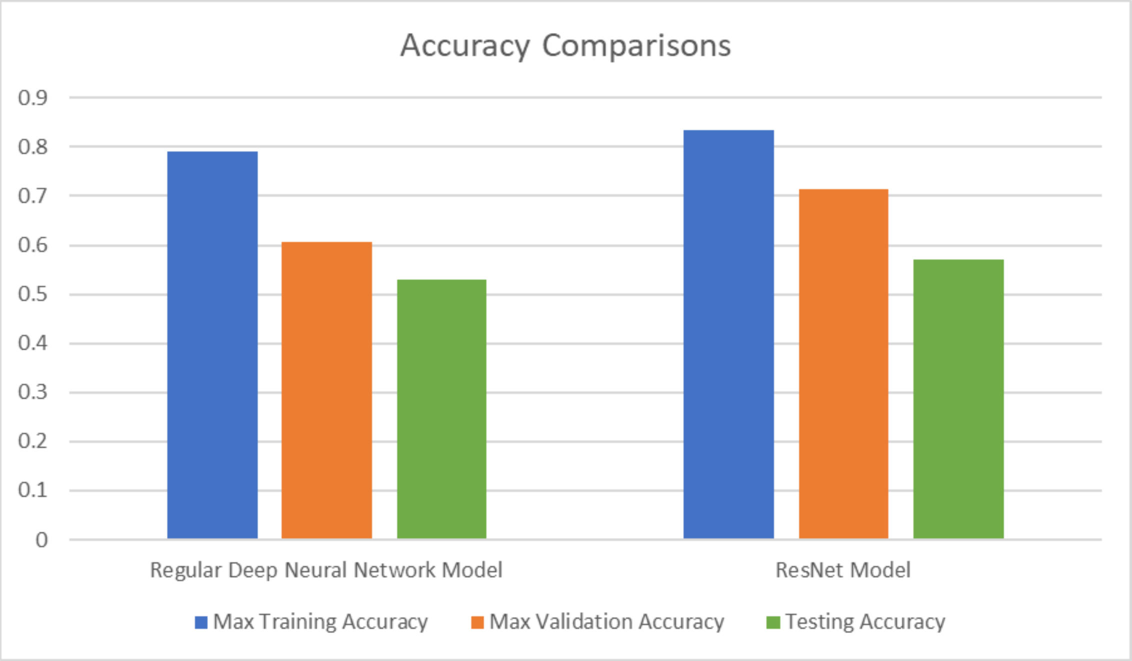


Chart 1: Comparison of Accuracies

As seen from the graph above, the ResNet Model is marginally better than the Regular Deep Neural Network Model. Even the test accuracy seems to be marginally better.

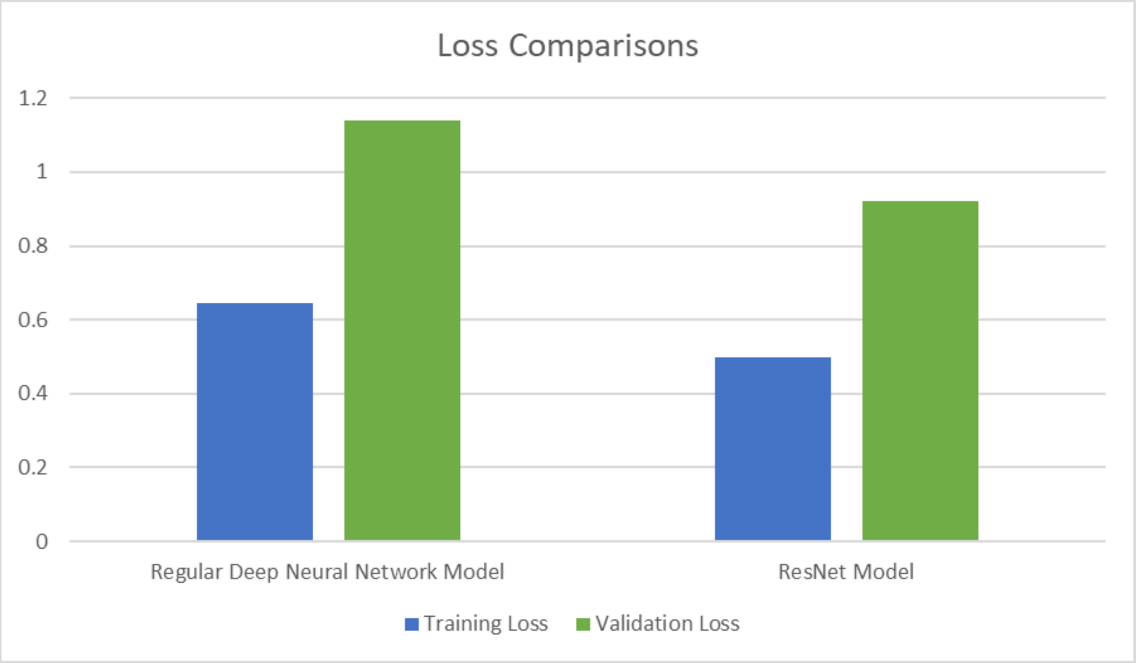


Chart 2: Comparison of Losses

Loss is calculated on where the model fails and it should be as small as possible. The graph above shows that the ResNet model has lower training and validation loss. Hence, ResNet model seems to be a better choice.

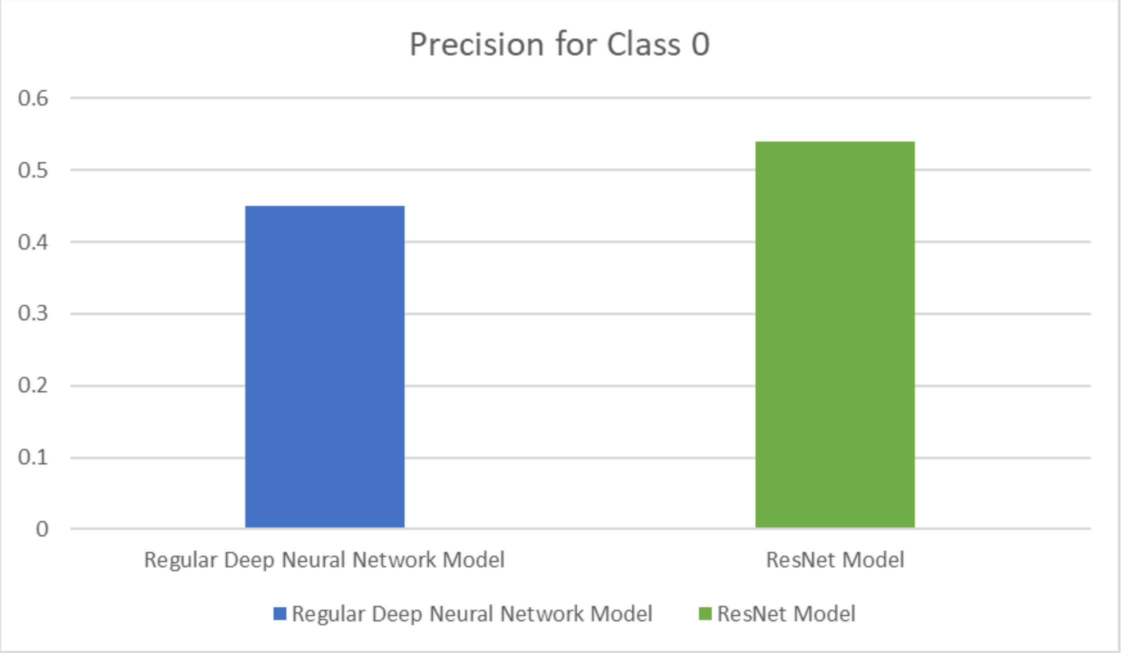


Chart 3: Comparison of Precision for Class 0

The last parameter that will be considered is the Precision for Class 0 as it is one of the most important class for this project. Class 0 represents the COVID class. As seen above, the precision for class 0 is marginally better in ResNet Model.

IMPLEMENTATION

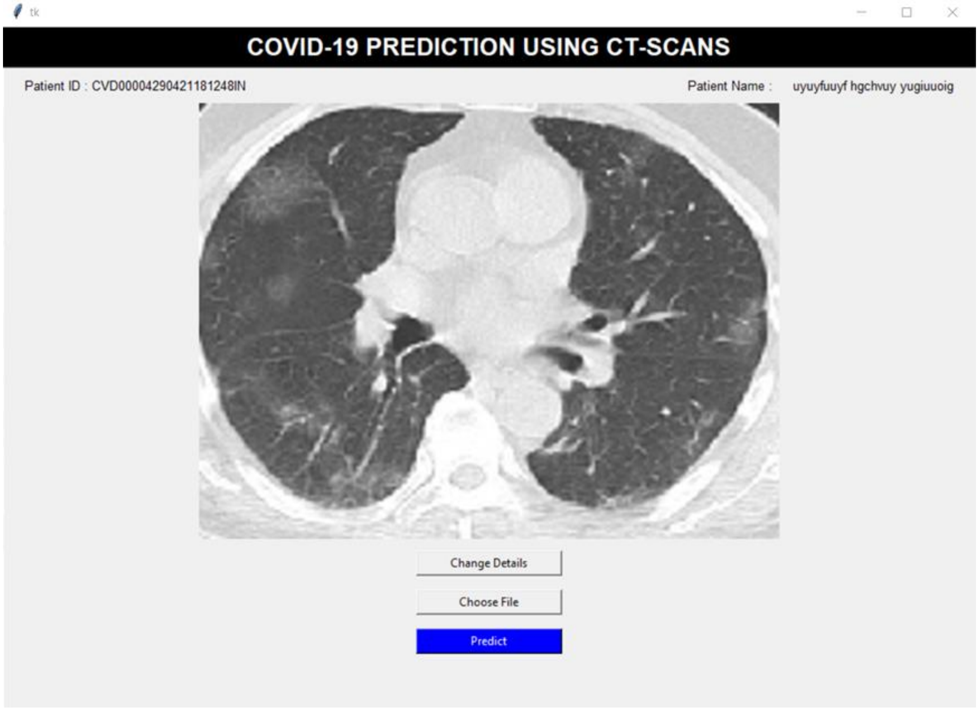
Algorithm

1. Select whether a “New Patient” or an “Existing Patient” in the New/Existing User Page.
2. If “New Patient” is selected, then redirect to Registration Page.
3. Check whether required fields are filled completely.
4. If filled completely and in required format, store the details in JSON file of the patient’s folder and the common database then redirect to Scan Details Page, else show prompt to fill the required details.
5. In Scan Details Page, give the prompt to select the scan image. On pressing the predict button, save the Scan in the Patient’s Folder and update the prediction result of the scan in the JSON file of the patient and the database record then redirect to Display Details Page.
6. Show all the stored details in Display Details Page and give the option to change/ update the details and scan of the patient.
7. If “Existing Patient” is selected in New/Existing User Page, then redirect to Display Details Page.
8. Give prompt to type the patient ID or select the patient from ‘show all patients” button.
9. Display all details in Display Details Page of the entered patient ID.

DEPLOYMENT

Desktop Application:

The user will first have to select whether he/she is a new Patient or an Existing Patient. If New Patient, then the user will be asked to fill the required details and then will be redirected to Scan Details Page after saving all the entered details. In Scan Details Page, the user has to select a scan image as show in the figure below.



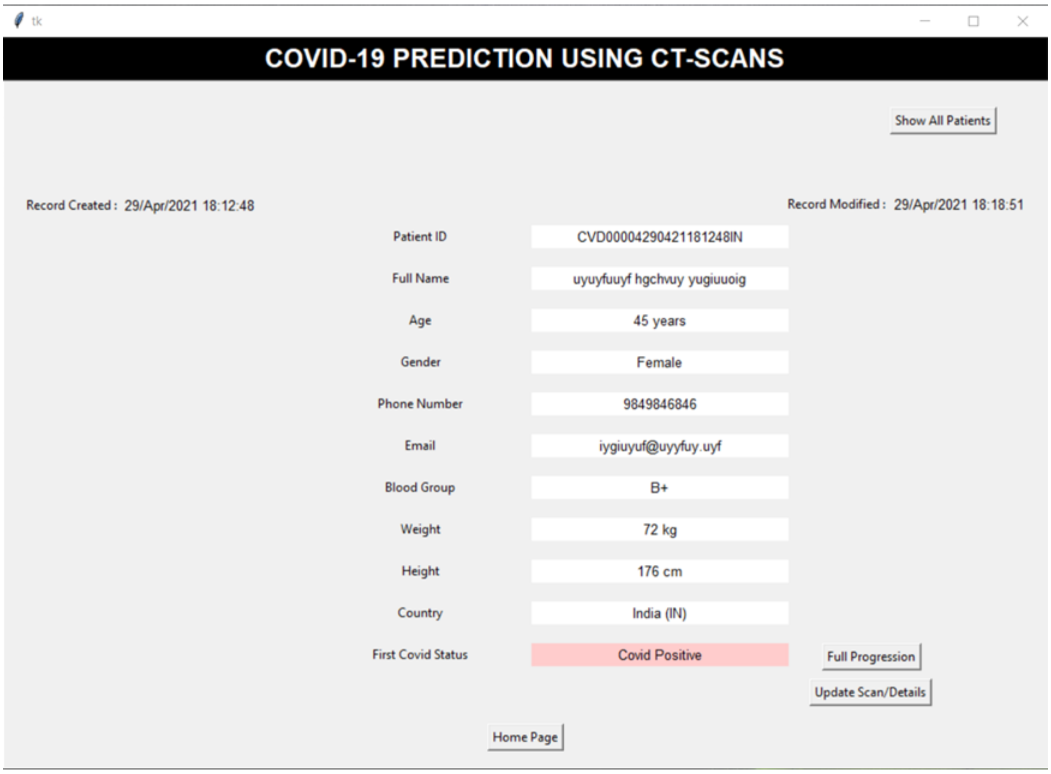
COVID-19 PREDICTION USING CT-SCANS

Patient ID : CVD00004290421181248IN

Patient Name : uyuyfuuyf hgchvuy yugiuuoig

Figure 1: User selecting a Scan in Scan Details Page

On pressing the predict button the image will be sent for prediction to the ResNet Model and it will be stored in a folder with the Patient ID generated in Registration Page as the folder name. Then all the details entered by the user will be stored and the user will be redirected to the Scan Details Page where prediction of the scan image selected by the user is stored after which the user is redirected to Display Details Page where all the stored information about the patient is displayed as shown in the image below.



COVID-19 PREDICTION USING CT-SCANS

Record Created : 29/Apr/2021 18:12:48

Record Modified : 29/Apr/2021 18:18:51

Patient ID	CVD00004290421181248IN
Full Name	uyuyfuuyf hgchvuy yugiuuoig
Age	45 years
Gender	Female
Phone Number	9849846846
Email	iygiuyuf@uyyfuy.uyf
Blood Group	B+
Weight	72 kg
Height	176 cm
Country	India (IN)
First Covid Status	Covid Positive

Figure 2: Stored details being shown in Display Details Page

Apart from this the Desktop application can show overview of all the patient’s status as a table and as a graph.

RESULTS

The entire software was tested multiple times against multiple cases. Multiple tests were conducted on singular functions of the application. Other functions like storage/retrieval of data, scans, etc. was also tested against some conditions. Apart from this to improve the performance the concept of threading was implemented and tested. Even though there is only a minor improvement in performance, the implementation of threading was understood. Followed by that, the ResNet Model was tested against 30 images from multiple datasets and it was able to predict 17 of them correctly, so the accuracy of the model on test images is 56.66%, which is a decent performance but definitely has room for more improvement.

CONCLUSIONS

Hence, a decent model has been implemented to detect coronavirus using CT-Scans. This system uses a Convolutional Neural Network based on the ResNet Architecture to perform the task of classifying. The desktop app has been developed in tkinter and it stores the patient details partially in a database and fully in a JSON file. It also stores the CT-Scans of the patient for future Reference/Review. This will help to store and use data in an organized manner.

FUTURE SCOPE

The system proposed may assist clinicians and doctors in making appropriate decisions for Coronavirus and may also mitigate the problem of heavy loads on testing facilities since the target for this project is mainly hospitals. On further improvement in accuracy, this system might be beneficial to speed-up diagnostic workflow in many cases.

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