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Covid-19 Detection Using Deep Neural Networks.

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Abstract - *Covid-19 is inciting panic amongst people for several reasons. It's a new virus and currently there is no vaccine or cure. Its novelty means that doctors and scientist are not sure how it behaves and how it might evolve. The World Health Organization (WHO) labeled the virus as a pandemic. In this wave of panic a neural network that could help in early detection of COVID 19 in patients would help put people's minds at ease. The proposed Neural Network will input the symptoms that people are experiencing along with other data relevant to prediction of COVID 19 like age, recent travel history, etc. These features will be entered into the Neural Network, and it will predict the probable chance that you might have contracted COVID 19. This Neural Network will not only impact people's lives but also create a sense of awareness among people.*

Key Words: **Artificial Intelligence, Reinforcement Learning, Deep Neural Networks, Covid-19, CNN.**

1. INTRODUCTION

The coronavirus outbreak has not only infected millions of people but has also led to thousands of deaths. This virus, despite having lower fatality rate, has caused thrice the number of deaths as compared to the combined number of deaths caused by both MERS and SARS. This is majorly caused by the fact that COVID 19 is highly contagious. It has been observed that the symptoms of COVID-19 are like that of common influenza, which makes it difficult to detect. Due to these factors, it is critical to detect positive cases of COVID-19 as early as possible so that we can prevent the spread of this pandemic. It is extremely necessary to make diagnostic tools that can aid in the detection of COVID-19. Deep neural network is a technology where there are multiple layers along with an input and output layer. Deep Neural Network aims at learning feature hierarchies. We are using symptoms of COVID 19 patients as the input features of deep neural networks. The symptoms will include running nose, fever, cold, cough, sore throat and it will also consider the age, history of pre-existing diseases and recent travel history of the person. We will collect data from patients admitted within various hospitals, this data will include records of patients who tested positive as well as those who tested negative for COVID-19. Our neural network model will analyze the symptoms of thousands of patients and also take into account external factors like their recent travel history, pre-existing diseases and all of this data will help it to generate precise prediction. This deep neural network model will allow us to predict the chances of a person being COVID 19 positive at an early stage and it will also create awareness among other individuals. A huge amount of data can be pooled from millions of people, and this will enable us to improve the accuracy of the model.

2. DESIGN

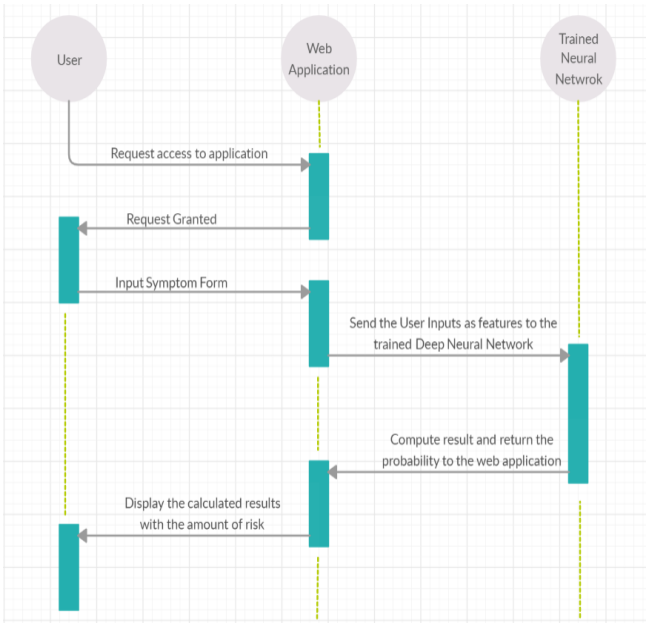

Fig.: Sequence Diagram for Application Architecture

3, The Application Architecture

Application Architecture focuses on helping the user understand how the application works in the real world. To use the application, user access the web-based application using internet browser, after the access is granted, the user is presented with a friendly user interface in which user has to provide the information asked in the application which is then sent to the trained neural network. It includes information such as the symptoms of Covid – 19, age, and previous medical history and diseases etc. This information would help the trained neural network to find the probability that the user is suffering from Covid-19 and suggest helpful tips to ensure safety and good health. Thiis supposed to be the functioning of the application when the user will enter the details on the web application. The application can be used as many times as the user feel that

the symptoms are changing and as the trained neural network is dynamic, with new patient's data, the network gets better and the probability of the user suffering from Covid-19 gets more accurate.

The deep neural network responsible for prediction consist of three parts

1) Input Layer

2) Hidden layers

3) Output Layer

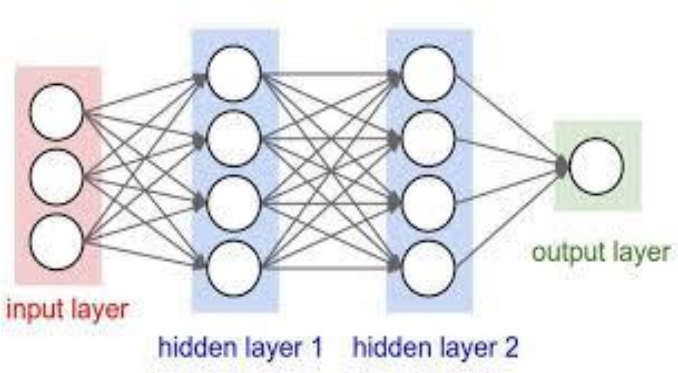

Chart: Deep Neural Networks

To use the deep neural network, first we have to train the network, Training of DNN requires data which can be collected by various hospitals, the data which contains the symptoms and information of the patient such as age and previous diseases and whether that patient is suffering from Covid-19, after collecting the data, it has to be sent for pre-processing and then fed into the input layer of the neural network with input features such as the age, symptoms of Covid-19, previous medical disease etc. The input layer supplies these features to the first hidden layer and the weights of these neurons compute the output value of that layer. After computing the output values, they are mapped by a nonlinear activation function. The result of the activation function is then forwarded down to the next hidden layer. This process continues up to the output layer where a sigmoid function is used to compute the final probability of the Covid-19 detection which lies between 0 and 1.

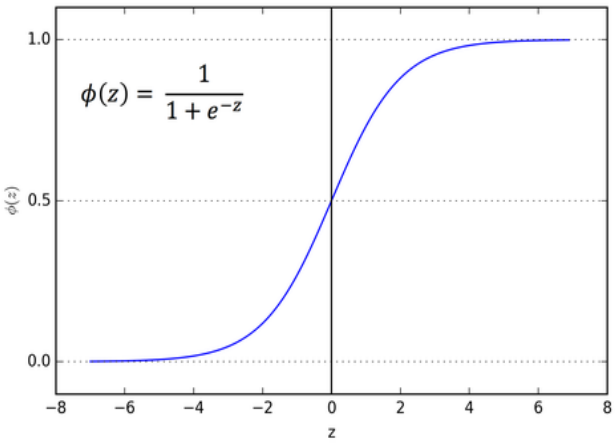

Fig.: Sigmoid Function

The sigmoid function is the activation function more commonly known as squashing function, which limits the output range between 0 and 1.

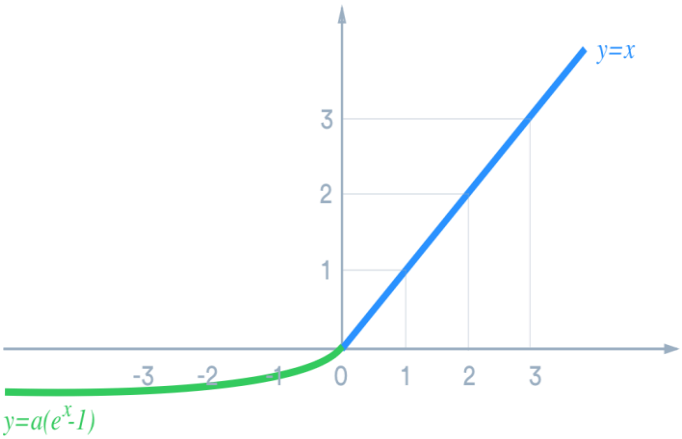

Fig.: Leaky Relu

The Leaky ReLU function modifies the function to allow small negative values even when the output is zero such that the negative values are not neglected while training the neural network. After the training of the deep neural network, ***I***t is integrated with the web application.

The user can then send his data through the web application, which is then processed by the deep neural network and the result is returned to the user interface through the web application.

4. Experimental Results:

After executing the web application with the cumulated dataset, we found the accuracy of the neural network to be 65 %, however the accuracy of the model can be increased if the model is trained with the live dataset from the hospitals and if the hyper parameters are tuned effectively.

Here the user is entering the information and then the information is sent to the trained neural network and the sent back to user's interface.

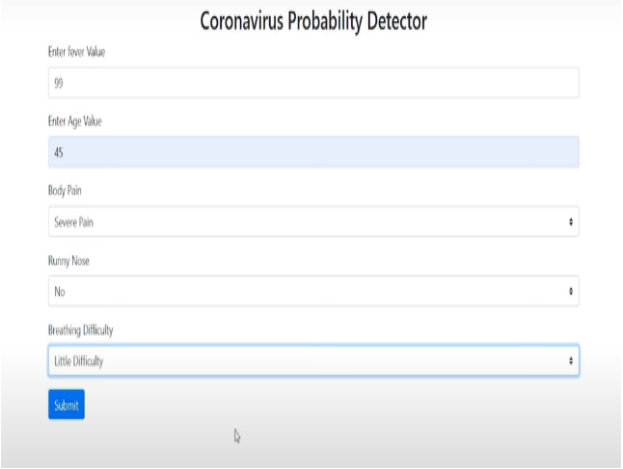

Fig.: Application Interface

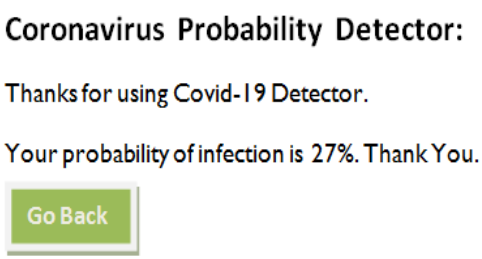

Fig.: Application Interface Result

5. Addressing the Emerging Challenges

Not only increasing the overall accuracy but also decreasing the number of False Negatives will be a major challenge before using the proposed solution on real-world entities because a minor flaw in the system can put the life of the patient in danger. A strong model generalizes the examples rather than memorizing them. Therefore, over-fitting should be minimized by using regularization techniques. Also one of the major concern is to remove outliers from the training data, so that these data points don't influence the model in the wrong direction.

6. Advantages

Predictive computing tools provide powerful insights that can help us with early detection of COVID-19. These technologies are still in their infancy stages but with adequate amount of data collected from hospitals we can generate tools that can produce precise results. With our deep neural network model, individuals with COVID-19 symptoms or recent travel history can simply input the features/symptoms that they are experiencing into the model and expect to get a near accurate percentage of them having contracted COVID-19. This knowledge can help people self-quarantine themselves and prevent further propagation of COVID-19. we can generate tools that can produce precise results. With our deep neural network model, individuals with COVID-19 symptoms or recent travel history can simply input the features/symptoms that they are experiencing into the model and expect to get a near accurate percentage of them having contracted COVID-19. If the percentage predicted by the model is high then that knowledge can help people self-quarantine themselves and prevent further propagation of COVID-19. If the predicted percentage is low than this early prediction can also suppress unwarranted panic amongst people. Sometimes people having only a few symptoms of COVID-19 may avoid getting medically tested but they can use our model to input the features to get a predictive analysis of the chances of them being infected. This can enable people to realize if there is a real need to get medically tested or not. An early prediction model can also lower the mortality rate as the people with high chances of being infected by COVID-19 may seek early medication.

7. Further Work And Future Scope

Considering the power of deep neural networks, we are not limited to predicting the probability of Corona detection. Given enough data these deep neural nets can be trained to predict the mortality rate or the risk of a patient's life. An early detection of whether the infected patient's condition will further degrade can help the medical examiners to arrange for necessary equipment to save the patient's life. This will be a great leap towards advancement in the medical sector. The collection of data for such features will surely require great efforts and enhance the complexity of the model along with its usefulness. Such a complex network of neurons will require greater computation power.

Neural networks can be improved using techniques like Hyperparameter tuning and regularization. There are certain parameters whose values are set before the learning process begins. They are known as hyperparameters. If

these parameters are tuned effectively the performance of the neural network can be increased by a massive amount. Learning rate is one of the most important hyperparameters. This parameter corresponds to the speed at which the gradient decent converges to find the minima of loss function. Using an optimum value of learning rate will help the neural network set the weights and reach the minima of the loss function with great speed.

Sometimes the model learns even the tiniest details present in the data. This can give rise to overfitting. Regularization is an effective technique to prevent overfitting of the data. It

helps to reduce the complexity of the model and decreases weights to avoid fitting noise in the data. Hence the reduced complexity results in the neural network converging faster in the forward direction and the learning begins to improve. Using these techniques, the predictive ability of deep neural networks can be increased to a great extent.

8.Conclusion

A detailed study of the rising amount of cases and the factors affecting the patients of Covid-19, can help in making the deep neural network more efficient and accurate, thus allowing people to check the probability of them having Covid-19 from home, which in turn will save lives of thousands of medical healthcare workers who are risking their life and exposing themselves during this pandemic to test and treat patients.

The proposed approach is a preliminary attempt at making the deep neural network for the early detection of Covid-19 and thus stopping its fast propagation before everyone is affected by it.

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