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Covid-19 Prediction using X-Ray

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Abstract: ***COVID-19 is a highly transmissible viral infection that has a severe impact on health globally. The detection for the severe acute respiratory disease coronavirus-2 (SARS CoV-2), which is responsible for coronavirus disease 2019 (COVID-19), using chest X-ray images has gaining life-saving importance for both patients as well as doctors. In addition, in most of the countries that are unable to purchase laboratory kits for testing purposes, this becomes even more vital option. This aim is to present the use of TensorFlow, Keras, and OpenCV using CNN model in a web application using a Python backend with a Flask web development framework for the high-accuracy detection of COVID-19 disease using chest X-ray images. Dataset was manually collected from various publications. This dataset currently contains 1719 negative images and 538 positive images with an accuracy of 99.115%. This CNN network achieved the best accuracy by utilizing multiple features from an X-ray image. For evaluating through the network, it has tested it on a total of 3257 images to report the actual accuracy achievable in real circumstances. Anyone can use this computer-based application on any computer system for the detection of COVID-positive patients using their chest X-Ray images and will give a result in few seconds.***

Keywords: Covid-19, CNN, Detection, Web Application, X-ray.

I. INTRODUCTION

The COVID-19 pandemic continues to have a devastating effect on the health and well-being of the global population, by causing the infection of individuals by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The critical step in the fight against COVID-19 is effective screening of infected patients, such that those infected can receive immediate treatment and care, as well as be isolated to avoid the spread of the virus. RT-PCR testing is the standard technique as it is highly specific but on the other hand, it is a very time-consuming, laborious, and complicated manual process that is in short supply.

An alternative screening method for the detection of COVID-19 screening has been radiography testing, where chest radiography imaging is conducted and analysed by radiologists to look if there are any visual indicators for viral infection. It was found in early studies that patient's current abnormalities in chest radiography images are characteristic of those infected with COVID-19, with some suggesting that radiography testing could be used as a primary tool for COVID-19 detection in epidemic areas.

Using this technique, near accurate detection of COVID-19 positive patients can be implemented in a few seconds. As a part of this research, it has also contributed a tool that can be used to detect COVID-19 positive patients. Even in the absence of a radiologist or if there is any difference in opinions of doctors, using the deep learning-based tools will always give an opinion without the need for human intervention. In this paper, the data available from open sources have shown the efficiency of the proposed tool in terms of classification accuracy and sensitivity. It has also been compared with the existing benchmark work.

II. LITERATURE REVIEW

Detection of COVID-19 from Chest X-Ray Images Using Convolutional Neural Networks by Boran Sekeroglu, Ilker Ozsahin proposed a model which involves the training of deep learning and machine learning classifiers. 38 experiments were performed using convolutional neural networks. In this model images and statistical data were considered separately. The accuracy achieved was 98.50%[1].Detection of COVID-19 using chest X-ray images by Rachna Jain, Meenu Gupta, Soham Taneja & D. Jude Hemanth proposed a model using Deep learning. Deep learning is the most successful technique of machine learning, which provides useful analysis to review an outsized amount of chest x-ray images which will critically impact on screening of Covid-19. PA view of chest x-ray scans was taken for covid-19 patients as well as healthy patients. After cleaning up the images, deep learning-based CNN models are used and compared. The accuracy got was 97.97%[2].Deep-COVID: Predicting COVID-19 from chest X-ray images using deep transfer learning Shervin Minaee, Rahele Kafieh, Milan Sonka, Shakib Yazdani, and Ghazaleh Jamalipour Soufi deep learning models to detect COVID-19 patients from their chest radiography images. The model consists of a dataset of 5000 Chest X-ray images. This model achieved a specificity rate of near 90%[3].Automated detection of COVID-19 using deep neural networks with X-ray images by T Ozturk, M Talo, E A Yildirim, U B Baloglu, O Yildirim and U. R Acharya proposed a model for automatic COVID-19 detection using chest X-ray images. The proposed model provides accurate diagnostics for binary classification and multi-class classification.

This model got an accuracy of 98.08%[4].Automatic Detection of Pneumonia using Deep Learning by Sheikh Rafiul Islam; Santi P. Maity; Ajoy Kumar Ray; Mrinal Mandal proposed a paper that suggests a deep learning-based framework for automatic detection of pneumonia on X-ray images to assist the medical practitioners. Results show that the proposed approach achieves a prediction accuracy of 97.34%[5].Deep Learning method for pneumonia classification from Chest X-ray Images During COVID-19 by Abdullahi Umar Ibrahim, Mehmet Ozsoz, Sertan Serte, Fadi Al-Turjman & Polycarp Shizawaliyi Yakoi proposed a model that performs two-way classification (i.e., COVID-19 vs. normal, bacterial pneumonia vs. normal, non-COVID-19 viral pneumonia vs. normal, and COVID-19 vs. bacterial pneumonia), three-way classification (i.e., COVID-19 vs. bacterial pneumonia vs. normal), and four-way classification (i.e., COVID-19 vs. bacterial pneumonia vs. non-COVID-19 viral pneumonia vs. normal). For non-COVID-19 viral infection, the proposed model achieved 94.43% accuracy[6].

III. METHODOLOGY

In order to reach our desired goal python programming language is used to perform image processing data science training of Conventional Neural Network Model and for website in backend python language is being used and in front JavaScript and HTML.

A. Phases of Model

1) *Creating Dataset:* In phase one, dataset is created. The images in the dataset are then categorized as COVID-19 positive and COVID-19 negative. The columns where COVID-19 is written are fetched from the csv file and the names of these images are stored using their indexes. All the images which are extracted here will then be written into the dataset. Similarly, COVID-19 negative images are fetched with the help of the column index and stored in a database.

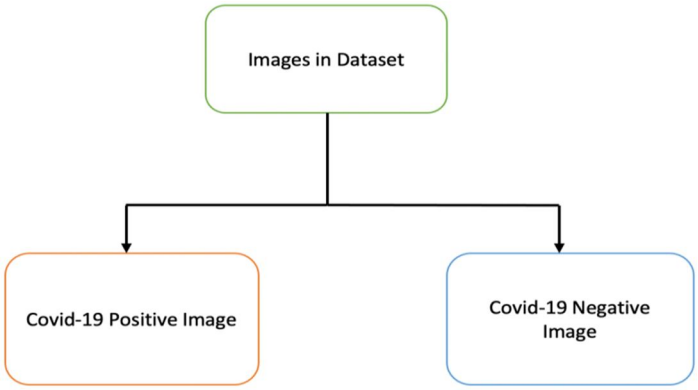

Fig 1. Categorising Image Dataset into Covid-19 Positive and Negative

2) *Data Pre-processing:* After spiting the images of covid-19 positive and negative images into two different folders from the data. Label dictionary is also created in which it will only store information of X-ray image whether it belongs to positive or negative criteria. Next step will have categorised them into “Covid-19 Positive” and “Covid-19 Negative” X-ray images. Define image size into 100x100 and make two empty list “data” and “target”. In “data” list all X-ray images will be stored and in “target” the Covid-19 Positive and Negative information will be stored. From the categories, names of images will be stored and further via names images will do imported and converted them into grayscale image, resized all images into 100x100.

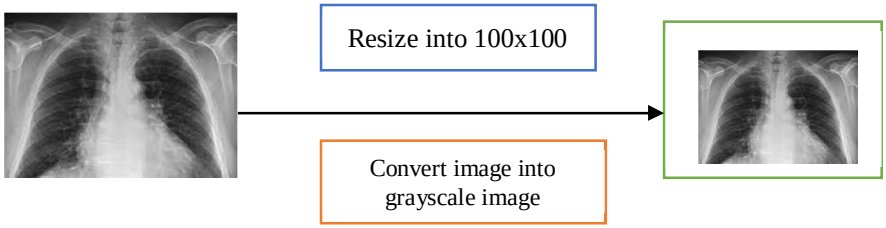

Fig 2. Data Processing Phase

After this all images will be appended to “data” list and in “target” label dictionary information will be appended. Further the images in “data” will be converted into binary and also converted into 4-dimensional. At last, data and target array will be saved for further process.

3) *Training with CNN:* In this Phase, first of all import data and target array and take two Conventional 2D layers 128 kernels of each dimension 3x3, 5x5, 7x7. This will further be converted in two Conventional 1D layer of 64 filters of dimension 3x3 and another 32 filters dimension 3x3.After this, the layer is being Flatten and converted into Dense layer with 128 kernels further same decremented into 64 kernels dense layer. After this the model will reach to output layer, which consist of to two neurons i.e., Covid-19 Positive or Negative X-ray image which will help us in prediction result.

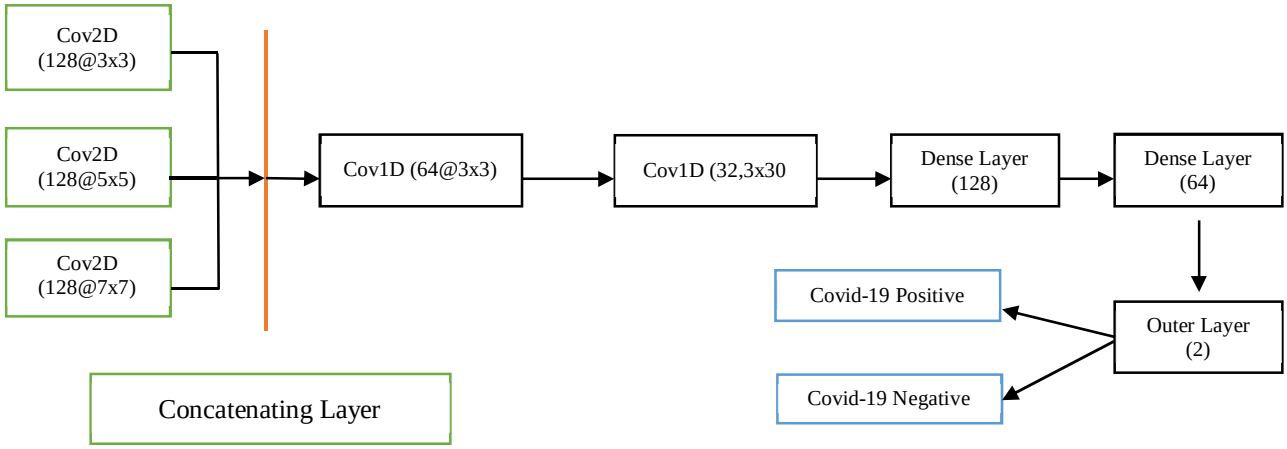

Fig 3. Training with CNN Phase

Next step data of images will split into 90% “training part” and 10% “testing part” in which model will be run for 20 Epochs. Best epoch model will be used for predicting Covid-19 Positive and Negative.

4) *Webpage Development:* Best model from the CNN model epoch will be imported to the webpage to predict the result. In backend Python language will be used to integrate with model for results and in frontend JavaScript and HTML language is being used to make option “Choose File” for Browsing X-ray images as input and “Predict” option for predicating the result Covid-19 Positive and Covid-19 Negative.

Fig 4. Webpage Development Phase

IV. RESULTS

After training the Convolutional Neural Network for 20 Epochs, we were able to achieve a testing accuracy of 99.11%.
The epochs can be increased for greater accuracy.

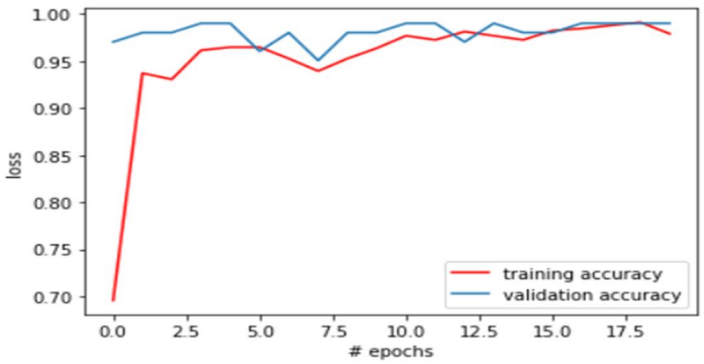

Fig 5. Graph of Training Accuracy v/s Validation Accuracy

It doesn't show any evidence of overfitting. The training loss and validation loss is decreased with number of epochs.

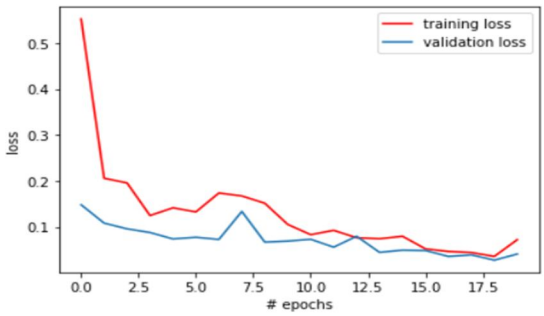

Fig 6. Graph of Training Loss v/s Validation Loss

The 15th model which had the greatest accuracy was saved and loaded in the Backend with Flask in **Python. The decoded** X-Ray images will be loaded in the **Frontend** with HTML and CSS. The **Backend** is made run by the Anaconda Prompt on the local host.

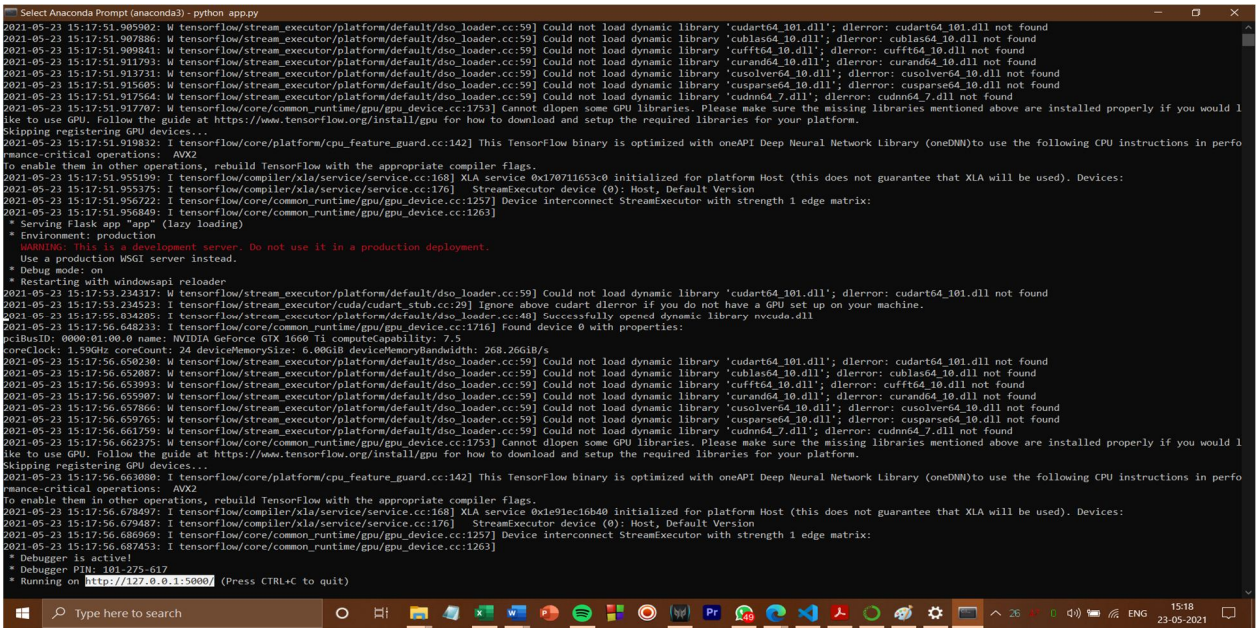

Fig 7. Execution of our Model and Generating URL to Access the Webpage

The Model can easily detect whether the person is Covid-19 positive/negative with a probability as well.

Fig 8. X-Ray image is Covid-19 positive with a positive probability of 0.98.

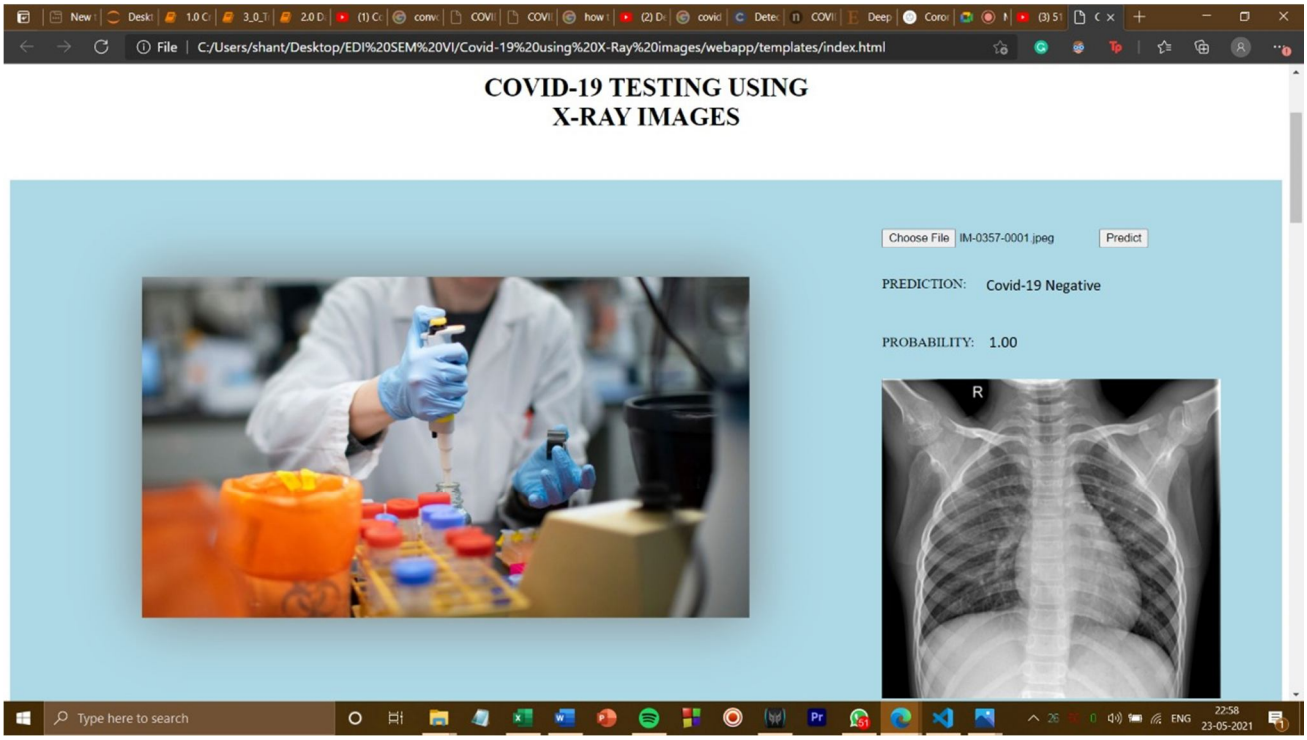

Fig 9. X-Ray image is Covid-19 Negative with a negative probability of 1.00

V. CONCLUSION

In these times of COVID-19 pandemic, where everyone is trying to cope up with the difficulties, there are some measures listed by the doctors that are necessary to follow. One of the important measures is to wear mask. The proposed model helps in detecting whether the person is infected by Covid-19 or not using OpenCV, TensorFlow, Keras, Flask and CNN. The accuracy of 99.11% is achieved for this model and its optimization can be done for using it in automated monitoring system. The proposed model can be used in hospitals to find out immediately whether the person is infected or not. RT-PCR tests take 1-2 days while using these X-Ray images, we will get results within a second and will help the world to end the pandemic and make Covid-free world.

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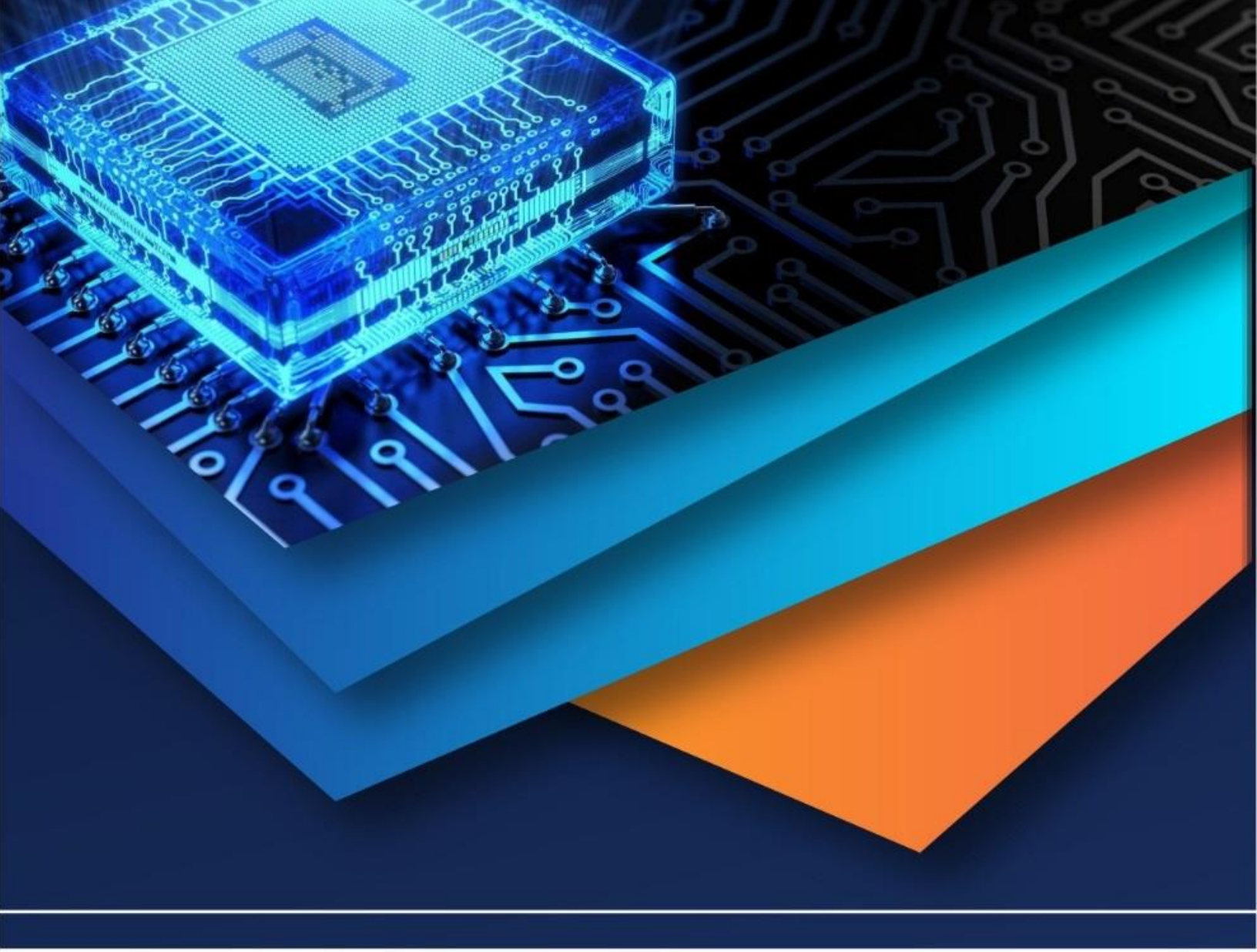

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