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Automatic Covid Detection using CT Images

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Abstract: ***COVID-19, the disease caused by the novel corona virus, can cause lung complications such as pneumonia and, in the most severe cases, acute respiratory distress syndrome, or ARDS. Another possible complication of COVID-19 is sepsis, which can cause long-term damage to the lungs and other organs.***
COVID-19 virus is primarily transmitted through droplets produced when an infected person coughs, sneezes, or exhales. These droplets are too heavy to float in the air and quickly fall to the ground or other surfaces. As everyone is aware, the corona virus disease 2019 (COVID-19) spread throughout the world in early 2020, causing the world to face an existential health crisis. Thus, automating the detection of lung infections from computed tomography (CT) images has the potential to supplement the traditional healthcare strategy for combating COVID-19. However, segmenting infected regions from CT slices is difficult due to high variation in infection characteristics and low-intensity contrast between infections and normal tissues. Furthermore, collecting a large amount of data in a short period of time is impractical.
Our proposed solution will analyse a CT image of the lung and detect the infected portion of the lung, as well as the percentage of the affected portion. The system will identify the infection severity and will help patients to take essential measures.
Keywords: Preprocessing, Segmentation, Feature Ex-traction, Classification, CT Images, Image Preprocessing.

I. INTRODUCTION

Corona-virus disease (COVID-19) is a viral infection caused by a newly discovered corona-virus. The majority of people infected with the COVID-19 virus will experience mild to moderate respiratory illness and will recover without the need for special treatment. People over the age of 55-60 , as well as those with underlying medical conditions such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer, are more likely to develop serious illnesses. The best way to prevent and slow transmission is to learn everything there is to know about the COVID-19 virus, the disease it causes, and how it spreads. Wash your hands frequently, use an alcohol-based rub, and avoid touching your face to protect yourself and others from infection.
Common symptoms include fever, cough, fatigue, breathing difficulties, and loss of smell and taste. Symptoms begin one to fourteen days after exposure to the virus. While the majority of people experience mild symptoms, some develop acute respiratory distress syndrome (ARDS), which can be caused by cytokine storms, multi-organ failure, septic shock, and blood clots.
Longer-term organ damage (particularly to the lungs and heart) has been observed, and there is concern about a significant number of patients who have recovered from the acute phase of the disease but continue to experience a range of effects for months afterwards, including severe fatigue, memory loss and other cognitive issues, low grade fever, muscle weakness, and breathlessness (known as long COVID).

II. LITERATURE REVIEW

The authors of the paper [1] studied about Cancer, which is one of the most serious and widespread diseases that is responsible for a large number of deaths every year. Among all types of cancer, lung cancer is the most common and has the highest mortality rate. Computed tomography scans are used to diagnose lung cancer because they provide a detailed picture of the tumour in the body and track its growth. Although CT is preferred over other imaging modalities, visual interpretation of these CT scan images may be an error-prone task and can cause a delay in lung cancer detection. As a result, image processing techniques are widely used in medical fields for early stage lung tumour detection.
The authors of the paper [2] studied that They propose a deep learning approach for the segmentation of body parts in computer tomography (CT) localizer images. Because of their variable field-of-view, diverse patient positioning, and image acquisition at low dose, such images pose challenges in automatic image analysis, but they are important for their most prominent applications in scan planning and dose modulation. Following the success of deep learning technology in image segmentation applications, we investigate the use of fully convolution neural network architecture to achieve the segmentation of four anatomies: abdomen, chest, pelvis, and brain.

The authors of the paper [3] introduced that the deep image prior (DIP) framework shows that convolution neural networks (CNNs) can learn intrinsic structural information from the corrupted images. In DIP framework, random noise is used as the network input and no high-quality training labels are needed. Furthermore, it has been shown that when the network input is not random noise but high-quality prior image from the same subject, the results can be further improved.

The authors of the paper [4] that studied the process of segmentation is an important step in the analysis and interpretation of medical CT and MR images. Segmentation is used in medical images to detect and extract feature areas. Finding the best medical image reconstruction technique is always difficult as technology advances. As a result, advancements in analysis and diagnosis have boosted medical imaging. Doctors and radiologists use ultrasound, MRI, CT-Scan, and other imaging techniques to visualize and examine internal human body structures without requiring surgery. Researchers focus on the review of tumour segmentation in CT and MR images in this paper. This paper compares different segmentation techniques while doing the comparison. Segmentation is the process of dividing a picture into smaller parts that have similar properties.

The authors of the paper [5] presents a novel method for detecting ground glass structure using statistical feature analysis and a grey level co occurrence matrix (GLCM). These GLCM-based features are thought to observe textural patterns in lung images that can distinguish between abnormal and normal lung. This method is tested on two normal and ground glass lung images. The results show that the proposed method is promising for identifying ground glass texture.

Reference	Consensus used	Contributions	Advantages	Disadvantages
[1] Nidhi S. Nadkarni , Sangam Borkar 2019	To exact the region of interest, morphological operation based	Image processing techniques are used widely in medical fields for early stage detection of lung tumor	It divides input image into various parts and gives the region of interest for further processing.	As it involves multiple steps like preprocessing, it is a tedius task.
[2] Hrishikesh Deshpande , Axel Saalbach 2019	To learn about segmentation of body parts in CT Localizers and applications	It investigate the use of fully convolution neural network architecture to achieve the segmentation	It supports multi-resolution, fully convolution neural network architecture F-Net.	Low accuracy on improper lining
[3] Kuang Gong; Kyungsang Kim, Mannudeep K. Kalra 2018	It reconstructs CT image using no-local deep prior	When the network input is not random noise but high-quality image, the results can be improved.	The low and high energy images are reconstructed jointly and benefit from the features extracted from the prior image	It requires large number of high-quality training images
[4] Kapil Kumar Gupta, Dr. Namrata Dhanda, Dr Upendra Kumar 2018	Study about image segmentation techniques	It focuses to compare different segmentation techniques. This used to subdivide objects for analysis.	It is better for Local Independent Projection based classification.	As complexity level increases, the percentage of segmentation in all cases is almost the same.
[5]Dr. Punal.M.Arabi, Nanditha Krishna 2016	Analysis of Lung CT images	It presents a novel method for ground glass structure diagnosis using statistical feature analysis using gray level co occurrence matrix	The values found for normal and ground glass lung give a better pattern identification than raw GLCM values	User must provide good CT image.

III. RESEARCH WORK

COVID-19 recognition is a difficult task that frequently necessitates looking at clinical images of patients. The transfer learning technique was applied to clinical images of various types of pulmonary diseases, including COVID-19, in this paper. COVID-19 has been found to be very similar to pneumonia lung disease. Further research is being conducted to identify the type of pneumonia that is similar to COVID-19. Transfer Learning allows us to discover that viral pneumonia is the same as COVID-19. This demonstrates that knowledge gained by a model trained to detect viral pneumonia can be transferred to detecting COVID-19.

When compared to the results of conventional classifications, Transfer Learning produces significantly different results. It is obvious that we do not need to create a separate model for classifying COVID-19 as traditional classifications do. This simplifies the herculean task by utilising an existing model for determining COVID-19. Second, because of the noise impedance from lesions and tissues, it is difficult to detect abnormal features in images. As a result, texture feature extraction is carried out using Haralick features that focus solely on the area of interest in order to detect COVID-19 using statistical analyses.

As a result, there is a need to propose a model to predict COVID-19 cases as soon as possible in order to control disease spread. We propose a transfer learning model to aid medical professionals in their prediction process. The proposed model outperforms the other models currently in use. This makes the time-consuming process easier and faster for radiologists, reducing virus spread and saving lives.

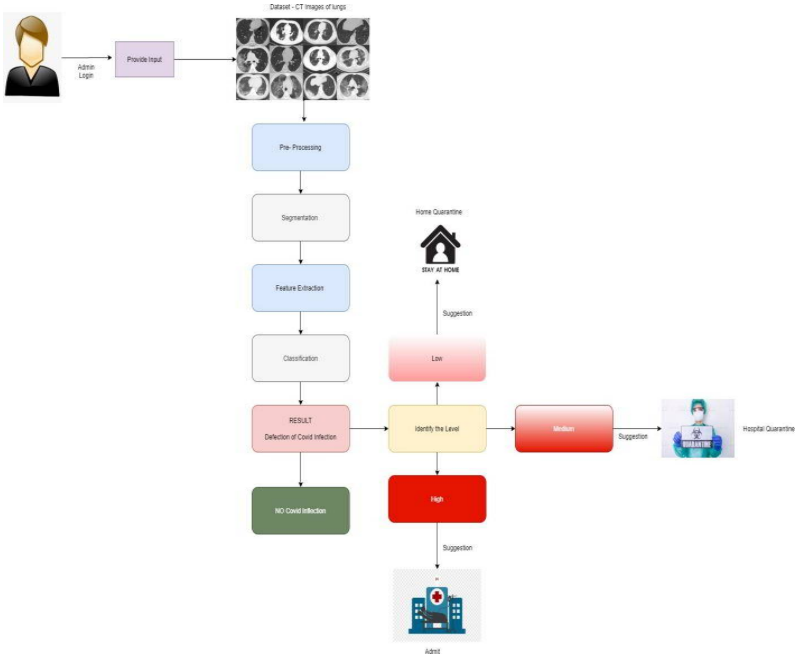
A. System Architecture

In this section, we are going to provide a brief introduction:

The system will have an admin module, through which a CT image will be uploaded. The system will then analyse the uploaded image and perform various activities such as pre-processing, segmentation, feature extractions, classification, and so on to provide us with the best possible result. The system will send him an alert and advise him whether he needs to seek emergency treatment or simply stay at home quarantined. There is currently no system in place that analyses CT images and provides alerts based on the results so that necessary actions can be taken.

B. Architecture Diagram shows the Complete Process of the System

The system wherein admin uploads the CT image to our system thereafter various preprocessing steps takes places on the uploaded image. Also, processes such as segmentation, feature extraction, and classification will be used to determine whether the CT image has a covid infection or not. If covid is positive then system will determine the level of severity and, based on that, will recommend the steps that the user should take. As if he or she requires home quarantine or hospitalisation. If the outcome is negative, no further action is required.



The above diagram gives the complete flow of working of the system where user or admin have to upload CT image

C. System Overview

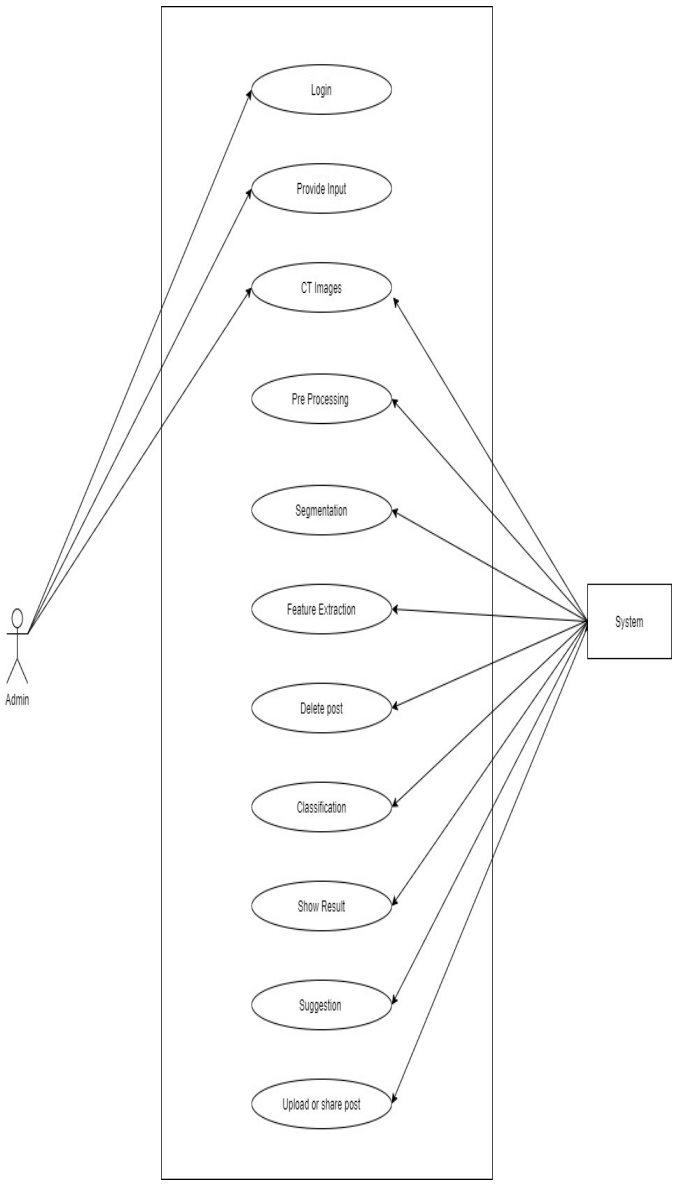


Fig. Use Case Diagram

D. Data Flow Diagram

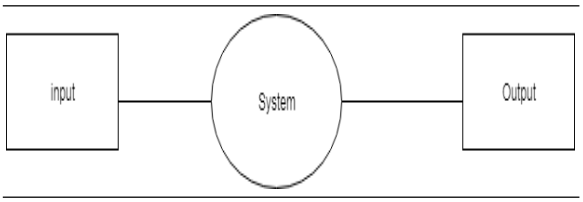


Fig. Data Flow Diagram

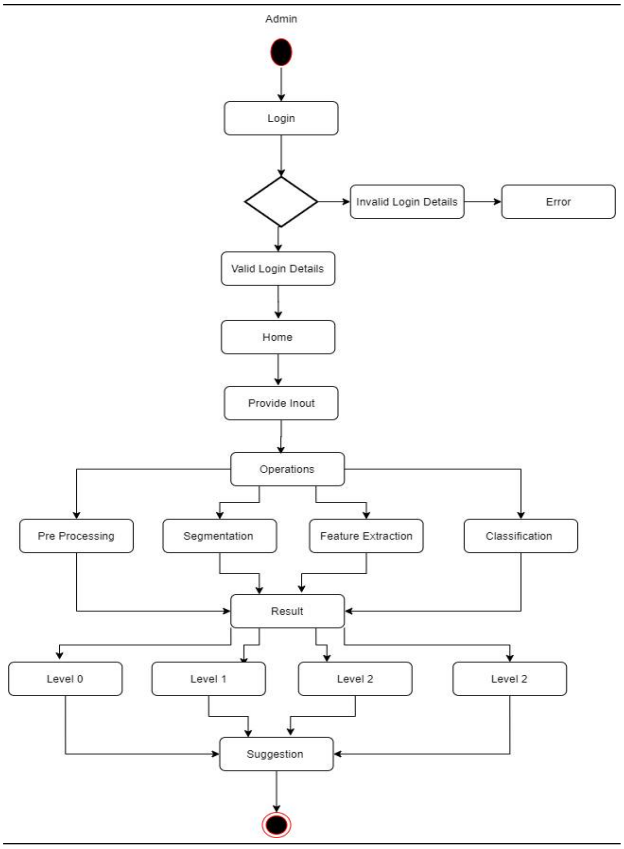
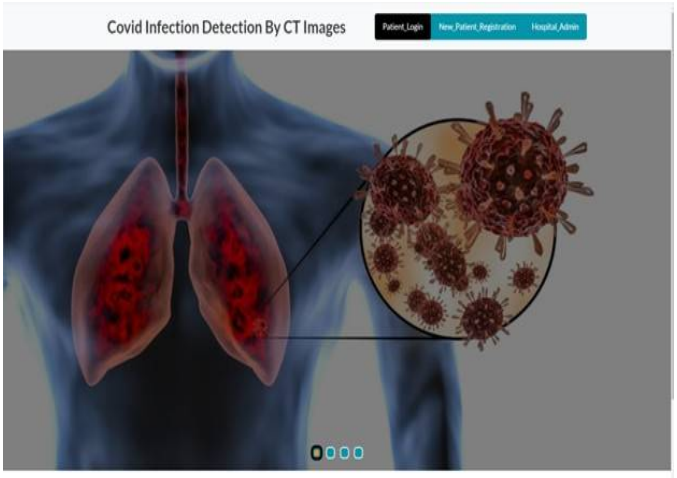


Fig. Activity Diagram

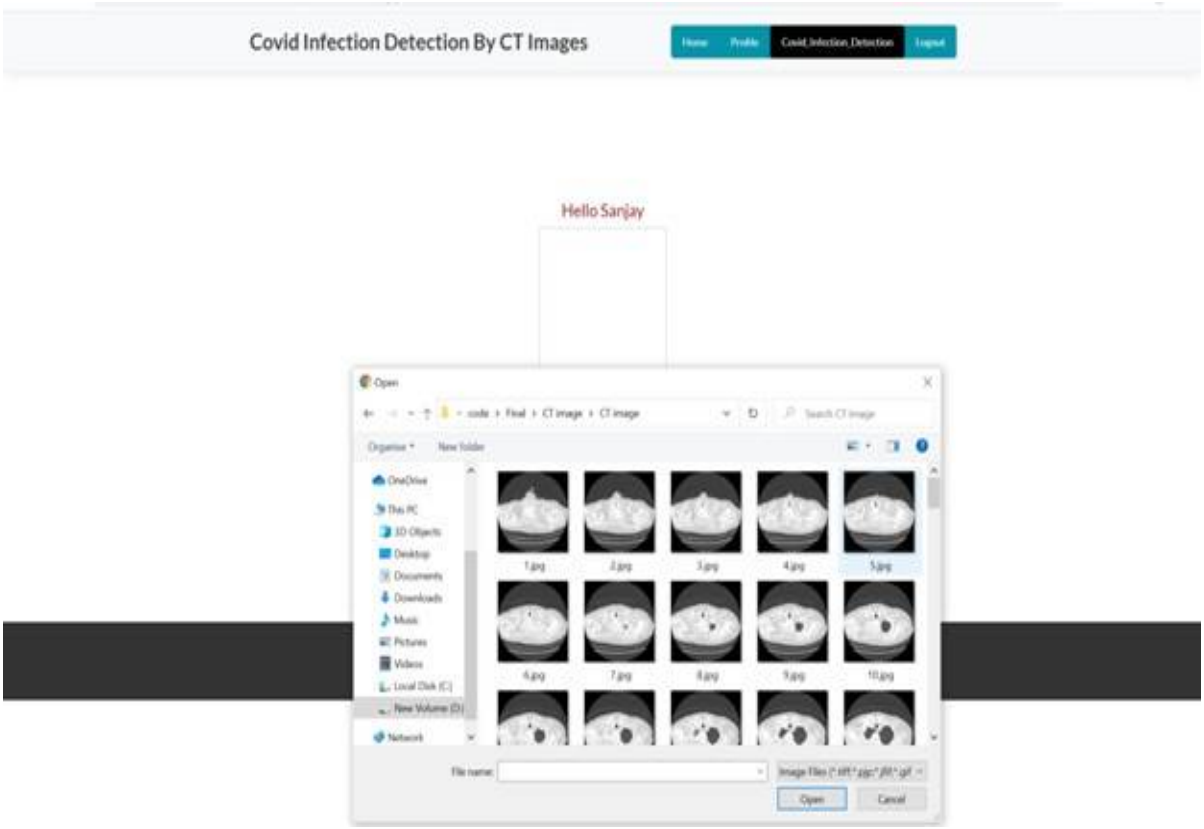
IV. RESULTS

Our implemented system will have an admin module, through which a CT image will be uploaded.
CT image provided to the system should be of High resolution and clear enough. The system will be capable to identify the severity of Covid-19. The system will analyze one image at a time.

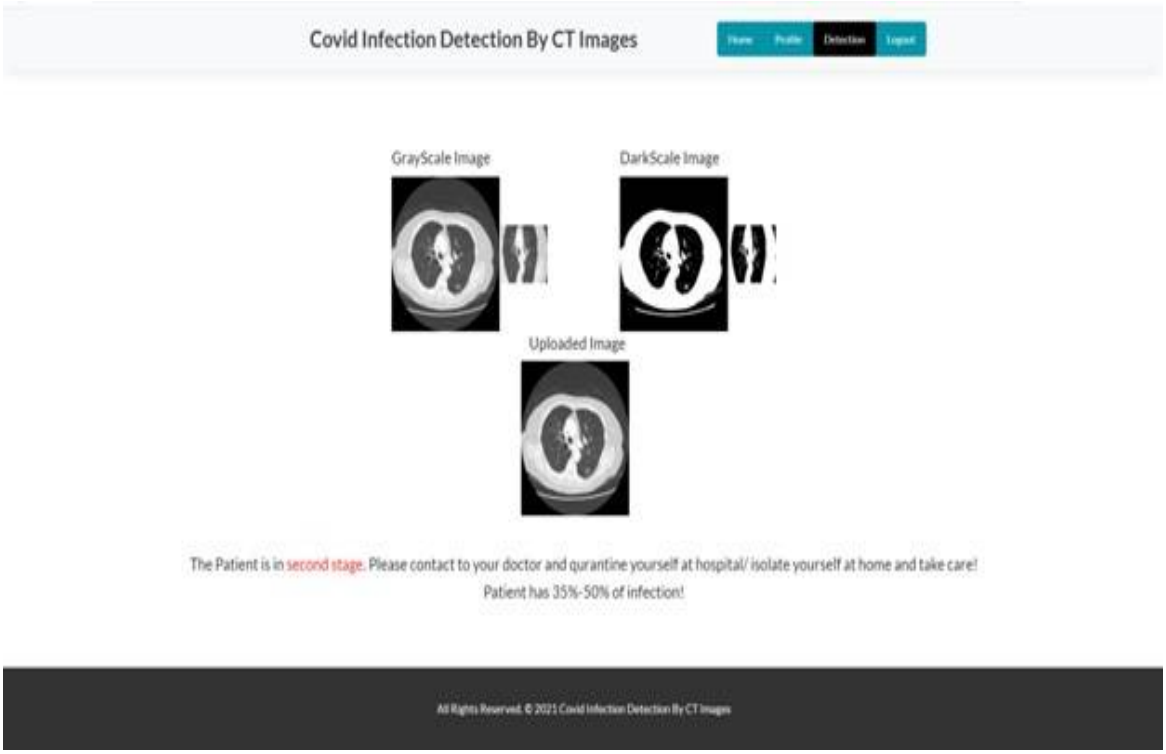
A. Outcomes



(Screenshot 1) Fig. Home Page



(Screenshot2) Fig. Browse and upload CT Image



(Screenshot 3) Covid-19 Result with Percentage

V. CONCLUSION

Our system plays a very crucial role as it helps in identifying the Covid-19 very early stage. It has a module for uploading the CT scan image. The further system willanalyze the uploaded image and will perform various activities which include Pre- processing, segmentation, feature extractions, classification, etc so that it will give us the perfect outcome. The system provides the alert also advice such that he has totake emergency treatment, or just to have home quarantine, etc. So far there is no system implemented that analyzes the CT image, and based on the results obtained, provide alert and necessary actions can be taken. The system has a simple and user-friendly interface that will help users to adapt the features and functionality quickly.

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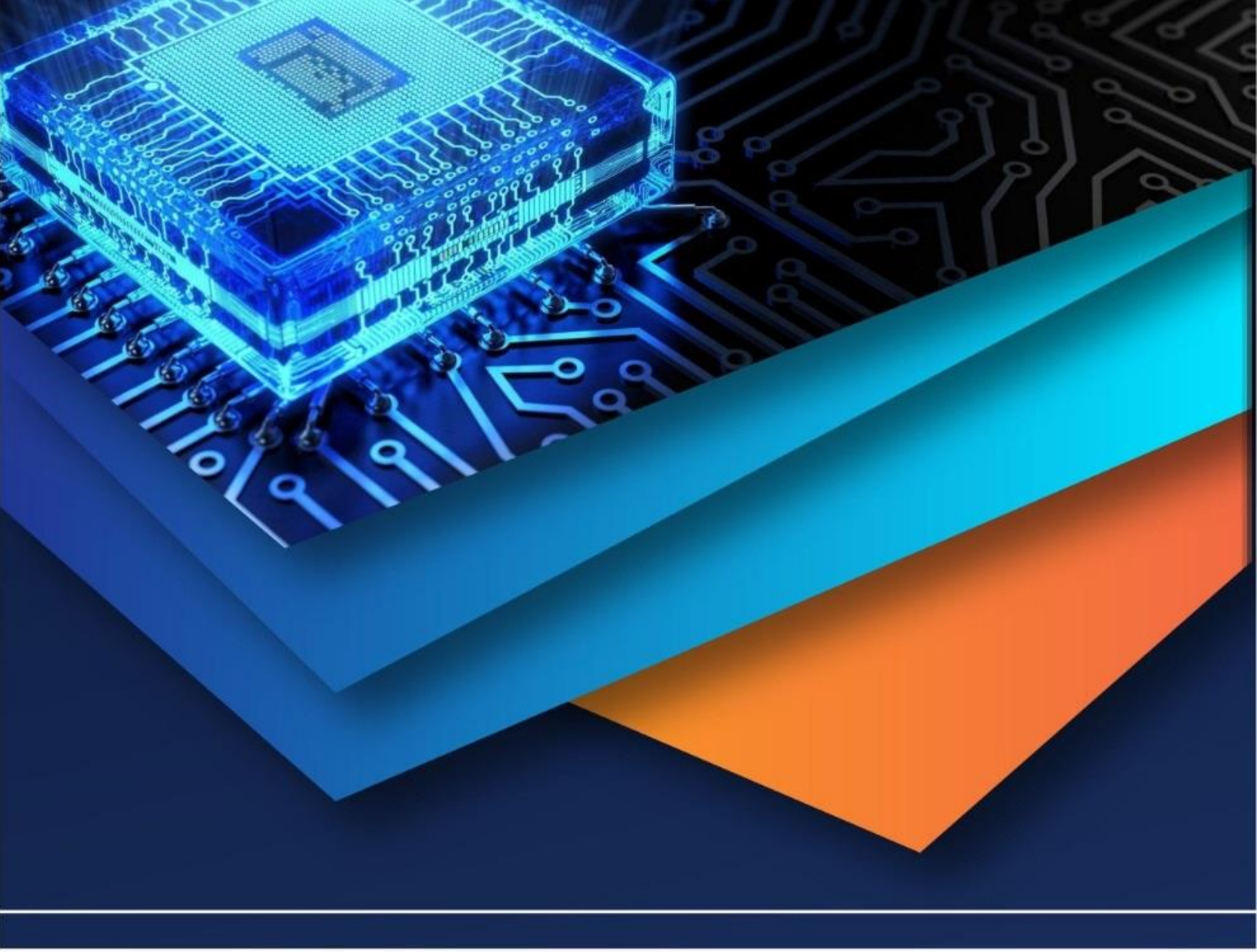

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