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Indian Currency Recognition and Authentication

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Abstract: ***It is very difficult for blind people to recognize or classify the Indian Currency into 10, 20, 50, 100, 200, 500 and 2000 rupees, therefore this project aims to classify the image into respective class of currency note. This is done using TensorFlow object detection which not only classify the image but also helps to localize/detect the currency in image provided by the user. Thus, the recognition part is done using object detection. Furthermore, the project also aims to authenticate the Indian currency means it helps to classify the image into real currency or fake currency. This is very much helpful because it helps to detect the fake currency and stop the flow of the same in market. Indian Currency Authentication is done using deep learning that is using Image Classification and Mobilenet model of image classification is used. The authentication is done using the watermark of Mahatma Gandhi which is present in each and every currency notes. So, each part is implemented using somewhat different approach.***

Keywords: Currency, Recognition, Authentication, Object Detection, Image Classification

I. INTRODUCTION

Today due to digitalization the use of paper currency is reduced, as the educated people are using online banking system or online payment transfer system. Although, there are people who are unaware of the same or are uneducated and don't know to use them. So, today also many people use paper currency for buying products or doing any kind of payment. This has given rise to the count of fake currency which is flowing in the market and people are finding difficult to recognize the fake currency. This paper provides an idea to classify the image into fake or real currency. The classification is done using Mobilenet which is a classification algorithm in deep learning. This model is lightweight and classify image very fast with good accuracy. For classification lot of images has been collected by clicking the photos. This can also be helpful for the banks but few improvements and update are to be done. The other part is recognition which helps to classify image and also detect the image from the live video provided by the user. The detection of currency is done using TensorFlow object detection API which uses a model known as SSD-efficientnet which provides a better accuracy as compared to another model when trained. The time taken for prediction was also less and the accuracy of prediction was also good. The training of both is done using free GPU which is provided by google colab. The training time for object detection was quite more as compared to classification because in detection it has to not only classify but also localise and draw the bounding box where currency is detected in an image.

II. OBJECTIVES

The objective of this project is to do the classification of images so that the disabled people can able to recognize what type of currency they have. This also helped to learned different features of currency note. The authentication is useful to stop the usage of fake currency and the people would be able to recognize the real currency using this very easily. The objectives of this can be expanded if the scope is increased to implement the project more efficiently.

III. METHODOLOGY

The flow chart shows how the project will run throughout. There is no need to login the user can select one option on the basis of their choice. The choice which is available to user is Indian Currency Recognition or Indian Currency Authentication. If the user selects Indian Currency Recognition, in that there are two options which are available to user to upload image or detect and classify the image. In upload image, the user has to upload image from the storage disk and then click on predict button. After clicking, the output that will generate will be classification of image that is 10,20, etc.

Otherwise, if user want to classify and detect it from live camera the user has to provide access to web camera and show the currency note in front of camera, which will generate a output as before. Else, in authentication part, to check the currency is fake or real, the user should upload image of currency, the system will predict the result and the output will be shown as it is on screen. The methodology for both is different and the way in which the dataset was collected where also different. The flowchart of the system is given below:

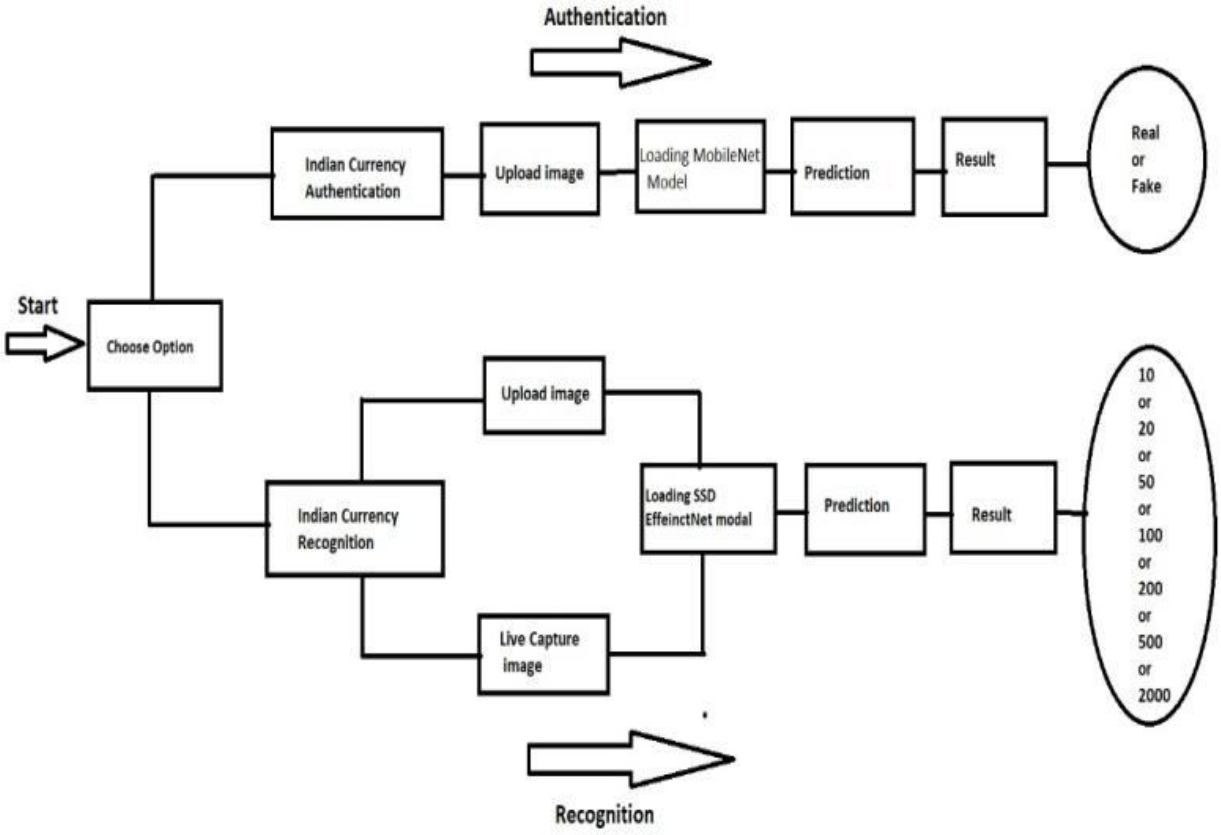

Fig 1. Flow chart of the system

The whole process is shown below:

A. Dataset Collection

For recognition, the different Currency notes were collected and the picture was clicked using a mobile phone. The images were clicked at different backgrounds and at different light intensity, so that the model can learn images at different variations. This would be helpful to avoid overfitting and improve the test accuracy. Some images were also downloaded from google. This variation led to collection of useful features from image to classify and localised the image efficiently. The images were divided into training, validation and testing data. The training data was approximately 80%, 10%, 10% out of total data respectively. In other, that is for authentication there were only two classes fake and real, so the number collected for this was less as compared to recognition. But the real currency images were collected such that the watermark is visible clearly. So, the real Currency image photo was clicked in good light while for fake currency the watermark is not present in the current note. Similar to recognition for authentication the images were divided into training, validation and test data.

B. Image Annotations

The labelimg tool is used for labeling or annotations of images in recognition dataset, each class of currency dataset is labelled. The XML file is generated after annotations, which contain the class, coordinates of the bounding box. This XML file and image both are provided for training the recognition model. For authentication, there is no need for labelling or annotations as only classification is done for this. The different class of images are kept in their concern directory such as real currency images is kept in real directory similarly for fake currency. This is understood by the image Classification algorithm. Furthermore, the images of authentication are pre-processed using Image Data Generator a function by keras library which helps in rescaling of images, shift range and many more. The image is divided into batch size so that the images are trained in batches instead of training images one by one which takes more time.

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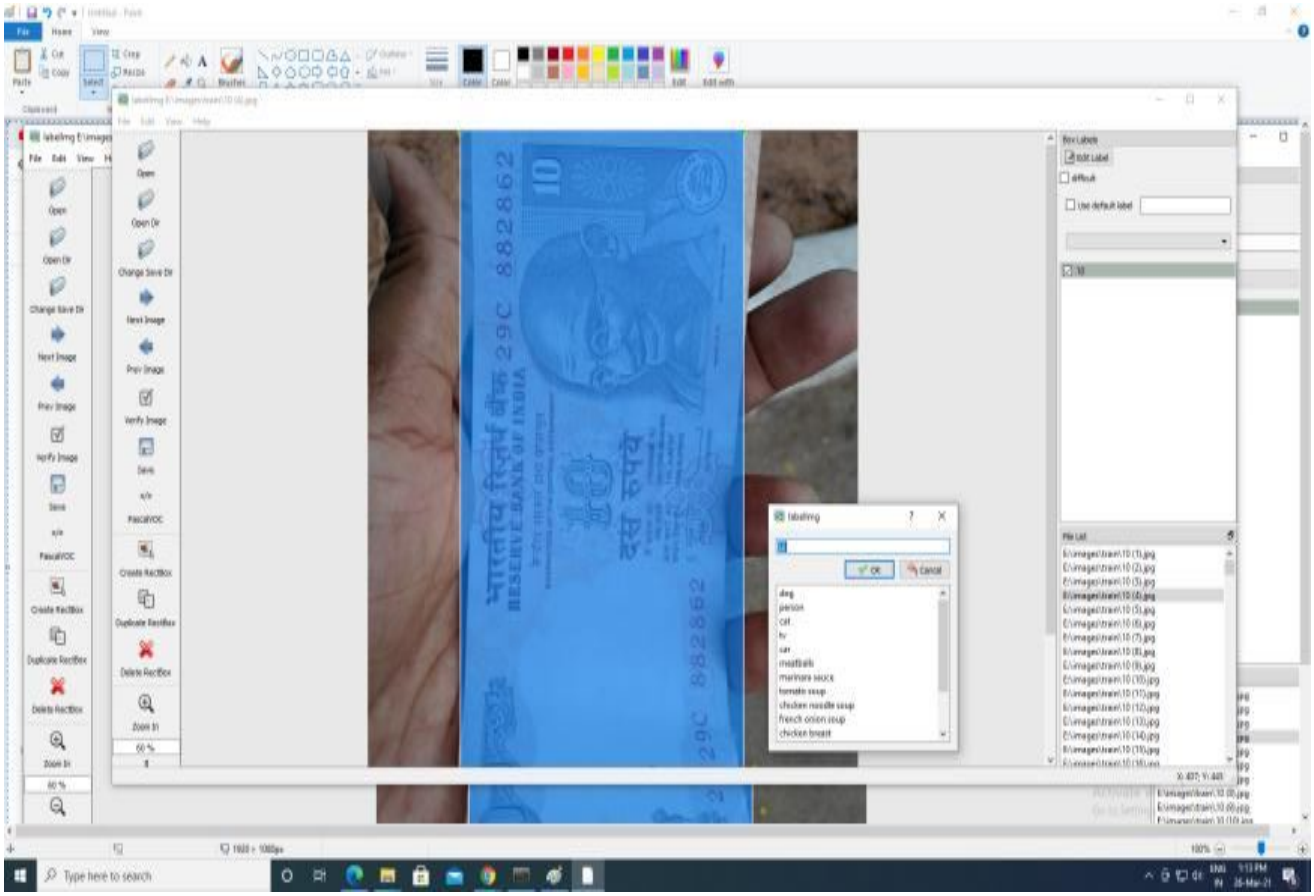

Fig 2. Image Annotation of Indian Currency Recognition

C. Model Training

The recognition model is trained using ssd-efficientnet which is a TensorFlow object detection API algorithm. Here in this the SSD (Single Shot Detector) is object detection algorithm which is used to detect the object that is the currency note in image whereas efficientnet is classification algorithm which after detection of currency helps to classify the image into respective class. The SSD algorithm instead of finding the object using different size of boxes draws the grid and try to find out the region of interest. In this, first the object is searched in whole image and if object is found out which might be of any shape, then the bounding box is drawn. The box area is then provided for classification of image to efficientnet which helps in classification. The area is then classified into respective currency class.

The training of image is stopped when the training accuracy is reached high and validation accuracy is also comparatively good. The validation accuracy and training accuracy should increase while training loss and validation loss should decrease per epoch. The model is said to be well trained if both the above factors is achieved and the model predicts correctly for unknown image which was not present for training.

In authentication, the classification algorithm mobilenet is used which is a light weight model and predicts the result fast and with good accuracy. The accuracy for this algorithm was quite good as compared to other algorithms. The model was trained for 20 epochs and the image was pre-processed before passing the image for training. The accuracy for both was above 90% in recognition and authentication.

D. Exporting the model

The model trained for recognition is exported, so that it can be used for prediction in future. The model is stored in inference graph which stores the checkpoint as well as the weights of the trained images. For other, that is authentication the classification model is stored with the help of library pickle and it is stored in the form of pb which is an extension to save the model. The saved model is stored in directory for future reference.

IV. RESULT S AND DISCUSSIONS

To evaluate how the system is been performing the evaluation metrics is used. The evaluation metrics for Indian Currency Authentication which uses image classification as a concept are confusion matrix which gives the different scenario such as True Positive, False Positive, False Negative, False Positive. The classification report is generated which includes precision, recall and F1 score which must be higher. This all factors are calculated on test data which is an unseen data. For the recognition part the different loss is plotted such as regularization loss, classification loss with the help of Tensorboard. The evaluation matrix for the recognition is intersection over union and mean average precision and mean average recall. All the evaluation and the output of the same is shown in images below.

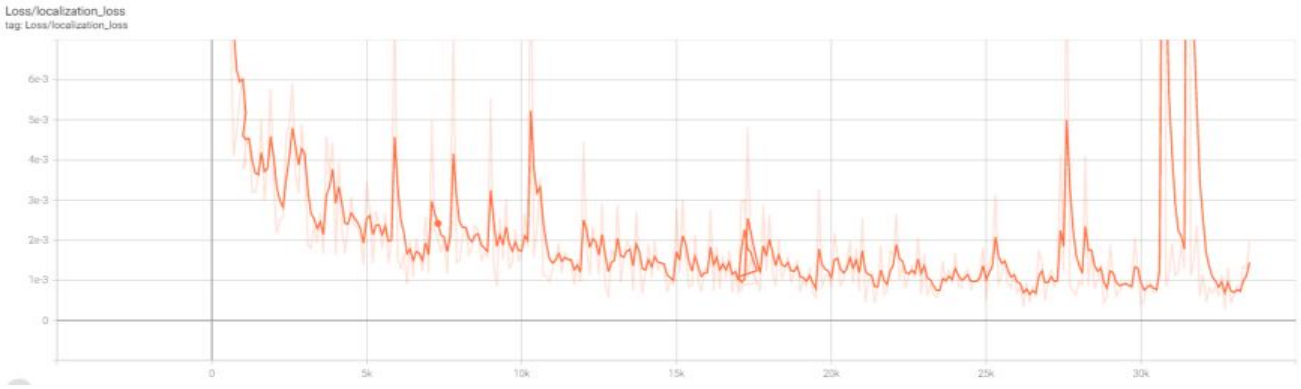

Fig 3. Localization loss of Indian Currency Recognition

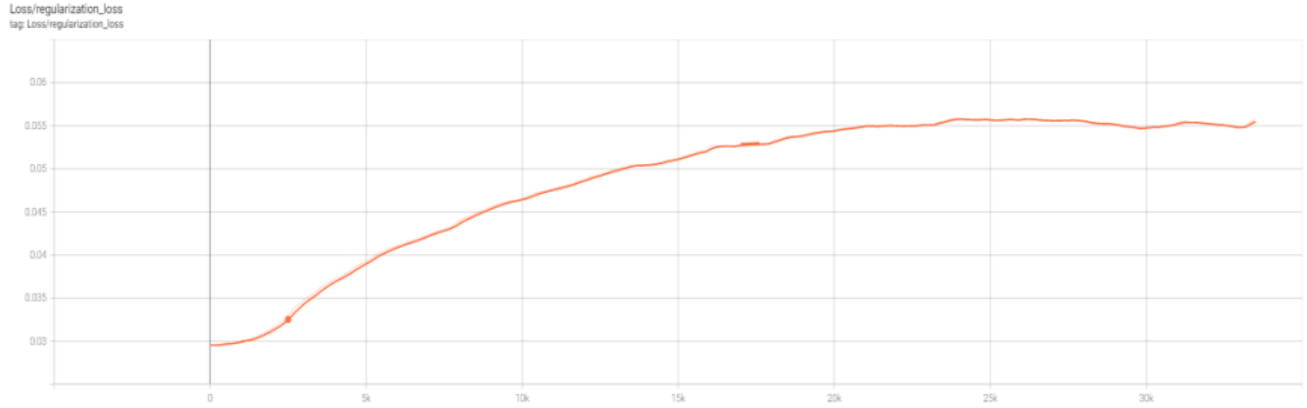

Fig 4. Regularization loss of Indian Currency Recognition

Fig 5. Total loss of Indian Currency Recognition

The above images shows the different losses which was found out while training the model for Indian Currency Recognition. The loss of each decreases with increase in number of epochs

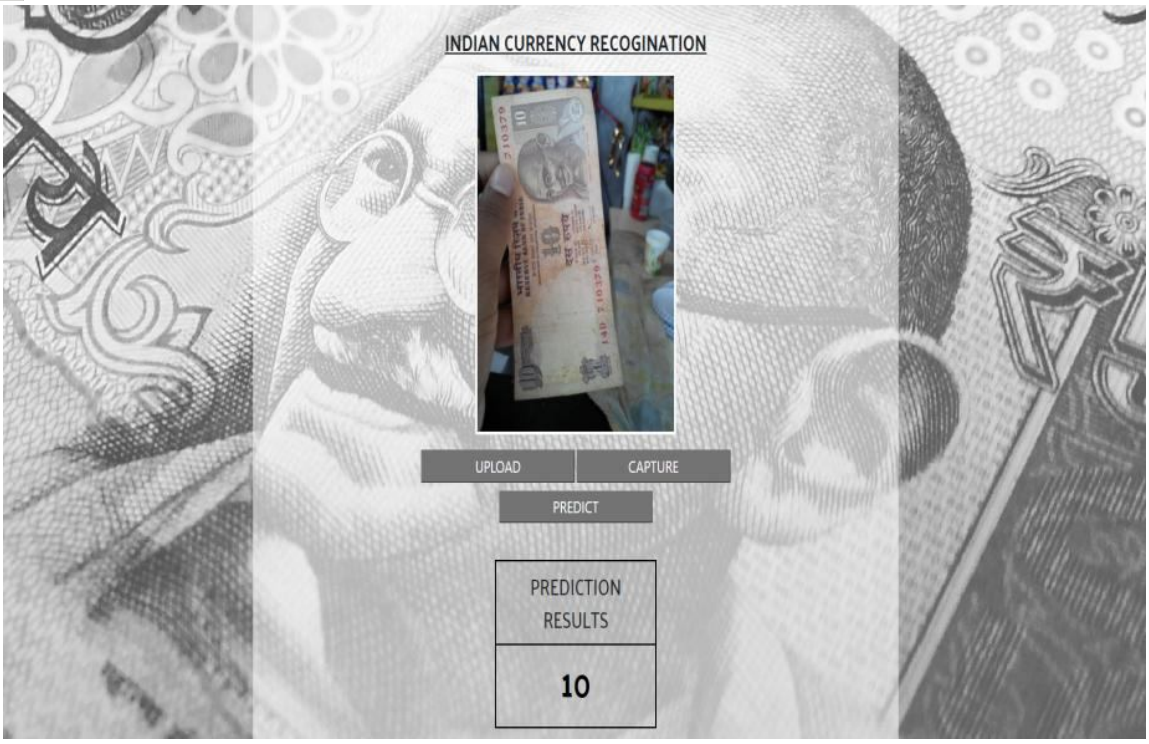

Fig 6. Output of Indian Currency Recognition by uploading Image

The above image predicts the result when the image is uploaded by the user . The uploaded image is predicted by the model when image as input is provided to the system and the result is shown on the screen.

Fig 7. Output of Indian Currency Recognition by capturing using live camera

The above output is the image which is captured using live camera, where the bounding box is drawn and image is classified into respective class.

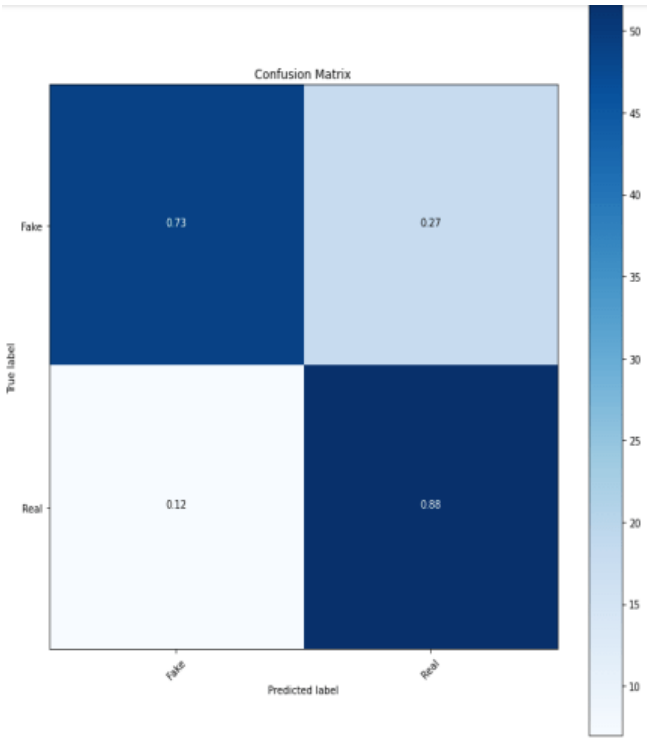

Fig 8. Confusion Matrix of Indian Currency Authentication

Classification Report

	precision	recall	f1-score	support
Fake	0.88	0.73	0.80	67
Real	0.74	0.88	0.81	59
accuracy			0.80	126
macro avg	0.81	0.81	0.80	126
weighted avg	0.81	0.80	0.80	126

Fig 9. Classification Report of Indian Currency Authentication

The evaluation matrix for Indian Currency Authentication is shown above which gives how the model performs for the test data

Fig 10. Output of Indian Currency Authentication by uploading Image

As the watermark is present in the currency the image is classified as real, if the watermark is not present in the currency, then it is predicted as fake currency.

V. CONCLUSION

This project is used to classify the images, so that the people who are not able to recognize it can easily classify it using our system where as due to difficulties to identify real or fake currency, this would be helpful to identify it correctly with minimum error. This might have be done in past but the latest technology that is deep learning and its newest algorithm is used to do above task which might be helpful or overcome the disadvantages present in previous ideas.

VI. ACKNOWLEDGEMENT

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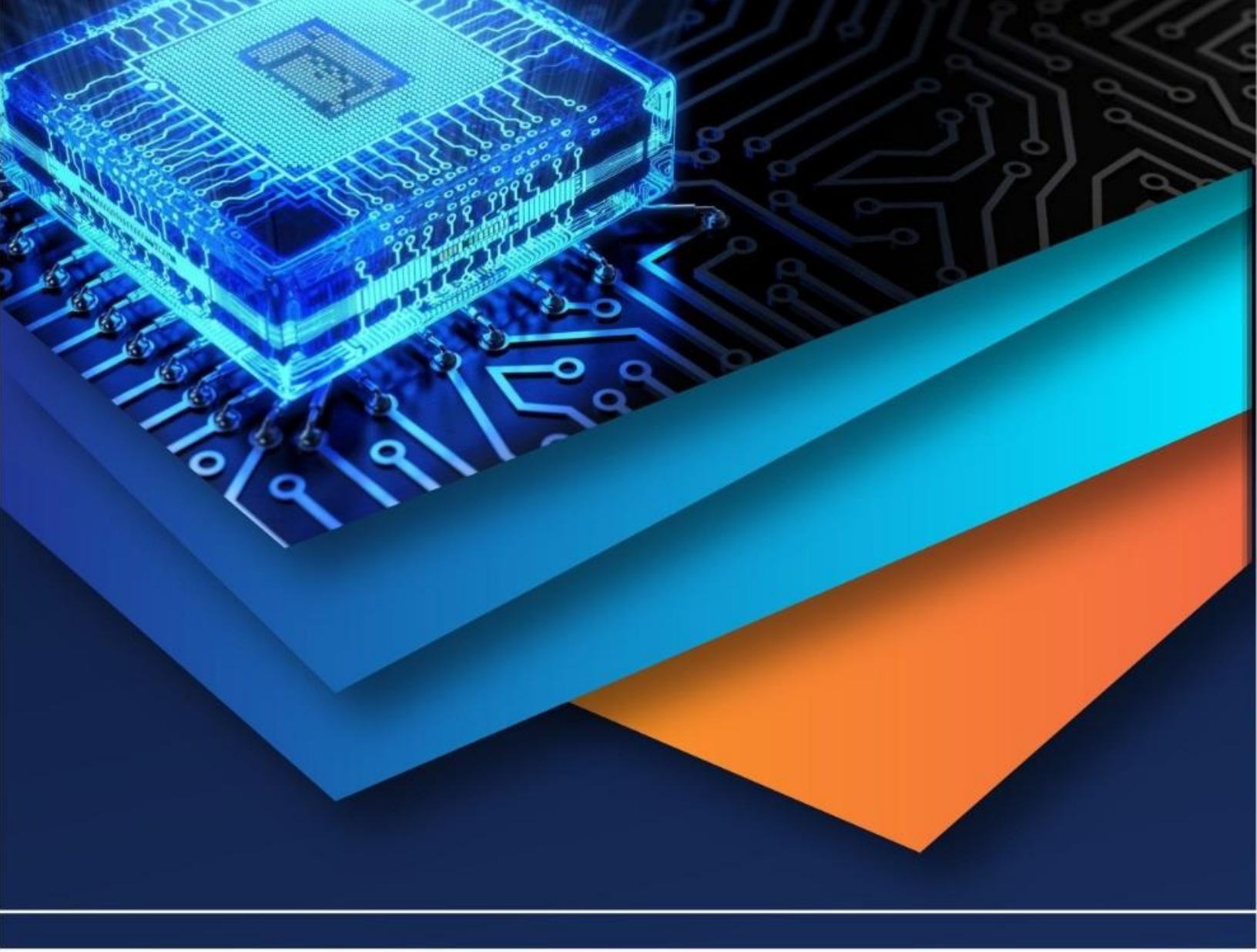

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