iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6019

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Evaluation of Brain Tumor MRI Imaging Test Detection and Classification

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Abstract: ***Brain tumor is the deadly cancer. It can occur at any age. World is worrying about brain tumor, almost survival chances of affected human being is very less. However it is possible to recover from the brain cancer, if it is detected early stage. For the purpose of recognition or detects of tumor, deep learning is used in the field of medical research. Deep learning has become the important method for complex tasks such as image classification and object detection. Here, we used MRI kaggle dataset downloaded by internet. CNN is the most popular neural network model used for image classifications. Keras was designed to enable fast experimentation with deep neural network. Here we used Tensor flow and python programming environment for the development of our proposed system. This system is more applicable in medical sector. Within this proposed method we used fully automatic segmentation and feature extraction of brain tumor detection and classification using CNN techniques.***

Keywords: Image processing; MRI; Brain tumor; Segmentation; Classification; Deep learning; CNN

I. INTRODUCTION

Health problems are becoming more prevalent in today's world than ever before, and People's lifestyle is also becoming more and unhealthier. Brain tumors damage DNA in some way to most cancer-causing reactions. And the brain tumor triggered other signs of cancer in the body as well. Cell phones can cause some brain cancers, as confirmed by the organization of the WHO. The brain and central nervous system (CNS) comprises more than 120 types of tumors. The most widely use of CT, MRI, and PET image scans to see whether or not the patient has a brain tumor. Because of what we Using MRI scans to detect patient brain tumors. Determining the size of the tumor is a significant obstacle in brain tumors preparation and objective evaluation. MRI technologies are now a tool of great importance.

MRI uses digital computers and intense magnetic fields, radio-frequency signals to create full organ pictures, tissues, joints, and the entire structure of the inner body.

The first phase in brain tumor assessment includes finding a qualified neurologist. Then test the size which malignancy of the actual tumor, and also search for brain tumor metastasis. The neurologist can then prescribe the therapies needed to control the tumor. Generally, if the tumor is accessible and can be removed effectively, the neurologist may refer patients to a brain surgeon for treatment and removal of the tumor, although other procedures, involving radiotherapy and chemotherapy, can also be done. Tumors can begin in the brain or tumors can expand to the brain elsewhere in the body. The depending on the tumor, some tumors are also quite curable and are unlikely to return, while others are more dangerous, easily spread, and harder to treat. This is mainly due to the involving cells and impacted portion of the brain.

Two common brain tumor classes are present: primary brain tumors begin in brain tissue and continue to remain there. Secondary tumors are also more frequent in the brain. All such cancers begin off elsewhere within the body and then go to the brain. Without clear proof something can be done to cure the certain disease. Side effects have recent or ever-strong headaches, blurry vision, and loss of balance, depression and seizures. In certain cases, signs cannot be present. Treatments require surgery, chemotherapy, and radiation. Brain tumor identification stages and Brain tumor segmentation in MRI (magnetic-resonance-imaging) has been an important area of study in the field of image analysis. Detection of brain tumors helps in identifying the exact scale, shape, border and position of the tumor.

The image processing system used to identify brain tumors requires a number of steps. The phases include image-acquisition, Feature-Extraction, Segmentation, Classification and Prediction. CNN-Deep learning methods are very effective in detecting and classification. For this system we use tensor-flow platform because it have good packages for image processing to get good accuracy.

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II. LITERATURE SURVEY

Shuang Wu et.al, [1] they concentrated on determining the effective radiomics-based ML approach for the estimation of genotype IDH in gliomas. They carry 126 patients with brain tumor MRI set for review of the imaging. They used RF for classification, giving high accuracy with the resulting 0.88-0.981, where comparison of the remaining 8 approaches to machine learning. They also used varying classifiers for comparisons, such as NN, FDA RF and etc.

D. J.Hemanth, et.al, [2] they suggested increase in performance of the general GA methodologies so as to improve the dynamic nature of the formal GA. The Gray Level Difference Method (GLDM) extracted higher-order statistical-features (contrast, cluster hue, energy, entropy, variance, correlation, similarity and skewness, etc.). Back Propagation neural network was used for the aim of classifying tumors.

Ranjeet Kaur et.at, [3] they implemented model named location and classification of brain tumors using ML and DL strategies. This system used classifications using ANN, CNN, and SVM. The SVM machine learning algorithm from this proposed approach gives reasonable precision. They had to use MRI image set for processing and that was accessed for image acquisition process from BRATS 2013-2015-2017, IXI, RIDER as well as other local dataset. Adaptive- Histogram-Equalization, Median filter and Adaptive Median Filter used for pre-processing of images. Threshold-based, edge-based, clustering-based, and region-based segmentation were used in segmentation. They used DWT and GLCM techniques in the extraction of features.

M Malathi et.al, [4] they developed a method for segmentation of the brain tumor from CNN technologies by using MRI image processing module. It is fully-automatic segmentation for high-grade brain tumor type glioma, used in the convolution-neural-network. To this proposed system, they used BRATS2015 dataset. The system divided the brain tumor into edema, non-enhancing tumor, tumor enhancement, and tumor necrotic. They used tensor-flow in python-based anaconda environments.

Megha H C [5] the study of several research papers which were based on tumor detection, rendered those different authors used different methods of tumor detection and classification. Different classification methods, which were provides less accuracy compared to CNN model. For that proposed system built with CNN classification model for good accuracy.

III. METHODOLOGY

The system starts processing as soon as input is obtained, which takes image as an input, perform the operations on an image and produces the output as tumor or non-tumor (Fig 1, Fig 4, Fig 5, Fig 6).

Steps involved in pre-processing the image are as follows:

A. Image acquisition
B. Image enhancement
C. Image segmentation
D. Feature extraction
E. CNN classification
F. Prediction

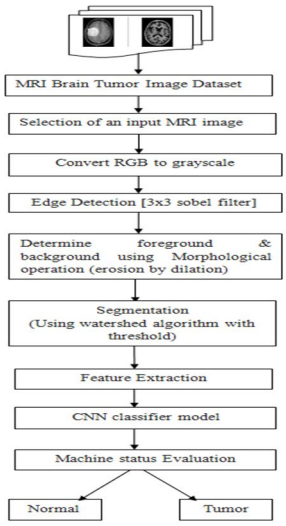

Fig 1: Proposed Method

Here we discuses about each steps of algorithm in one by one

1) *Image Acquisition:* The application program is developed using HTML and Django. The application program provides user interface to the users. Through this interface the user will input the image. Provide the input as an image, it may be following types such as jpeg, png, the provided input image will be fed into server. At the server, the image will go under various image processing operations or technologies where, it will provide guaranteed and or expected outcome.
2) *Image Enhancement Technique:* This technique used to improve the quality of a given image, it loads to better outcomes.
3) *Image Segmentation:* As name suggest, if partitioning the image into multiple segments which results in better analysis. In our proposed system we had done image segmentation using morphological operations. Morphological operations are works with the shape of the image. To remove the unwanted noise on the image used threshold algorithm.
4) *Feature Selection and Extractions:* It performs the selection of subset of an input image, which selects the subsets of an image where algorithms shared focus on and ignoring the rest. Feature extraction focuses on finding shapes and objects in an input image.
5) *CNN Classifier:* After performing the above mentioned pre-processing techniques, we use CNN classifier. This CNN deep learning technique, process the image to predict determine whether the given image is a tumor or non - tumor and provides the classification accuracy. The different layers are involved in CNN algorithm are Convolution-layer, Pooling-layer, Activation-layer, Fully-connected-layer.
6) *Convolution-Neural-Network (CNN):* Neural networks are composed of artificial neurons, which simulate biological neurons in a limited way. Here, we have set of elements such as x1, x2…..xN are inputs, which are connected to F (). The connection between the input and the activation functions is done by the set of weights, indicated by w1, w2…..wN.

X = (x1, x2……xN)

Ω = (w1, w2……wN)

Besides these, we have bias now; the output of activation function is represented by the Z.

Where, Z = f (∑^N xi*wi + b) where i=1, here bias.

Bias represents or indicates an extra neuron included with each pre-output layer and stones the values of 1 for each active. Activates functions helps in selecting the neurons (Fig 2).

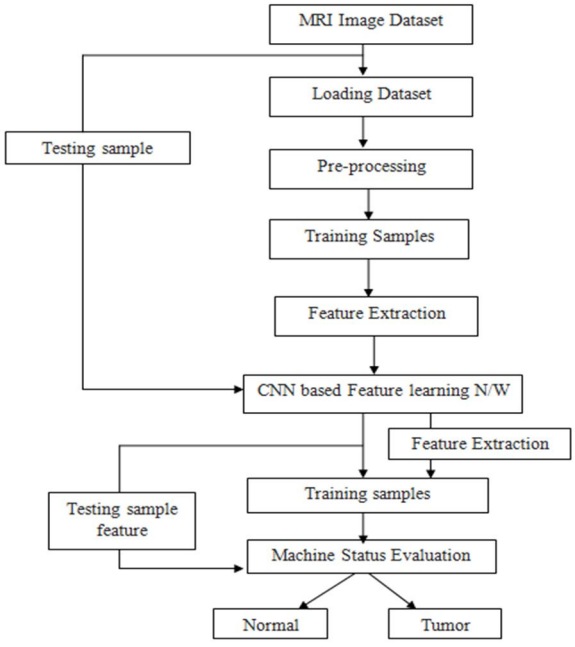

Fig 2: Proposed system CNN model flow diagram

Algorithm: Brain tumor detection and classification using CNN in image-processing (Fig 3, Fig 7, Fig 8, Fig 9, Fig 10, Fig 11, Fig 12)

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Volume 8 Issue VI June 2020- Available at www.ijraset.com

a) *Step 1:* Start

b) *Step2:* Here, we need to create dataset, as train dataset and validation dataset. Train dataset contains the data which neural network wants to learn. Validation dataset contains the same dataset, which helps us to determine whether the system (neural network) learning or not.

c) *Step 3:* Importing libraries

i) Keras ImageDataGenerate - This image data generator function to generate multiple data from the single image by shrinking, zooming, resizing it.

ii) Import Sequential - Sequential is an object of neural network.

iii) Conv2D - Extract the feature of input image data.

iv) Maxpooling2D - It helps to reduce the size of the data.

v) Activation - To tell neural network towards activation functions.

vi) Dense – Helps in creating layers.

d) *Step 4:* Feature Extraction

i) Train_data.dir - Data from which network learn.

ii) Validation_data.dir - Data which tells whether the network learning correctly or nor.

iii) nb_train_samples - How many samples we need from the dataset.

iv) Epochs - The number of iteration.

v) Batch size - Number of images given at a point of time.

vi) if K.image.data.Format () - To check image in the right or correct format that is RGB (3, w, h) here, 3 is channel represent RGB.

vii) else input_shape = (image width, image_height, 3)

viii) Train_datagen - (generate training data) by resizing the image, shearing, zooming etc.

ix) Test_datagen - (neutral image) to validate.

x) Train_generator - train.datagen.flow.from.directory.

xi) Path - Gets the data from the specified path.

e) *Step 5:* Connection of neural network

i) Sequential () – It is an object of model.

ii) Conv2D () - Which extracts feature from the image (3X3) pixels).

iii) Activation (relu) - ReLU stands for rectified linear unit, which is an activation function.

iv) Maxpooling2D () - If reduces the image to concentrate on required features.

v) Flattern () - Converts 2D image into 1d image.

vi) Dense (64) - Add or connects 64 nodes to the hidden layer.

vii) Dense (1) - 64 hidden nodes connect to one output.

viii) Activation (sigmoid)- which is activation function for neural network. The input to this function is represented or connected in between 0 ranges to 1.

ix) Model.Summary () - Represents the conclusion of the network such as how many hidden layers we added, size of hidden layer, input of the hidden layer and output of the hidden layer.

x) Compile () - It compiles all the layer together, where we can input and get an output

xi) Model.Save_Weights (file.H5) - After done with the execution of neural network, saves the weights of those nodes, because which helps in interface implementation, hardware implementation etc.

xii) Now the system learnt whole data. Input an image to the neural network, check whether it works as expected.

xiii) Image-to-array () – Convert image to array.

f) *Step 6:* Prediction

Result = model. Predict (img) - It specifies 0 to 1, then print whether it is tumor or non-tumor.

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IV. RESULT AND DISCUSSION

Here we have taken MRI dataset from kaggle website. This dataset contains more than 500 images downloaded by different kaggle website links (https://www.kaggle.com/simeondee/brain-tumor-images-dataset and https://www.kaggle.com/navoneel/brain-mri-images-for-brain-tumor-detection). These datasets used for testing, training and validation purpose. In this proposed method we used supervised learning concept. The input MRI images are computed by CNN, checking with each and every hidden layer and predict a final output to display in user GUI window. CNN is one of the best classification neural networks. It gives more accuracy than other methods because CNN is very powerful algorithm for any complex structure of image processing and object recognition. Here we get loss and accuracy value from this method.

Result of the proposed system as shown below.

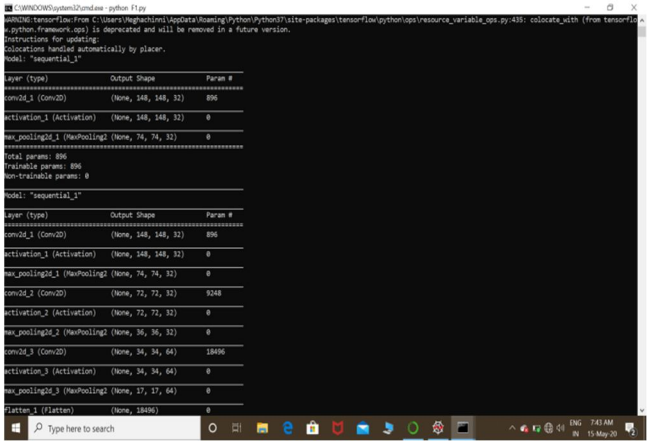

Fig 3: Execution of the Model and Layers of the model

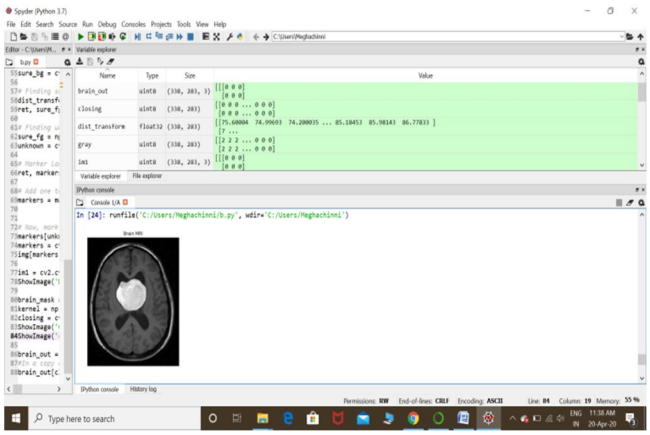

Fig 4: Selected Brain tumor MRI image

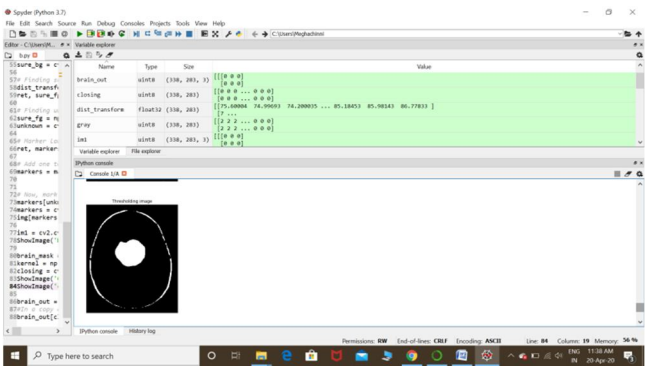

Fig 5: Threshold image of the MRI Brain tumor

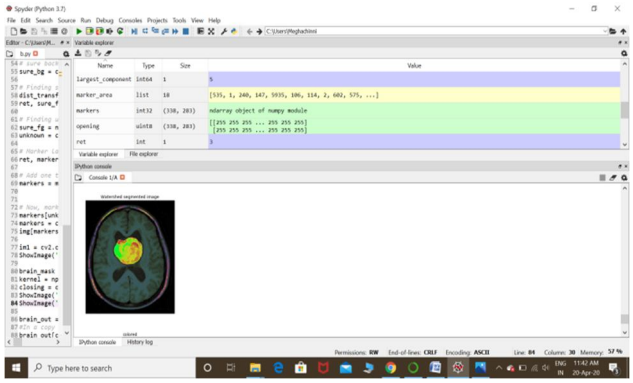

Fig 6: Watershed Segmented image

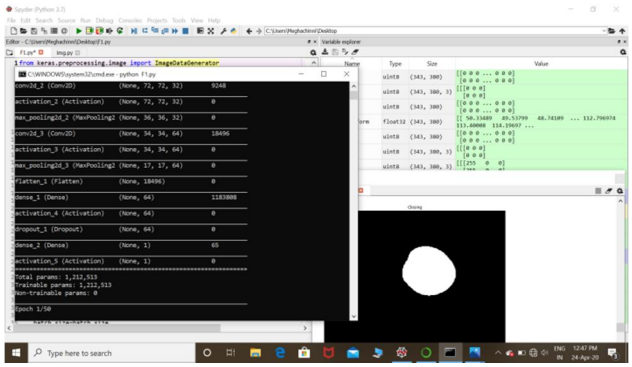

Fig 7: Closing Segmented image

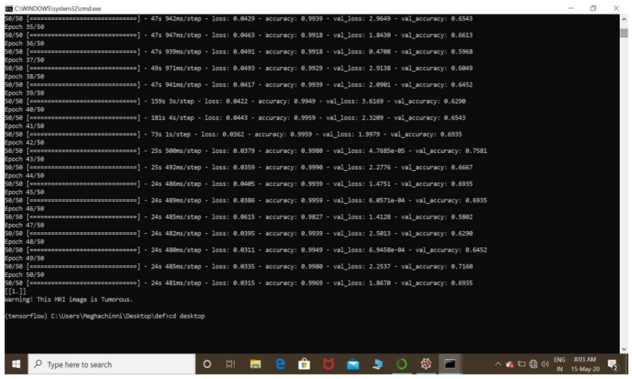

Fig 8: Accuracy of the input image

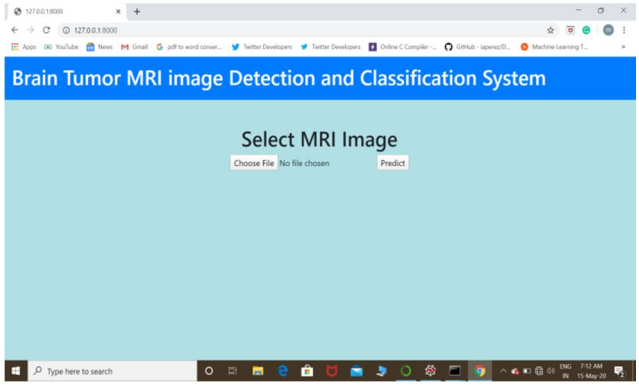

Fig 9: Interface of the proposed system for users

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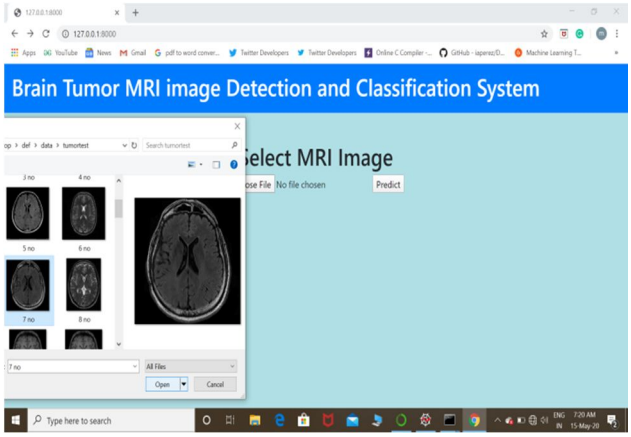

Fig10: Select MRI input image (Dataset) from GUI

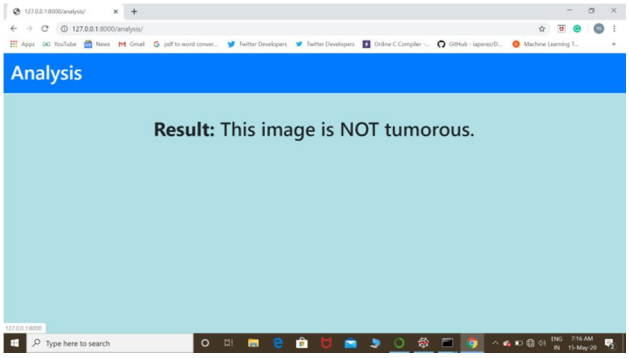

Fig 11: System Evaluation for given Brain tumor MRI input image

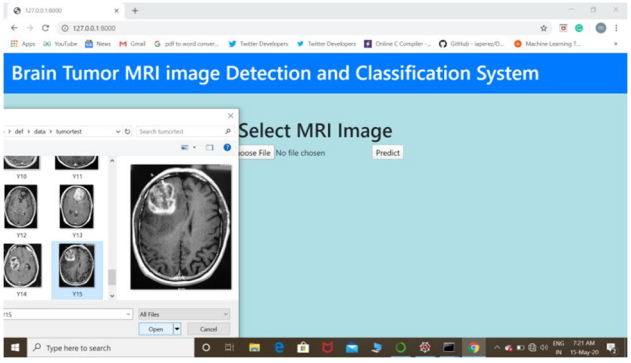

Fig 12: Select MRI tumor image from dataset

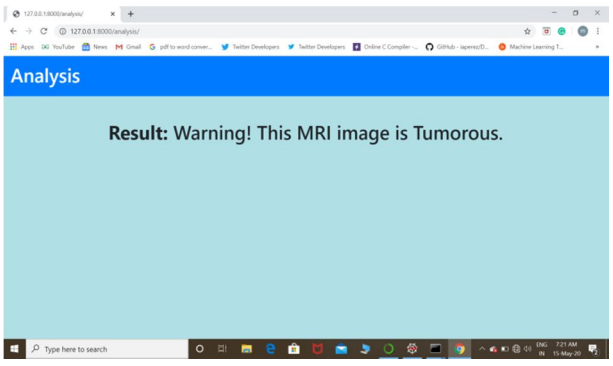

Fig 13: System Evaluation for given Brain tumor MRI input image

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

V. CONCLUSION

Brain tumor is dangerous. It can happen at any age. World is worried about brain tumor, the chances of affected human beings survival is less. Here we used kaggle MRI Brain tumor image dataset from different website. So here, the image processing is helps to identify the tumor with different pre-processing techniques are used. Keras is an open source neural network library written in python. Keras was designed to enable fast experimentation with deep neural network. GUI is designed using HTML and Django, here we can input an image and see the predicted result. A Final word about our model is which is rapidly using model in the field of image recognition and classification. CNN is one of the best classification neural networks. Which provides more accuracy compared to any other model and it is easy to develop compared to other model. CNN takes less parameters generally improves the time it takes to learn as well as reduce the amount of data required to train the model. CNN operates in such a way that in a convolution layer, neurons only receives input from a previous layer. Output is the fully connected Network layer. CNN works by extracting features from the images. CNN learn feature detection from hundreds of hidden layers. We used this model for the classification and detection of brain tumor if it is presented in the given input image. The model provides the more accuracy which is ranging from 90% to 99 %, which no other models can provide. It is better suitable for medical field in future precautious.

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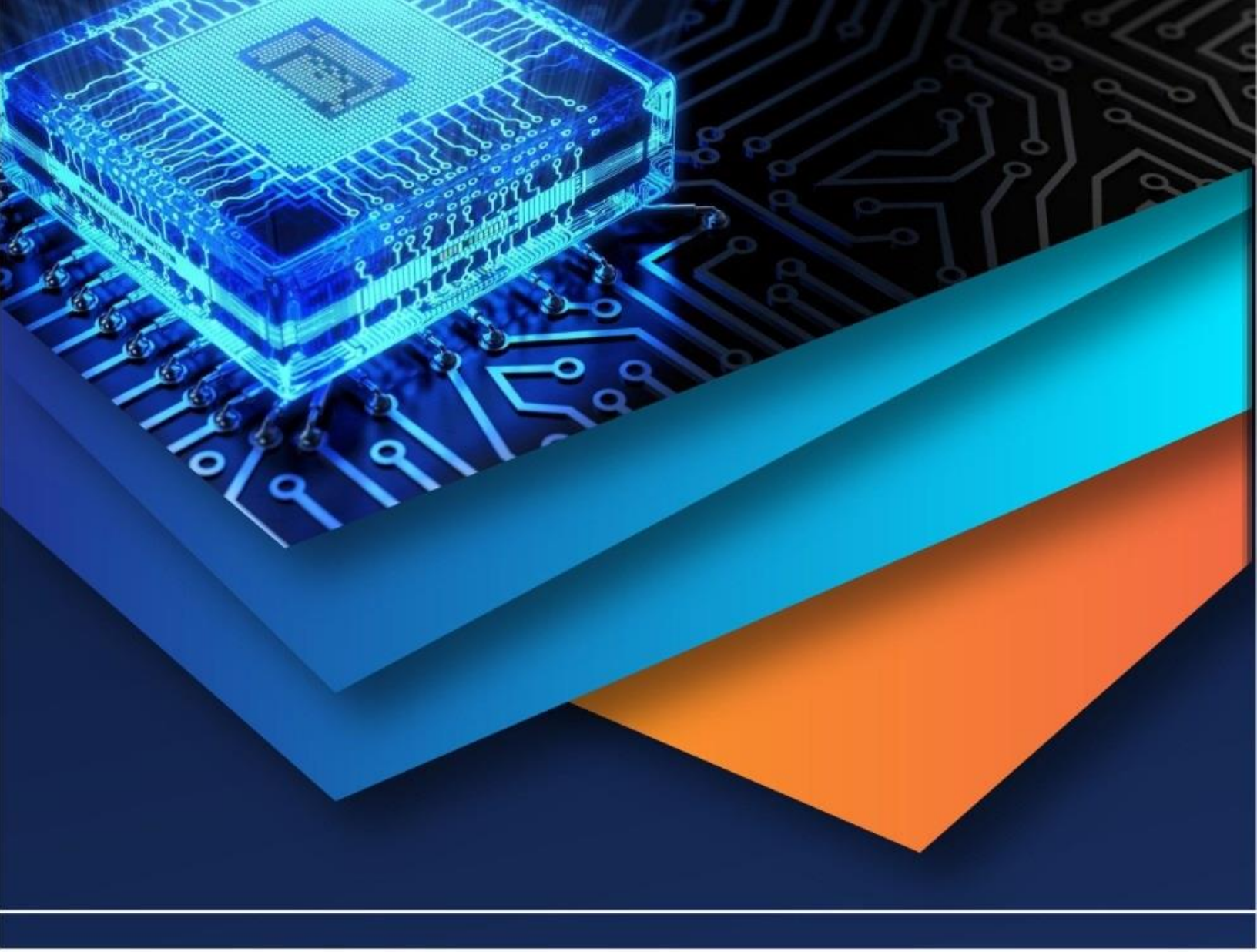

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