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A Novel Approach for Identification of Brain Tumour Type in MRI Images using AI Techniques

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Abstract: The main intention of this research is to develop an automated approach that identifies the type of brain Tumour from MRI images of various patients using image processing Techniques. Brain Tumour is a solemn issue that, if not identified at right time and treated in a right way, can lead to impediments, and sometimes require surgery or lead to deaths. Whenever early stage tumours or malignant tumours raise, they can trigger the increase in density within the skull. This may be one of the major reasons for brain damage, and sometimes cause life-threatening. Right treatment and right diagnostics at the right time should be carried out to save the lives. One best technique to discover brain Tumours is Magnetic Resonance Imaging (MRI). This helps in using image processing and AI techniques in detecting Brain Tumour type accurately which helps the oncologist to treat the Tumour efficiently. It has the inclination to yield correct results by implementing on various methods and data sets. By using appropriate image processing and AI techniques on CO-LAB, this work is carried out to identify the type of Tumours like Pituitary Tumour, Glioma Tumour, Meningioma Tumour and no Tumour.
Keywords: Glioma, Logical Regression, Meningioma, MRI, Pituitary, SVM, Tumour

I. INTRODUCTION

Brain Tumour is one of the belligerent diseases among persons of different ages. these are responsible for maximum percentage of all chief CNS (Central Nervous System) Tumours. Each day throughout the year, thousands of individuals are detected with various type of tumours and main among them is brain Tumour. The detected Brain Tumours may either be an early stage can cancer tumour (benign) or later stage cancer tumour (malignant). Other types of brain Tumours are Pituitary Tumour, Glioma Tumour, Meningioma Tumour. Now a days, if we observe, a very large data related to images are generated through multiple resources. The generated images are assessed and analysed by experts like the radiologist before starting the treatment. Manual examination may not always give accurate results because of the complexity that is associated with brain Tumours and their features. Various Applications and techniques related to automated classification and by using Artificial Intelligence (AI) algorithms. Machine learning process has always proved and provided higher accuracy when compared to that of manual classification techniques. The proposed work deals with classification and detection of Tumour type by using Support Vector Machine (SVM) and Logical Regression. This serves the doctors across the world to identify, analyse and concentrate on the treatment based on the type of the Tumour identified by the system. This saves lot of time and helps doctors to start the right treatment in time for getting best results and in saving the lives.

As per the data available the five year survival ratio of individuals with a cancerous tumours in brain across the United States is roughly 36%.[1] similarly during the last decade the persistence rate is nearly 31%. Old age, young age or middle age whatever may be the age, after diagnosing the individuals, age factor is having significance in survival rates after the treatment. The five year existence rate for the individuals below fifteen years is approximately 75%. For the individuals between the age group fifteen and thirty nine, the five year survival seems to be around 72%. For the people aged 40 plus it appears to be 21%. The existence rate for men is around 34 percent and for women is 36 percent among the people with a cancerous brain Tumour. Gliomas Tumours mainly obtain from the cells named glial cells. These usually maintain formation of Central Nervous System and also provide nutrition to that system.

Gliomas are the tumours that can be generated from various glial cells. Meningiomas are diagnosed from trusted source more often in women than men. [2] very rarely found tumour is Pituitary carcinoma. From the trusted sources it is recorded that very less pituitary cancers are chronicled in the United States every year. It is observed that about maximum individuals with pituitary were diagnosed in their old age or seen after death which is approximately seventy five percent. According to the American Brain Tumour Association, it is observed that early-stage pituitary tumours account for about thirty to forty percent.

These are mostly seen among young individuals along with pregnant ladies and men who are in the age group of forty and fifty. One among every fourth person may have a early stage Pituitary Tumour and is termed as (adenoma). Such tumours are very difficult to identify as they are noncancerous and doesn't seem to observe any symptoms.

Among all the brain tumours identified, twelve to nineteen percent of the tumours are often considered as Pituitary tumours. Maximum of these pituitary Tumours are early stage tumours and almost all of them can be treatable. The available master glands play very crucial role in performance of every individual.

These are termed as pituitary glands and they look in the size of a pea nut. These are mostly present behind eyes and are seen in the front of the brain and beneath it.

The hormones generated by the pituitary glands has the capabilities to normalise important organs of the body along with the critical glands which includes thyroid, testicles, adrenal, ovaries etc.

Pituitary glands that generate tumours are generally tumours without cancer or in rare cases will form early stage cancer tumours. Many of them generate hormones and are treated as functioning tumours. Some of the tumours that do not generate hormones are considered as non functioning tumours.

II. LITERATURE SURVEY

An eight bit image having information related to brightness and ranging from 0 to 255 is seen in MRI (Magnetic Resonance Imaging) images. Here the value '0' is considered as black colour and white colour is represented by the value '255' [3]. To generate images with some significant information from radio waves, a strong magnetic field is used by the MRI machine. [4]. From MRI images, Ashfaq Hussain discussed about the Semantic Segmentation to find the Brain Tumour and used GLCM features for SVM Classification [5].

III. METHODOLOGY

The proposed work deals with identification of Tumour type from the MRI Tumour images. A simple predictive model was created to identify the Tumour. Brain Tumour MRI Data set was taken from Kaggle. IT consists of training and testing data. The training data consists of 4 folders which have four categories of brain Tumour MRI images.

They are, pituitary Tumour with 827 training and 74 testing images, Glioma Tumour with 826 training and 100 testing images, meningioma Tumour with 822 training images and 115 testing images and NO Tumour with 395 training images and 105 testing images.

The dataset is provided by Kaggle which is an online subsidiary of Google machine learning and data science community with various data experts and machine learning specialists. The dataset provided are pre-processed and contain training as well as testing data sets in different folders.

To produce the best results the size of the images are reduced to equal pixel size. Here the dataset is reduced to 200 x 200 pixels. This helps in displaying the resultant images with equal dimensions. The dataset is trained and tested by using Support Vector Machine and Logical Regression. The accuracy of training data set and testing dataset is obtained for the two models on the mentioned four data sets. Finally, results are analysed

A. Algorithm

1) Step-1: Read the MRI Images
2) Step-2: preform the pre-processing on images.
3) Step-3: Reduce size of the images.
4) Step-4: Divide data into train set and Test set.
5) Step-5: Complete Feature topping.
6) Step-6: Perform Training to the model.
7) Step-7: Examine the model.
8) Step-8: Repeat this process on different datasets.
9) Step-9: Apply the process on SVM & Logistic Regression.
10) Step-10: Analyse and compare the results.

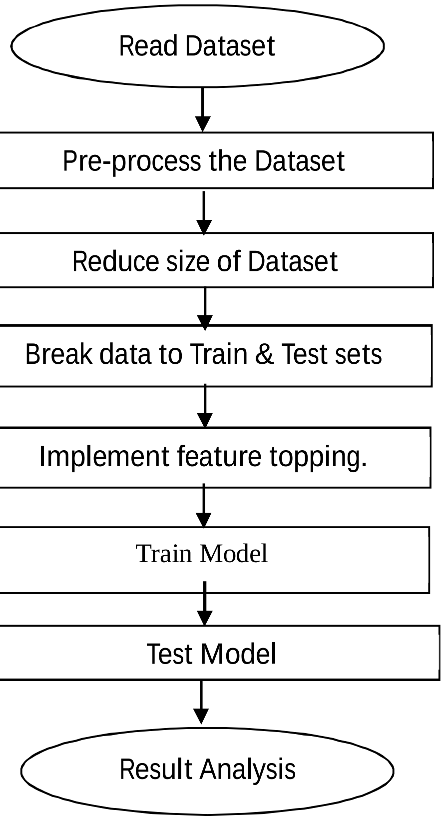

Fig.1 Block Diagram

The data set is classified into training and testing data sets with various combinations of train and test splits such as 80 % - 20%, 85% - 15% and finally 90% - 10%. SVM and Logistic Regression algorithms were applied on data set individually on each type of pituitary Tumour, glioma Tumour, meningioma Tumour. The training accuracy and testing accuracy is calculated for each data set individually. The classification and identification of Tumour is done for all the images present in the dataset and a sample results were shown in a 8x8 matrix representation. Similarly all the datasets are clubbed into single dataset and the process is repeated by using the both algorithms and with the similar train and test split ratio with three different values. The results proved to be better for SVM when compared to logistic regression for individual datasets and for complete data set with all images. Results proved to be more promising, and the results were discussed below.

IV. RESULTS

The results for various datasets using SVM and Logistic Regression for multiple splits.

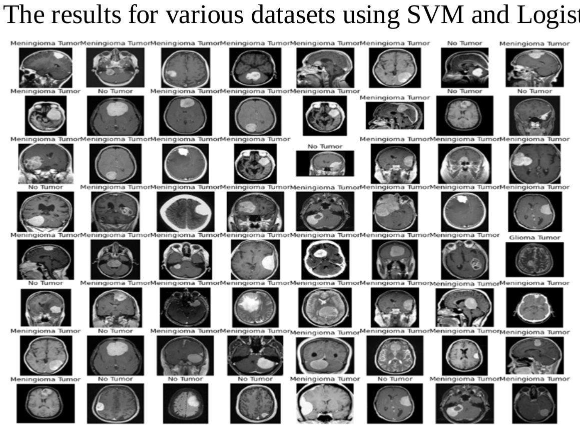

Fig.2 Meningioma Tumour

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.8729508196721312

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9681397738951696
     Testing Score: 0.8811475409836066
```

Train vs Test split ratio: 80-20

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.8743169398907104

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9661508704061895
     Testing Score: 0.8688524590163934
```

Train vs Test split ratio: 85-15

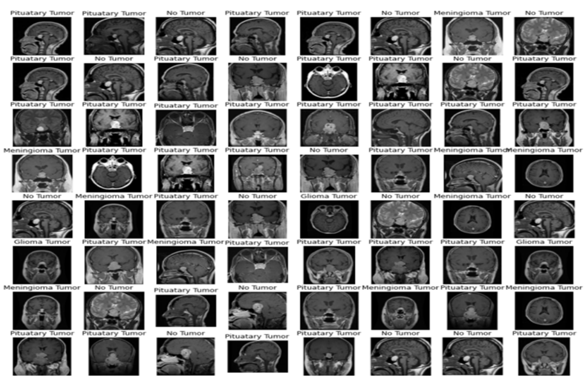

Fig.3 Pituitary Tumour

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.9836956521739131

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9903660886319846
     Testing Score: 0.967391304347826
```

Train Test Split: 85-15

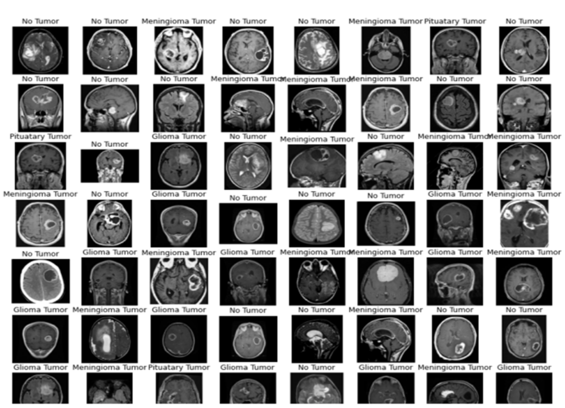

Fig.4 Glioma Tumour

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.8934426229508197

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9698630136986301
     Testing Score: 0.8934426229508197
```

Train vs Test split ratio: 90-10

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.9673469387755103

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9918116683725691
     Testing Score: 0.9714285714285714
```

Train Test Split: 80-20

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.983739837398374

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9927206551410374
     Testing Score: 0.967479674796748
```

Train Test Split: 90-10

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.9428571428571428

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9836065573770492
     Testing Score: 0.963265306122449
```

Train Test Split: 80-20

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```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.9402173913043478

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9855351976856316
     Testing Score: 0.9619565217391305
```

Train Test Split: 85-15

```
[19] print("Training Score:", lg.score(xtrain, ytrain))
     print("Testing Score:", lg.score(xtest, ytest))

     Training Score: 1.0
     Testing Score: 0.943089430894309

[20] print("Training Score:", sv.score(xtrain, ytrain))
     print("Testing Score:", sv.score(xtest, ytest))

     Training Score: 0.9854280510018215
     Testing Score: 0.959349593495935
```

Train Test Split: 90-10

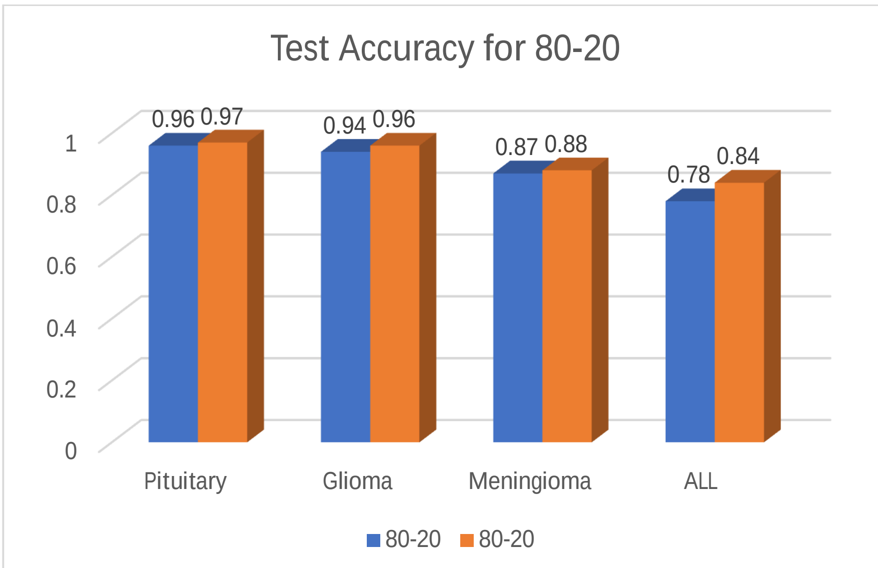

Fig.5 Test Accuracy with 80-20 Ratio

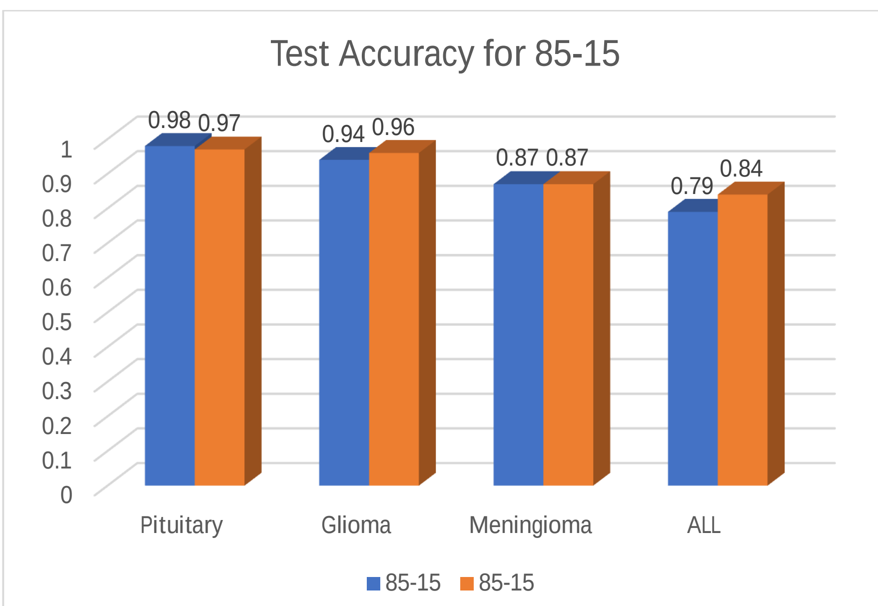

Fig.6 Test Accuracy with 85-15 Ratio

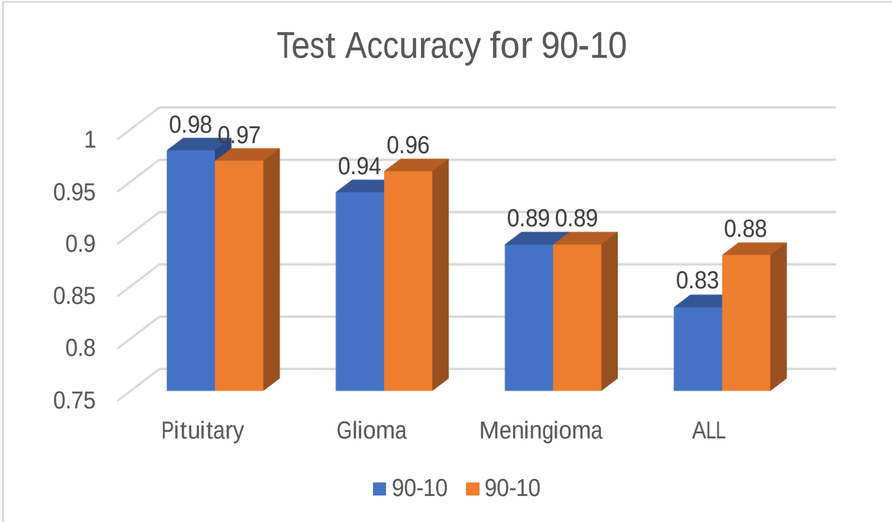

Fig.7 Test Accuracy with 90-10 Ratio

Comparative results of all datasets for various train and test splits on individual and combination of all images is in the below table-

Table-1 Train and Test Accuracy - Comparative Results

	80 - 20				85 - 15				90 - 10			
Share	Train		Test		Train		Test		Train		Test	
Method	LG	SVM	LG	SVM	LG	SVM	LG	SVM	LG	SVM	LG	SVM
PIT	1.0	0.99	0.96	0.97	1.0	0.99	0.98	0.97	1.0	0.99	0.98	0.97
GLI	1.0	0.98	0.94	0.96	1.0	0.98	0.94	0.96	1.0	0.985	0.94	0.96
MEM	1.0	0.96	0.87	0.88	1.0	0.96	0.87	0.87	1.0	0.97	0.89	0.89
ALL	0.99	0.93	0.78	0.84	0.99	0.94	0.79	0.84	0.99	0.94	0.83	0.88

V. CONCLUSION

Acquiring a better understanding of the apparatuses that are driving to identify the Tumour and its type may provide a more detailed information about Tumours to oncologists to carry out right treatment targets. We took three types of MRI datasets related to Pituitary Tumour, Glioma Tumour, Meningioma Tumour and applied AI techniques to find out the type of the Tumour among the available images. The work is carried on multiple training and testing datasets and verified the training and testing accuracy by using Support Vector Machine and Logistic Regression. The Tumour test Accuracy results seem to be promising for Support Vector Machine which helps the Oncologists to start the mediation by concentrating on the right treatment for the identified Tumour. The future work may be carried out with other existing Artificial Intelligence Algorithms and techniques on the entire dataset and analyse the results for better diagnosis which helps to provide right treatment at right time and saves life's of the brain Tumour patients.

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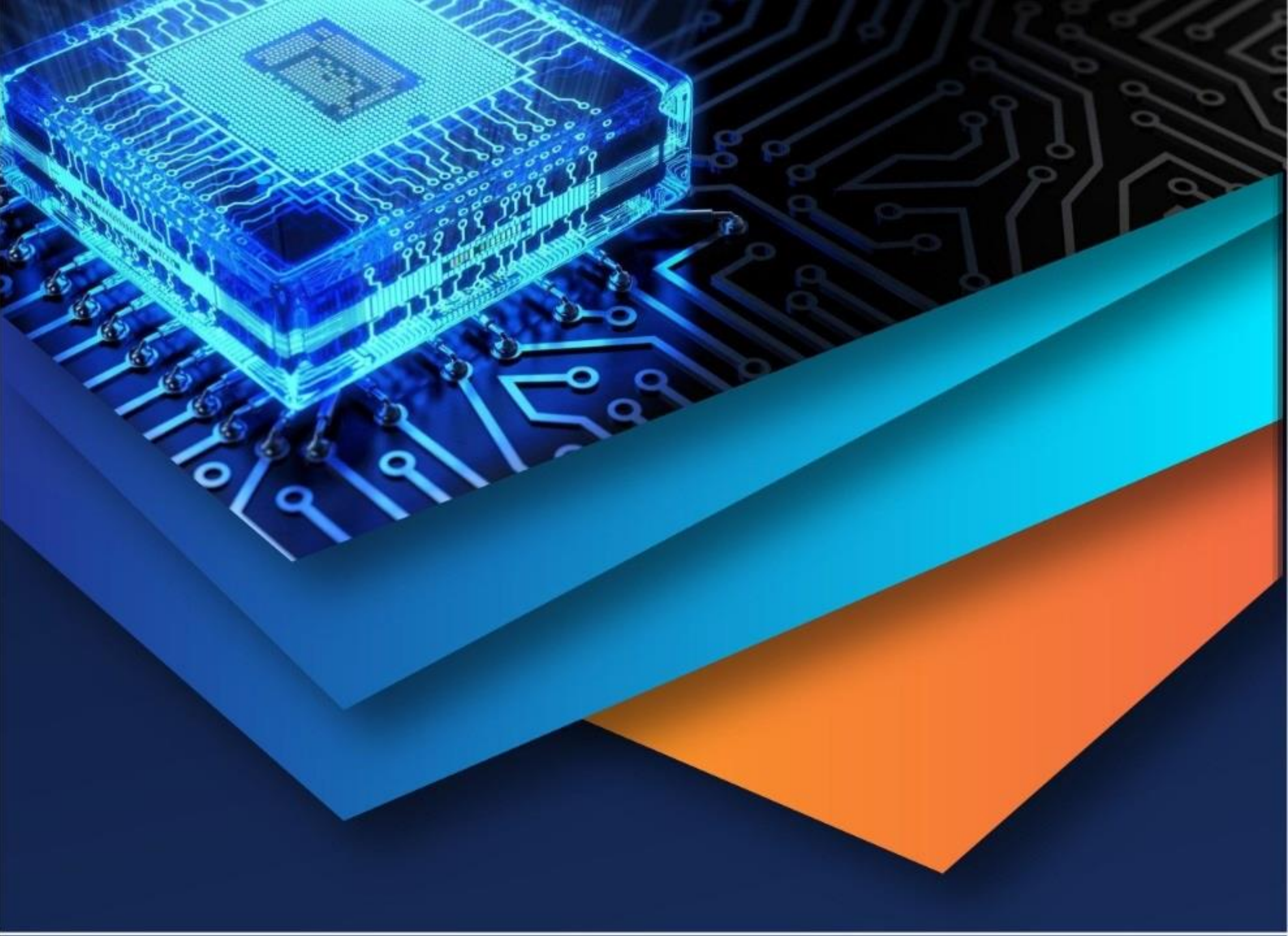

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