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Detection and Classification of Leukaemia using Artificial Neural Network

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Abstract*: Blood is the very important biological fluid present in human beings, which has various functions. Leukaemia is a blood disease which affects the normal functioning of the blood. The number of cases of leukaemia reported every year in India is approximately close to 1 million. Detection and classification of Leukaemia into its subtypes manually by humans is difficult and time consuming. Hence an automatic system to identify and classify Leukaemia may overcome this drawback. Technique proposed in this paper aims at quick detection of leukaemia images, and classifies them into their respective subtype. This is achieved using image processing with the help of MATLAB software. Images used are microscopic blood smear images. Using K- means clustering algorithm images are segmented and a Artificial Neural Network (ANN) is designed based on the features extracted. This neural network is trained to classify the images into their respective type.
Keywords*: Leukaemia, segmentation, Artificial Neural Network

I. INTRODUCTION

Leukaemia originates in the blood cells and produces a large number of abnormal white blood cells. This affects normal blood cells. And as a result ability of blood cells to fight against infections and other diseases reduces. Leukaemia has main four subtypes, which are Acute Lymphocytic Leukaemia (ALL), Acute Myelogenous Leukaemia (AML), Chronic Lymphocytic Leukaemia (CLL) and Chronic Myleginous Leukaemia (CML).

Traditionally leukaemia disease is detected manually by experts under microscope. This manual examination of the disease is time consuming, costly and totally depends on expert's knowledge and skills. Since leukaemia shows symptoms which resembles to normal minor disease it is very difficult to indentify it at very first stage. It is very important to identify it at early stages. Hence manual examination methods are not suitable.

Detection of leukaemia and its classification using an automated system may overcome the drawbacks of the traditional methods. Using a digital image processing it is possible to detect the leukaemia image and classify it into its respective type. Different types of image processing algorithms have been designed and developed to detect the leukaemia cells in the images. Microscopic blood cell images of different types of leukaemia are taken as the input to these systems. Image processing is composed of various techniques such as image pre-processing, image segmentation, feature extraction and classification. Segmentation and classification are very important steps in image processing. Classification accuracy depends on the correct segmented outputs.

This paper proposed a computer based system for correct identification of leukaemia images. K-means algorithm is used to segment the leukaemia images. Artificial neural network is designed and created for classification purpose. ANN is trained based on the features extracted from the image dataset.

Sos Agaian, Monica Madhukar, and Anthony T. Chronopoulos, in [1] suggest leukaemia image segmentation using k-means clustering algorithm. Mashiat Fatma, Jaya Sharma, in [2], proposed a system for leukaemia classification using neural network.

II. PROCESS OVERVIEW

Figure 1 shows the basic block diagram of the proposed leukaemia detection system.

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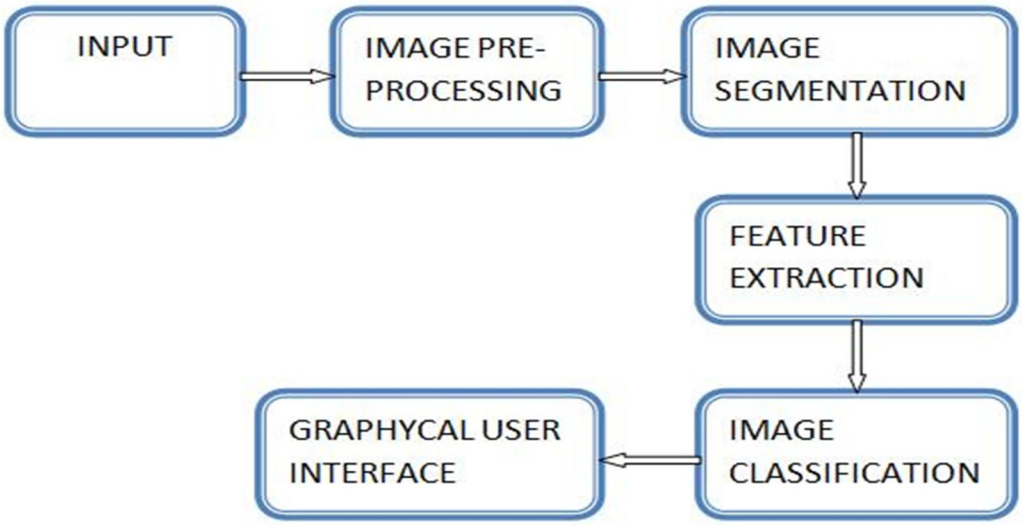

Fig.1. Basic block diagram of proposed technique.

A. Input

Digital image processing uses images as its input. These images can be real time images or pre captured stored images. Images are stored in the matrix form hence it becomes easy to work with image data in the MATLAB. In this proposed system images taken are microscopic blood smear images. These images are obtained from online database. Total 50 images are used.

B. Image Pre-Processing

Image pre-processing step is the very first step where different operations are performed on the image. At these step images are adjusted, enhanced, filtered to make the image suitable for further processing. In the proposed method image is converted to gray scale, reshaped and resized wherever it is needed. The RGB image is converted to Hue Intensity saturation (HIS) colour model. The saturation image is then used later for further processing.

C. Image Segmentation

Segmentation is the most important step in any image processing algorithm. Segmentation process aims to give only the desired part from the entire image. In this case it partitions the leukaemia cells from the rest of the image. There are various segmentation algorithms. And lot of research is going on segmentation algorithms. The accuracy of further steps that is feature extraction and classification totally depends on the segmented output. In this proposed system k-means clustering algorithm is used for segmenting the leukaemia cells.

K-means clustering divides the image into k number of clusters. This k value has to be pre-assigned in the system. In this k value is selected as 4. This value is selected for the used dataset by trying and testing. This value might change for different datasets.

D. Feature Extraction

Once image is segmented, segmented output image is used for feature extraction. Features of segmented image are extracted and used for classification. There are various types of features those can be extracted. Depending on the type of results required features are selected. In the proposed system statistical features those are extracted are energy, covariance, sum entropy, entropy, difference entropy, contrast, and correlation and information measure of correlation. These extracted features are used to train the Artificial Neural Network.

E. Classification

At this step image is classified based on the extracted features into its respective type. In the proposed system Artificial Neural Network is used as a classifier. The neural network used is feed forward network, in this case the information only moves in one direction. ANN is composed of input layer, hidden layer and output layer. It may have one or more hidden layers. Once the ANN is designed for the particular application, it is trained using relabelled dataset. It learns from different examples and once it is done it is

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ready to classify the test images. Accuracy of ANN is totally depends on the correct training. It learns from the training dataset hence the dataset has to be correct.

F. Graphical User Interface (GUI)

GUI is the tool available in MATLAB which allows code to be executed step wise. GUI makes it user friendly. And any non professional can use it easily.

III.EXPERIMENTAL RESULTS

An automated system to detect leukaemia cells and classify it into their respective type is designed and created successfully . Images are segmented using k-means segmentation algorithm. Various features are extracted successfully. Using these features a multilayer feed forward ANN network is trained. Total 38 images are used for training the ANN network. Following figures show the obtained results.

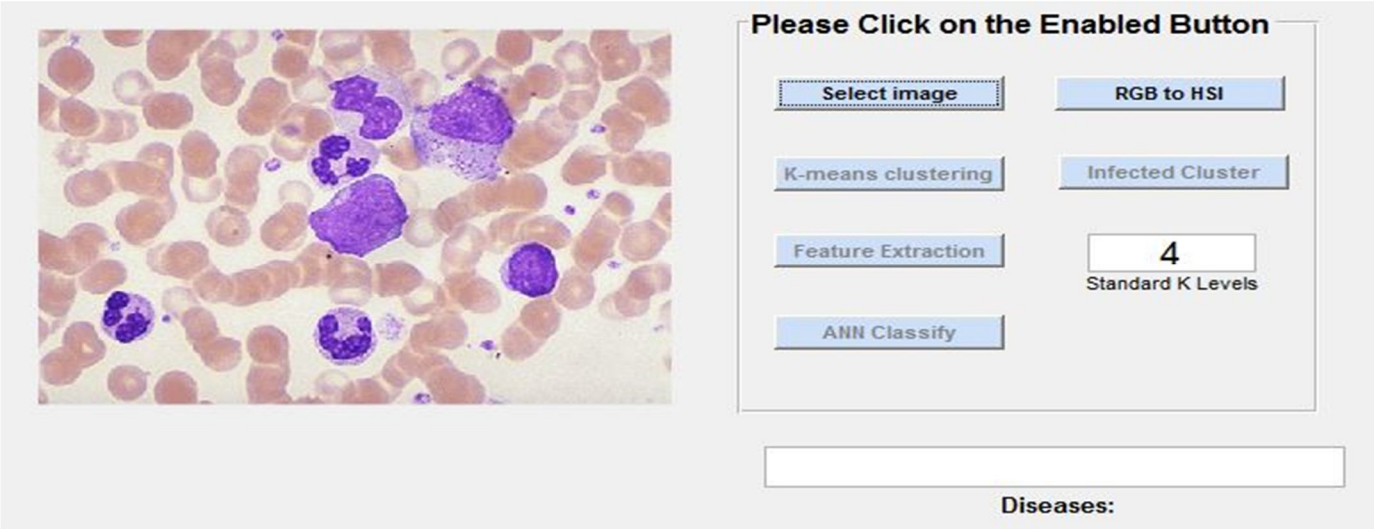

Fig.2. GUI display showing selected image

Figure 2 shows the GUI that is created for the proposed system. It has various push buttons. Once the present step is executed only then next push button enables. “Select image” allows browsing and selecting the image from the folder. Figure 2 shows the selected image. Once image is selected “RGB to HSI” button is enabled.

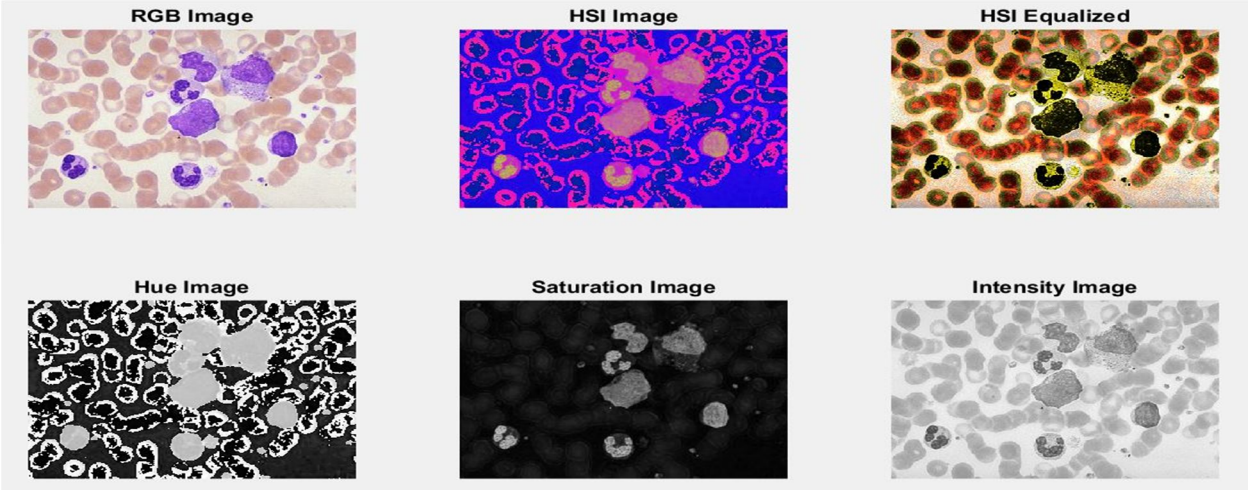

Fig.3. RGB to HSI model.

Figure 3 shows the selected image converted to HSI model. The saturation image resembles more correctly to the infected cluster. Hence it is used later to identify the cluster.

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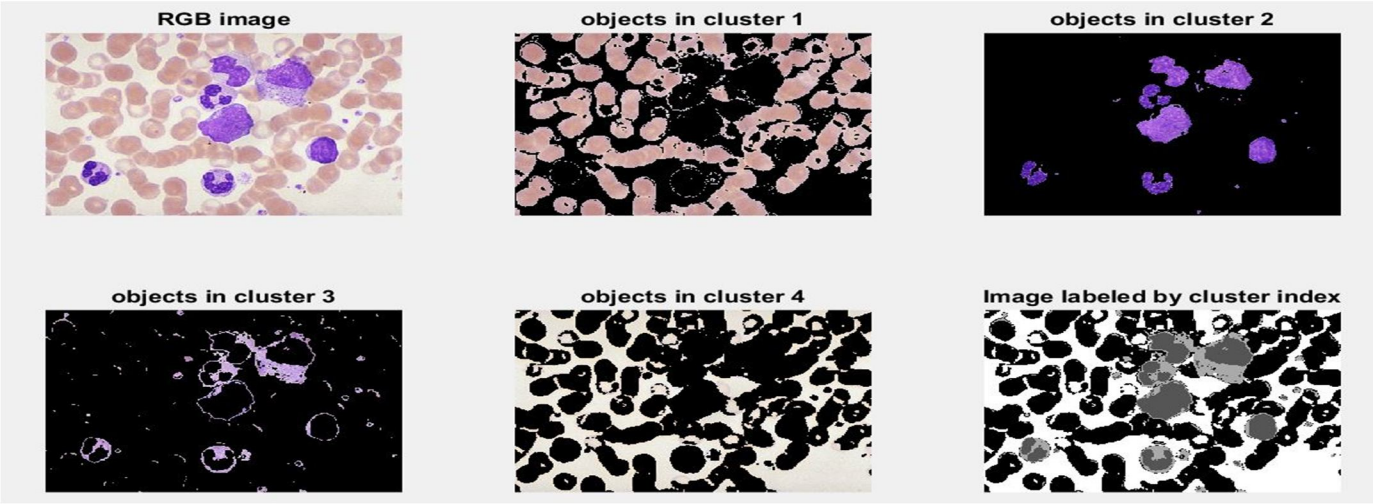

Fig.4. k-means clustering outputs (k=4).

Figure 4 shows k-means clustering output. K value is taken as 4 for the used dataset. It shows all four cluster of the selected image.

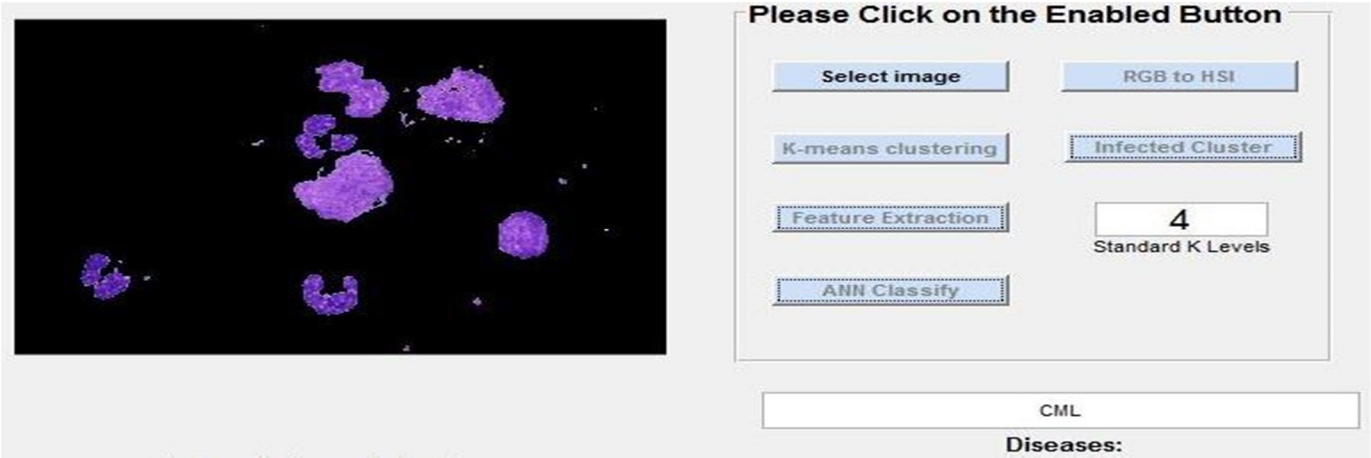

Fig.5. Detected CML cluster.

Figures 5, 6, 7 and 8 show obtained results. It shows the detected cluster and its type for four different images.

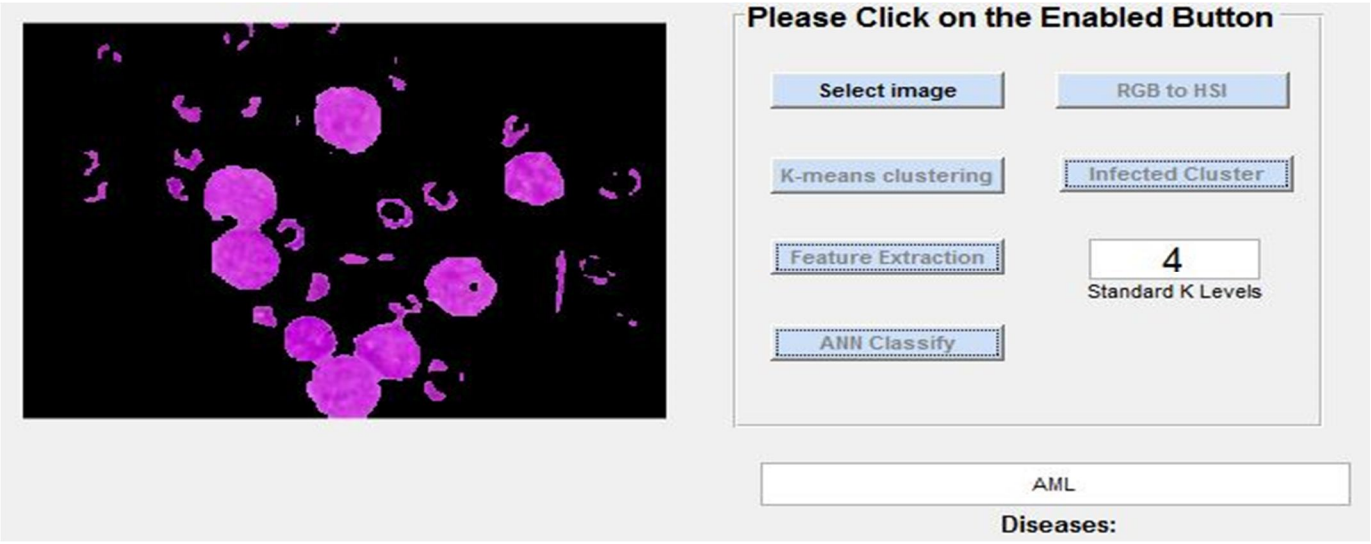

Fig.6. Detected AML image.

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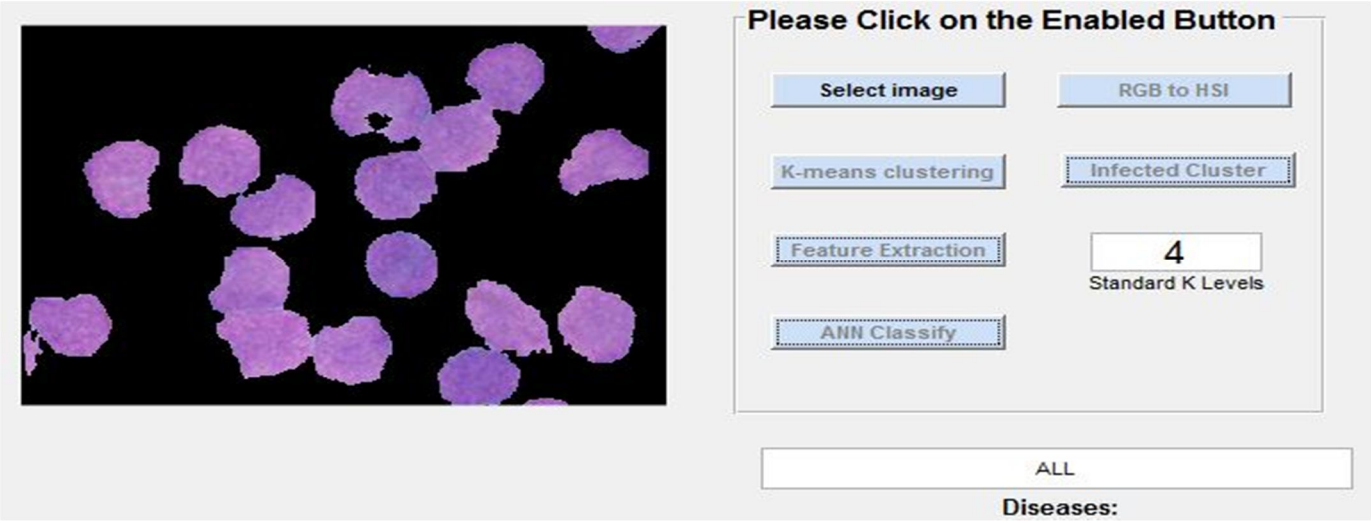

Fig.7. Detected ALL image.

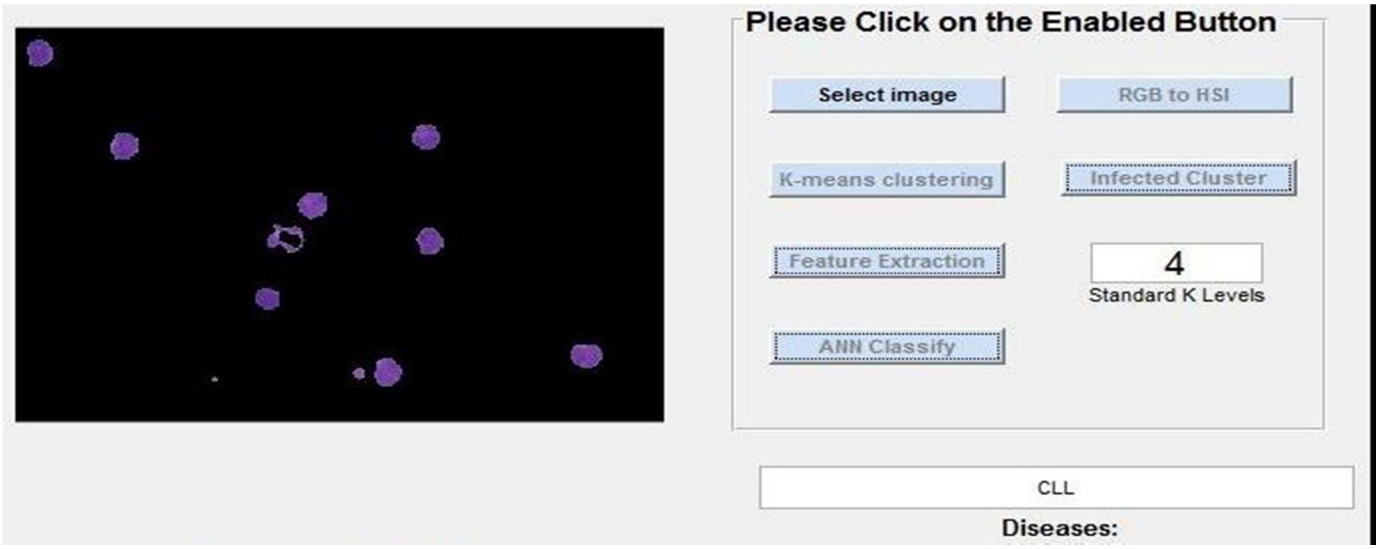

Fig.8. Detected CLL image.

IV. CONCLUSION

In this paper we have proposed a technique for detection and classification of Leukaemia into its types. For this k means clustering is used for segmentation. K value has been selected as 4. It gives 95% of segmentation accuracy for the used dataset. Various statistical features are extracted for classification purpose. ANN network is designed and trained for classification. 38 images have been used for training purpose. It gives 94.7% of classification accuracy. K-means algorithm has a drawback that it needs user to pre assign the k value. More work can be done to overcome this drawback. Larger dataset can be used and applied to the system in order to test the results. Different segmentation and classification algorithms can be used.

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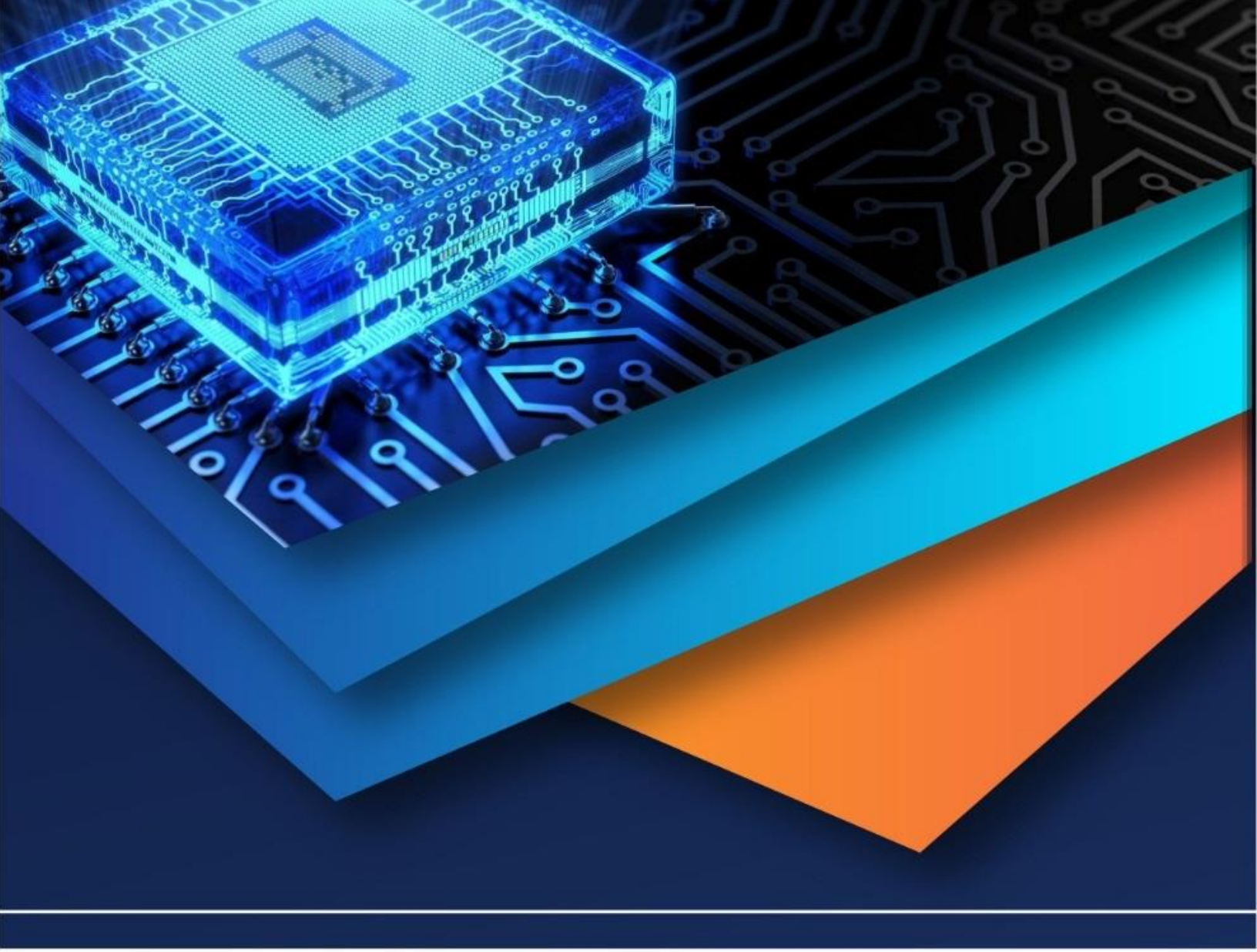

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