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Acute Mylogenous Leukemia Detection Using Blood Microscopic Images

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Abstract- Leukemia is a specific kind of cancer, where the blood cells i.e., RBC's, leukocytes or WBC's; lymphatic system or bone marrow gets affected. Blood tests aids in diagnosing blood cancer, where affected blood cells are enumerated. In this particular paper, Acute Mylogenous Leukemia (AML), which is general among adult, has been considered by us. The demand for automated detection of leukemia springs up when the medical practitioner recognize cancer cells, which is entirely manual and hence it is disadvantageous for the patients. Fully automated diagnosis system aids the medical for easier detection of the AML cells from the microscopic blood image which ameliorates the patient's endurance. Our propounded approach mainly comprises of image restoration, segmentation, texture and color feature extraction and eventually, classification is done. 30 sample images has been taken into consideration and the propounded approach managed to procure 98.6% accuracy. Eventually the procure results of our propounded approach is compared with the existing methods to show the amelioration in terms of accuracy.

Keywords- Acute Mylogenous Leukemia; microscopic blood image; image restoration; segmentation; texture; color feature extraction; classification; probabilistic neural network

I. INTRODUCTION

Image segmentation, texture features and color extraction has turned out to be an emerging, enthralling and arduous task related to the image processing field. Image segmentation plays a sententious character in analyzing medical images and for editing photos[1]. Numerous computational vision algorithm can also benefit from the presences of reliable and efficacious image segmentation methods. Let's say, numerous vision problem existing in the intermediary stages like shape from a outline, stereo shapes and object tracking could implement cluster segmentation technique masking from the rest of the scene. Numerous fully automated image analysis techniques are existing and are constantly ameliorated. On the other hand, there are a very less number of fully automated segmentation technique which can be implemented with ensured results generally. Numerous segmentation techniques were previously used which includes Otsu's segmentation and thresholding generation using automated histogram were implemented for the segmentation of WBC's from the blood images. Number of powerful techniques have been recently developed, which significantly outperforms existing methodologies in terms of the quality of segmentation.

II. ACUTE MYLOGENOUS LEUKEMIA

Acute mylogenous leukemia can be defined as a rapidly developing cancer consisting of blood and bone marrow, in which hematopoietic harbingers are seized in the early stages of development. It can also be said as the outcome of a maturational seize of the cells of the bone marrow in the premature evolution stage. In case of AML the bone marrow present in the human body generates numerous cancerous cells, which are also known as leukemic blasts. The development of these leukemic blasts comes to a halt and are not properly ameliorated, thus failing in fighting infections. These leukemic blasts results in seizing the production of normal WBC's, RBC's and platelets. This type of leukemia are also known as "mylogenous" because myeloid cells (a group of white blood cells) are affected due to it. These type of leukemia are caused due to antecedent hematologic malfunctions, environmental vulnerabilities, hereditary syndromes and prolonged usage of drugs. It is also known as acute myelocytic leukemia, acute granulocytic leukemia, or sometimes simply AML. It has been discovered that approximately 15000 people of the total countries population gets affected by this type of leukemia. The quotidian symptoms of acute mylogenous leukemia include anemia, decreased count of WBC's, decreased count of platelets, increased number of leukemic cells. AML is initially treated by the implementation of bone marrow or blood transplant.

III. RELATED WORKS

Image segmentation has got numerous application in the field of image processing .Segmentation is the technique were the input image is partitioned into various regions. Detection of Acute Mylogenous Leukemia by roughly viewing, is a deeply time engrossed process. Hence to resolve this issue, numerous researches on image segmentation has been done. Stanislaw Osowski et.al[2] has suggested the numerous pre-processing techniques of blast cells of mylogenous leukemia for developing the features in an ameliorated way.

C.D.,Ruberto, A.,Dempster, S.,Khan, B.,Jarra[3], has analyzed malarial parasite by the aid of infected blood cell images using morphological operators. F. Scotti et.al[4]has proposed a system for automatic analysis of acute leukemia identification based on the implementation of morphological operations in peripheral blood microscope images . Mohapatra , S. et.al[5],has implemented a strategy of segmenting fuzzy based blood images which aids in automatic leukemia detection.

Monica Madhukar et.al[6]has generated an automated system, which based on color and shape feature helps in classifying acute lymphoblastic leukemia . H.Ramoser et.al[7] has done extensive research on segmentation and classification of leukocyte in blood smear image. G. Ongun et.al[8],has developed a system for extracting features and classifying blood cells automatically for differential blood count system.

W.,Wongseree, N.,Chaiyaratana[9], has classified patients affected by thalassemia by the combined implementation of genetic programing and neural network. W.Shitong et.al[10] has implemented the ameliorated fuzzy based cellular neural network IFCNN for detection of WBC's. T.,Markiewicz et.al[11], has develop a system which aids in recognizing the leukemia cell by the help of bone marrow images , implementing Support Vector Machine (SVM) classifier. Ms. Minali et.al[12], has propounded an approach which aids in partitioning WBC nucleus from stained blood smear images, which is accompanied by corresponding feature extraction and classification techniques.

IV. PROPOSED METHODOLOGY

A microscope has been implemented by us for acquiring the blood cell images and have implemented MATLAB software R2009a for image processing. 30 microscopic blood cell images of various sizes have been acquired for testing. Our propounded approach ensures efficacious segmentation of blood microscopic image with 98.6% accuracy. The segmentation is carried out in the following steps which are mentioned below:-

A. Acquisition of Images

By the aid of microscope the blood images are acquired in this images are displayed in 2D matrix, where the pixels of the image are imagined as the element such matrices are entirely dependent on field of view and matrix size. Our propounded approach implements MATLAB for storing the images in a database and are displayed in Lab scale dimension of 512 *512.

Blood images have been taken from 15 female and 15 male patients, all of them lying between 60- 85 years. The blood microscopic images were procured from the tests and were stored in BMP image formats.

B. Pre-processing

In this specific phase, input image is compounded in a way such that even infinitesimal detail are ameliorated and unwanted noises are filtered commonly used noise filter methodologies are implemented which aids in the procurement of the feasible results. Conspicuous edges, sharpened image and noise reduction are the outcomes of image enhancement. Enhancement reduces the blotting out of the image and thus reduces the chances of getting twisted results from the intervening system. Eventually segmentation is also applied. This improved and fine-tune image helps in edge determination and ameliorates the overall quality of the image.

The blood microscopic images which are procured are stored in a MATLAB database and eventually transposed to LAB scale image having a dimension of 512*512; 2) further the image is processed to remove any unwanted presence of noises. 3) Eventually, the high pass filter (i.e., Gaussian Filter) works upon the refined image, which is of a higher resolution , aids in the procurement of sharpened image and also aids in edge detection.

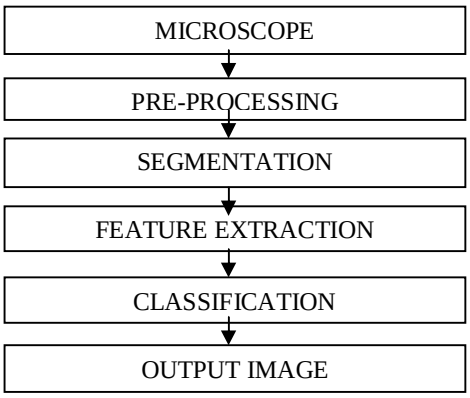


Fig. 1. Acute Mylogenous Leukemia detection phases

C. Segmentation

The technique of partitioning the image into segment can be defined as image segmentation. Considering the similar property, segmentation is implemented. This similar property are cluster together our propounded approach implements Lloyd's clustering technique which aids in the segmentation of blood microscopic images on the basis of alike properties. This technique broadens the k-mean clustering algorithm by introducing repeated segmentation scheme which explores the centroid of each set in the segment and eventually re-segment the input based on the closest centroid. This technique aids in the extraction of important image characteristics, based on which information can be easily perceived.

D. Feature Extraction

The process of defining a large set of surplus data into a feature set with a reduced dimension is known as feature extraction. The performance of classifier is greatly ameliorated by the feature selection; hence the correct feature selection becomes an important step [13]. The principle concern in generating the blood cell features is that the recognition of the various blast cells with highest accuracy is a great deal. The following features were implemented by us, which corresponds to the lymphocyte's nucleus and myelocyte's nucleus:

A. Color Features

In this scheme the color spaces corresponding to the RGB scale will be converted into HSV scale. Mean color values will be procured.

B. Texture Features

It comprises of the following:- i)energy, ii) homogeneity, iii)entropy, iv)angular second momentum, v) correlation, vi)contrast, are procured.

1) *Discrete Wavelet Transformation:* Discrete wavelet transform decomposes the image into different sub-band images, it splits component into numerous frequency bands called sub-bands. It will be applied on input image to get detailed information on texture and edge.
2) *Discriminative Robust Local Binary Pattern:* In this scheme, blood microscopic images are divided into regular cell grids and to obtain equitation histogram is implemented. Concatenation of the histogram at the last cell level generates a uniform result. LBP dependent representation are combined with some of the popular methodologies relating to the schemes of features selection so that the length of the feature set of DRLBP code are reduced. These combined representation consists of subspace learning, rule based strategies and boosting etc.

E. Classification Stage

In this particular stage, the principle concern is on the selection strategies of relevant classification technique, as it is the intriguing problem, because if an appropriate choice is given, the data available can ameliorate the accuracy in scoring of credit [14], [15]. Numerous statistical methods, which mainly focuses in solving binary classification problems, are widely available. In this specific paper, we have implemented a Probabilistic Neural Network (PNN), because the data is trained hastily and aids in data classification. The data having spikes and unwanted points. This type of networks are nothing but forward feed networks, comprising of three

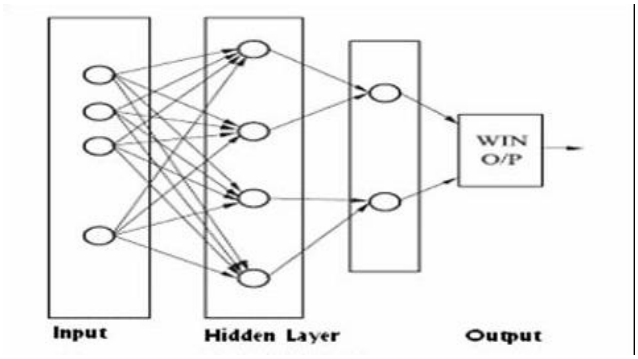


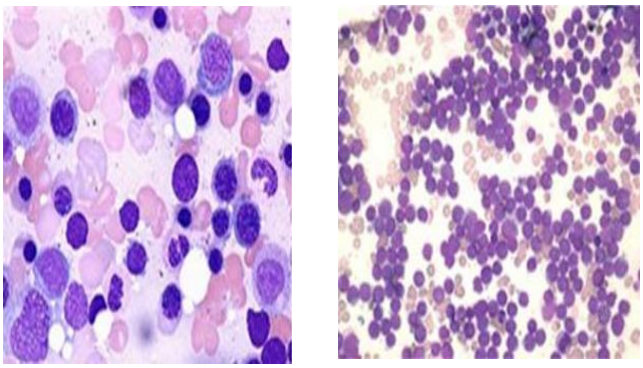
Fig. 2. PNN Architecture

layers namely input layer, hidden layer and output layer. PNN aids in training the data set quickly as the training is completed

in just only one pass of the training vector instead of using several passes. The probability density function for each and every class depending on a training set are enumerated with the aid of PNN. For each dimension present in the vector, an input image is present the hidden layer is connected to the input layer. The node present in the hidden layer enumerate the dot product of the vector which is provided as an input along with the test vector and subtracts, the value one from itself and the result obtained is divided by the square of the standard deviation.

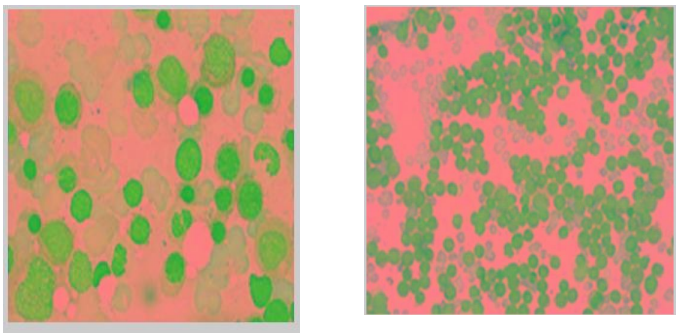
V. EXPERIMENTAL OUTCOMES

Let us consider the blood microscopic image containing the acute mylogenous leukemia cells in figure 3(a) and figure 3(b). The input image is converted into Lab scale. The outcomes are exhibited in the figure 4(a) and figure 4(b).



(a) (b)

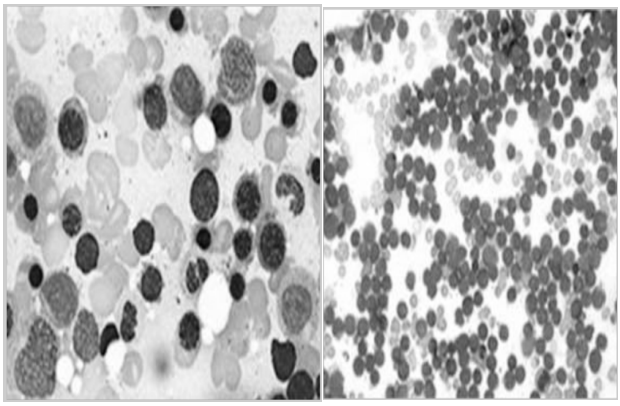
Fig. 3. Acute Mylogenous Leukemia Cell Images



(a) (b)

Fig. 4. Lab Scale Images

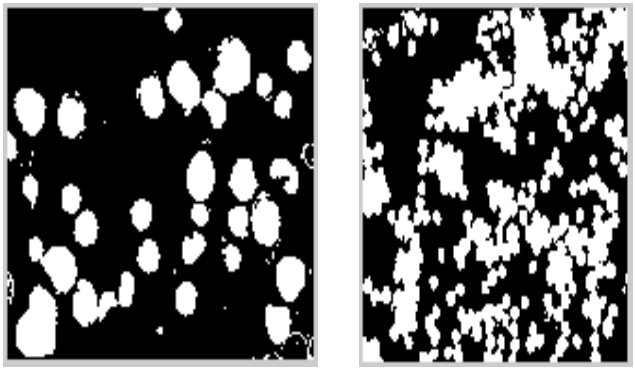
The Gaussian filtered output of the above figure(4), which is in Lab scale, is given below in figure 5 (a) and figure 5(b):



(a) (b)

Fig. 5. Gaussian Filtered Images

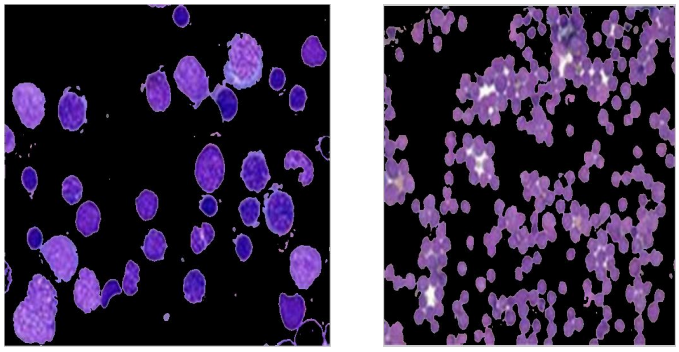
The Lloyd's Clustering algorithm is implemented on the above filtered images, whose outcome are given below in figure 6 (a) and figure 6(b):



(a) (b)

Fig. 6. Lloyd's Clustering Segmentation Outcomes

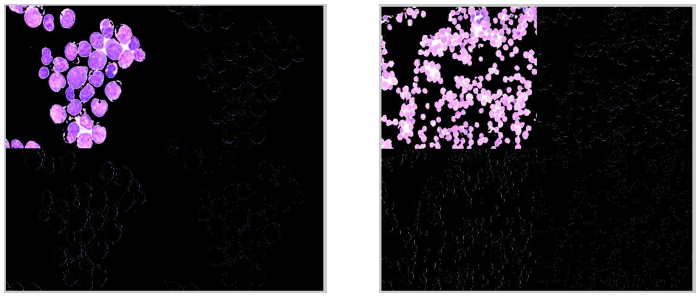
The output image obtained after the implementation of Lloyd's Clustering algorithm is masked with the original input image in the following outcome are obtained, which are displayed below in figure 7 (a) and figure 7 (b):



(a) (b)

Fig. 7. Outcomes of Masking

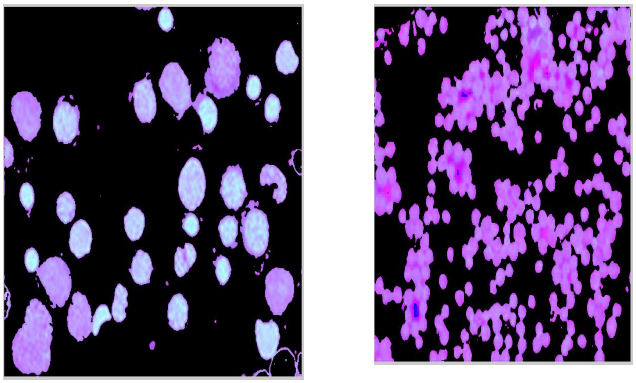
After the masking with the original image, the masked image is given to the DWT for changing the image from time domain to frequency domain for further extraction of the texture characteristics of the image using DRLBP. These outcomes are displayed below in figure 8 (a) and figure 8(b):



(a) (b)

Fig. 8. Outcomes of Discrete Wavelet Transformation

After the masking with the original image has been done, the feature extraction occurs, where it is converted to HSV scale. These outcomes are displayed below in figure 9(a) and figure 9(b):



(a) (b)
Fig. 9. Results of HSV Conversion

VI. CONCLUSION

This experiment was performed to detect Acute Mylogenous Leukemia cells by the implementation of medical imaging approaches. Image segmentation is mainly done by a technique based on Gaussian filtering and Lloyd's clustering technique. The experiments have been carried out in MATLAB. The propounded approach was tested with blood microscopic images acquired by the help of microscopy, thus precisely detecting the affected cells. In this specific paper we have implemented feature extraction methods by using DRLBP technique, which is finally classified with the help of Probabilistic neural network which helps us in detecting whether the cells are in normal or abnormal state. Our propounded approach gives more accurate and efficacious outcome when compare to other approaches. The suggested approach is easier to understand and implement.

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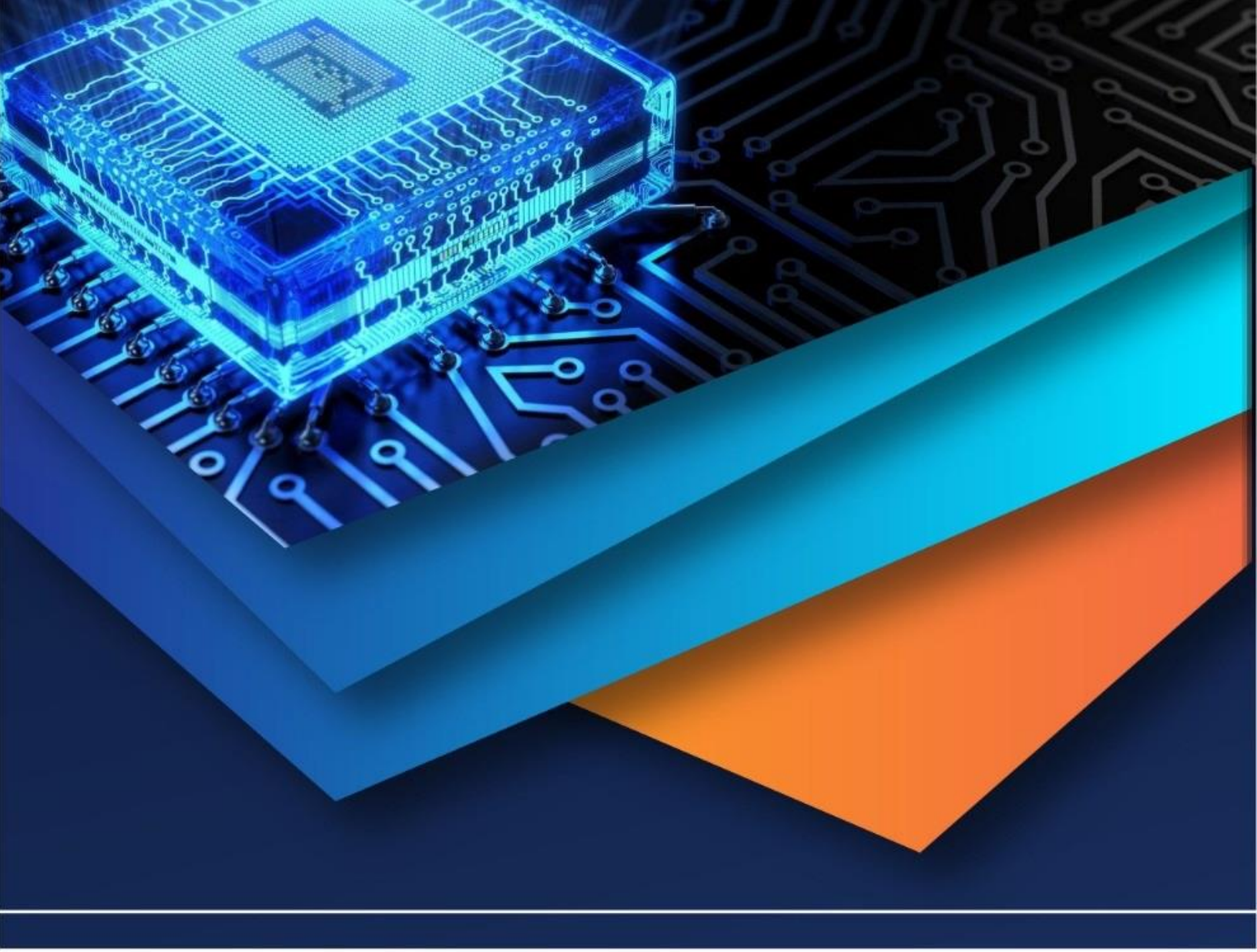

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