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Diabetic Retinopathy and Age Related Macular De-Generation Diseases Screening Using Local Binary Patterns Approach

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Abstract: This paper proposes a system to differentiate between diseased and healthy retinal images. Local binary patterns (LBP) is used as a main texture descriptor that provide generalizations to the gray scale and rotation invariant texture classification method. The goal is to analyze the texture of the retina background distinguishing between diabetic retinopathy (DR), age-related macular degeneration (AMD), and normal fundus. Experiments were designed and validated with the proposed procedure obtaining promising results. For each experiment support vector machine and neural classifiers were used. The result suggest that the method presented in this paper is a robust algorithm for describing retina texture and can be useful in a diagnosis aid system for retinal disease screening.

Keywords: Age-related macular degeneration (AMD), diabetic retinopathy (DR), diagnosis aid system, fundus image, local binary patterns (LBP), retinal image, Support Vector Machine (SVM).

I. INTRODUCTION

Age related macular degeneration and Diabetic Retinopathy are the most common retinal diseases occurring in aged people in the current society. The retina is the light-sensitive tissue in the back of the eye, when stimulated, retinal neurons send visual information to the brain. Diseases like age-related macular degeneration (AMD), diabetic retinopathy can irreparably damage or destroy these neurons, which fails to regenerate on their own. Age- related macular degeneration is a disease that blurs the sharp, central vision needed for "straight-ahead" activities such as reading, sewing and driving. AMD affects the macula, the part of the eye that allow to see the fine details. Diabetic affects blood vessels in the light-sensitive tissue called the retina that lines the back of the eye. Diabetic retinopathy involves changes to retinal blood vessels that can cause them to bleed or leak fluid, distorting vision. It is the most common cause of vision loss among people with diabetes and the leading cause of vision impairment and blondness among working-age adults. Hence these diseases need appropriate screening and diagnosis in the early stage which ignored can lead to critical conditions. In this work we propose an automatic retinal disease screening system that differentiates between the diabetic retinopathy, age related macular degeneration and normal images analyzing the texture of the retina background

II. LITERATURE SURVEY

Mookiah et al [1]In this work a different methodology for AMD characterization is done through local configuration patterns (LCP) rather than by LBP. Linear configuration coefficients and pattern occurrence features are extracted and a linear SVM is used after feature selection. The drawback of this work is it required the segmentation of exudates in addition to segmentation of main structures (optic disc and vessels) for feature extraction and, although three different classes are identified, they only focus on DR detection. Krishnan and Laude[2] In this work a system for an automated identification of normal and abnormal DR classes using digital fundus images was proposed. Local Binary Pattern (LBP), Entropies and Invariant moments were used to extract the salient features. In this work, a novel integrated index called Diabetic Retinopathy Index (DRI) is been proposed which is made up of different features, to diagnose the unknown class using a single number. The drawback of this work is it do not need previous segmentations but only handle with a disease at time, in particular with DR and AMD diagnosis. Garnier et al. deal[3]In the work a preliminary study for AMD detection from color fundus photographs is presented using a multiresolution texture analysis. The texture is analyzed at several scales by using a wavelet decomposition in order to identify all the relevant texture patterns. Textural information is captured using both the sign and magnitude components of the completed model of Local Binary Patterns. An image is finally described with the textural pattern distributions of the wavelet coefficient images obtained at each level of decomposition.

A Linear Discriminant Analysis is used for feature dimension reduction, to avoid the curse of dimensionality problem, and image classification. This approach shows promising results at low costs that in agreement with medical experts as well as robustness to both image quality and fundus camera model. The drawback of this work is it did not provide values to determine the accuracy of the normal and DR discrimination. T. Ojala, M. Pietikinen, and T. Menp [4] In the this work presents a theoretically very simple yet efficient multiresolution approach to gray scale and rotation invariant texture classification based on local binary patterns and nonparametric discrimination of sample and prototype distributions. The method is based on recognizing that certain local binary patterns termed ‘uniform’ are fundamental properties of local image texture, and their occurrence histogram proves to be a very powerful texture feature, a generalized gray scale and rotation invariant operator presentation is derived that allows for detecting the ‘uniform’ patterns for any quantization of the angular space and for any spatial resolution, and present a method for combining multiple operators for multiresolution analysis. The proposed approach is very robust in terms of gray scale variations, since the operator is by definition invariant against any monotonic transformation of the gray scale. Another advantage is computational simplicity, as the operator can be realized with a few operations in a small neighborhood and a lookup table. The drawback of this work is the built in spatial support of operators is inherently larger, as only a limited subset of patterns can reside adjacent to a particular pattern and operators may not be suitable for discriminating textures where the dominant features appear at a very large scale. Zhenhua Guo, Lei Zhang, David Zhang [5] In this work Local or global rotation invariant feature extraction has been widely used in texture classification. Local invariant features, e.g. local binary pattern (LBP), have the drawback of losing global spatial information, while global features preserve little local texture information. This work proposes an alternative hybrid scheme, globally rotation invariant matching with locally variant LBP texture features. Using LBP distribution, the principal orientations of the texture image are first estimated and then they are used to align LBP histograms. The aligned histograms are then in turn used to measure the dissimilarity between images. A new texture descriptor, LBP variance (LBPV), is proposed to characterize the local contrast information into the one-dimensional LBP histogram. LBPV does not need any quantization and it is totally training-free. To further speed up the proposed matching scheme, a method to reduce feature dimensions using distance measurement is been proposed. The experimental results on representative databases show that the proposed LBPV operator and global matching scheme can achieve significant improvement, sometimes more than 10% in terms of classification accuracy, over traditional locally rotation invariant LBP method. The main drawback of the proposed matching schemes is relatively big feature size. When the number of models increases, comparison takes longer time. T. Ojala, M. Pietikinen, and T. Menp[6] In the work this work presents generalizations to the gray scale and rotation invariant texture classification method based on local binary patterns. a generalized presentation that allows for realizing a gray scale and rotation invariant LBP operator for any quantization of the angular space and for any spatial resolution is been derived and a method for combining multiple operators for multiresolution analysis is presented. The proposed approach is very robust in terms of gray scale variations, since the operator is by definition invariant against any monotonic transformation of the gray scale. Another advantage is computational simplicity, as the operator can be realized with a few operations in a small neighborhood and a lookup table. Even though the results for multiresolution analysis generally exhibit improved discrimination over single resolutions, the drawback is that they also serve as a welcome reminder that the addition of inferior operator does not necessarily enhance the performance. T. Ahonen, A. Hadid, and M. Pietikainen[7]This work presents generalizations to the gray scale and rotation invariant texture classification method based on local binary patterns. a generalized presentation that allows for realizing a gray scale and rotation invariant LBP operator for any quantization of the angular space and for any spatial resolution is been derived and a method for combining multiple operators for multiresolution analysis is presented. The proposed approach is very robust in terms of gray scale variations, since the operator is by definition invariant against any monotonic transformation of the gray scale. Another advantage is computational simplicity, as the operator can be realized with a few operations in a small neighborhood and a lookup table. Even though the results for multiresolution analysis generally exhibit improved discrimination over single resolutions, the drawback is that they also serve as a welcome reminder that the addition of inferior operator does not necessarily enhance the performance. L. Nanni, A. Lumini, and S. Brahnam [8]This work focuses on the use of image-based machine learning techniques in medical image analysis. Variants of local binary patterns (LBP) are presented, which are widely considered the state of the art among texture descriptors, a detailed review of the literature about existing LBP variants has been provided and the most salient approaches are discussed along with their pros and cons, new experiments are reported using several LBP-based descriptors and a set of novel texture descriptors has been proposed for the representation of biomedical images. The standard LBP operator is defined as a grayscale invariant texture measure, derived from a general definition of texture in a local neighbourhood. Variants are obtained by considering different shapes for the neighbourhood calculation and different encodings for the evaluation of the local gray-scale difference. These sets of features are then used for training a machine-learning classifier (a stand-alone support vector machine).The drawback of this work is the concatenation among histograms obtained varying few parameters leads to a high correlations among features.

III. METHODOLOGY

In this work local binary patterns method is used for texture description Local binary patterns (LBP) operators are powerful means used for texture description. Image pixels are labeled using the original version of the operator, the 3 × 3 neighborhood of each pixel are thresholded by the center value and thresholded values are summed weighted by powers of two. Each bit pattern is circularly rotated to the minimum value to obtain the original rotation invariant LBP operator.

SVM and neural network classifiers are used to train the system. SVMs (Support Vector Machines) technique is most useful for data classification. Data is separated into training and testing sets involving classification task. Each instance in the training set contains several attributes (i.e. the features or observed variables or the features) and one \target value" (i.e. the class labels). When the test data attributes are given the target values of the test data are predicted by SVM model (based on the training data). A Support Vector Machine (SVM) is a discerning classifier precisely characterized by a separating hyper plane, the algorithm outputs an optimal hyper plane that categorizes new problems based on the supervised learning given labelled training data.

In neural networks learning technique, in advance the patterns that are to be recognized are known and the input values of the training set are classified with desired output. In before, the weight initialization is done with random values. In turn the perceptron is provided with each training set. The desired output is obtained by comparing the output from the perceptron to every input set. More than two classes are represented using a perceptron structure and a learning rule is defined for the network using the multi-layer perceptron or multi-layer feed forward network model. Each layer that is been divided into input layer, the hidden layer and the output layer gives the input to the next.

The methodology used here is as shown in Fig.1.

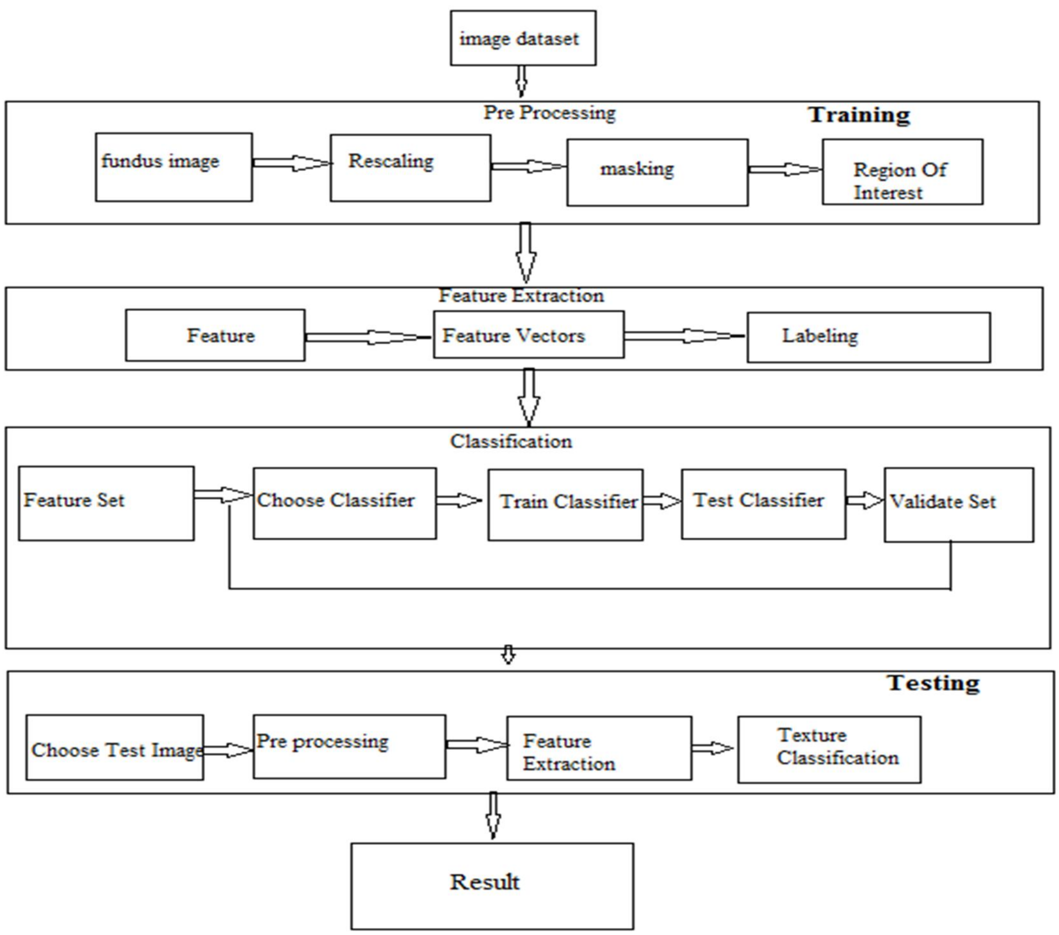

Fig.1 System Architecture

A. Pre-Processing

In this module, Image datasets composed of images from different databases are obtained and subsets are generated from each dataset with age related macular degeneration, normal, and diabetic retinopathy. Dataset images with salt and pepper noise, doubtful diagnosis, vascular network, images with highlights around the vessels associated with young retinas are excluded as they do not comply with certain quality criteria.

B. Feature Extraction

In this module, Local binary patterns are used for texture description, the images are resized to a standard size to obtain comparable local binary pattern texture descriptors in the preprocessing stage. The local binary patterns (LBP) and rotation invariant local variance (VAR) operators are used to characterize the texture of the retina background, in the feature extraction different statistical information is extracted from histograms to use it as features in the classification stage.

C. Classification

In this module, the feature set is obtained and the classifier is trained for classification by support vector machine and neural network classifier. The neural network classifier is used as an advanced classifier. A final classifier is made using the whole model set for feature subset selection and thereafter the whole model set is used for training the classifier. Classification divides the spectral or spatial feature space into several classes based on a decision rule to extract the pixels to be used for training the classifier to recognize certain categories or classes and determine the discriminant functions in the feature space.

D. Testing

In this module, the test dataset is selected with test images having diabetic retinopathy, age related macular degeneration and normal images, and the validation set is tested on the final classifier to obtain the results.

IV. EXPERIMENTAL RESULTS

The system is made to learn from the training data, the test data is fed to the system, then the test data generates the result for test data to measure accuracy of prediction and then with outcome as whether the person is suffering from the disease or normal.

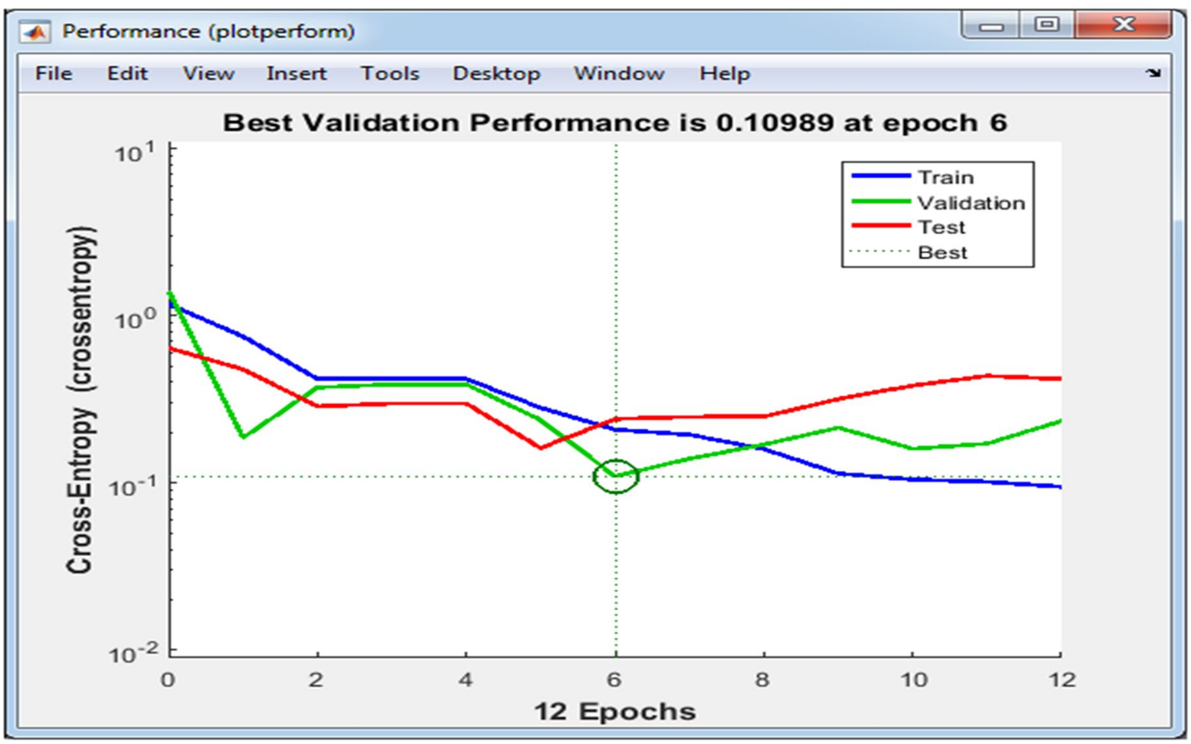

Fig.2 The performance graph of neural classifier

TABLE I. CONFUSION MATRIX FOR SUPPORT VECTOR MACHINE

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Class	Normal	Diseased
Normal	5	1
Diseased	0	22

TABLE II. CONFUSION MATRIX FOR NEURAL NETWORK CLASSIFIER

Class	Normal	Diseased
Normal	6	0
Diseased	0	22

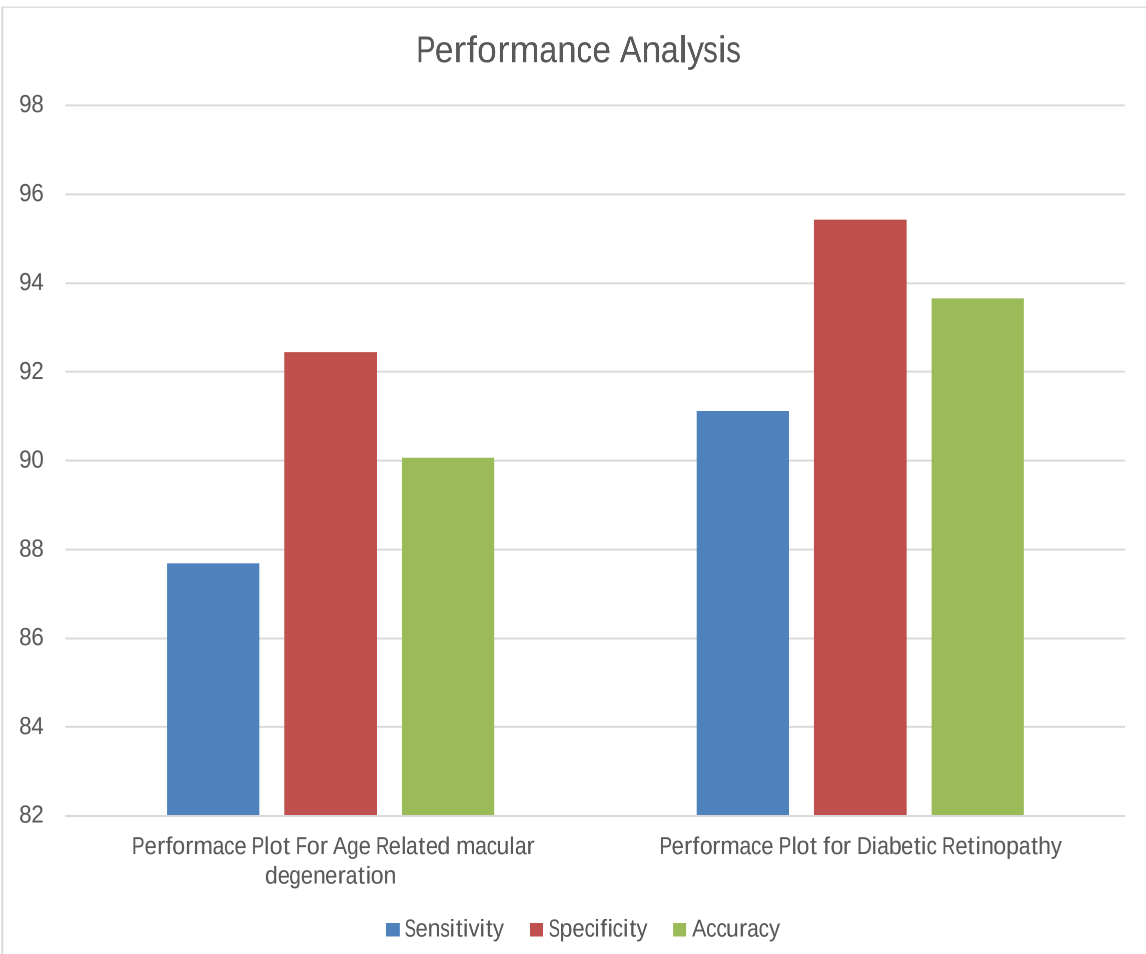

Fig.3 Performance Plot for age related macular degeneration and diabetic retinopathy

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V. CONCLUSION

In this study, an automatic disease screening software is developed for identifying and distinguishing the AMD, DR and normal images. LBP is used as a main texture descriptor for feature extraction which makes it a better approach compared to other methods due the availability of a large number of features, the diabetic retinopathy stages are predicted for identifying the disease severity, the system is made to learn from the training data and is tried with another set of data of testing phase with support vector machine and neural network classifiers for guaranteeing the systems legitimate working. As a future work, a multi stage classification can be implemented to identify the severity of diseases and also must be worked on more datasets.

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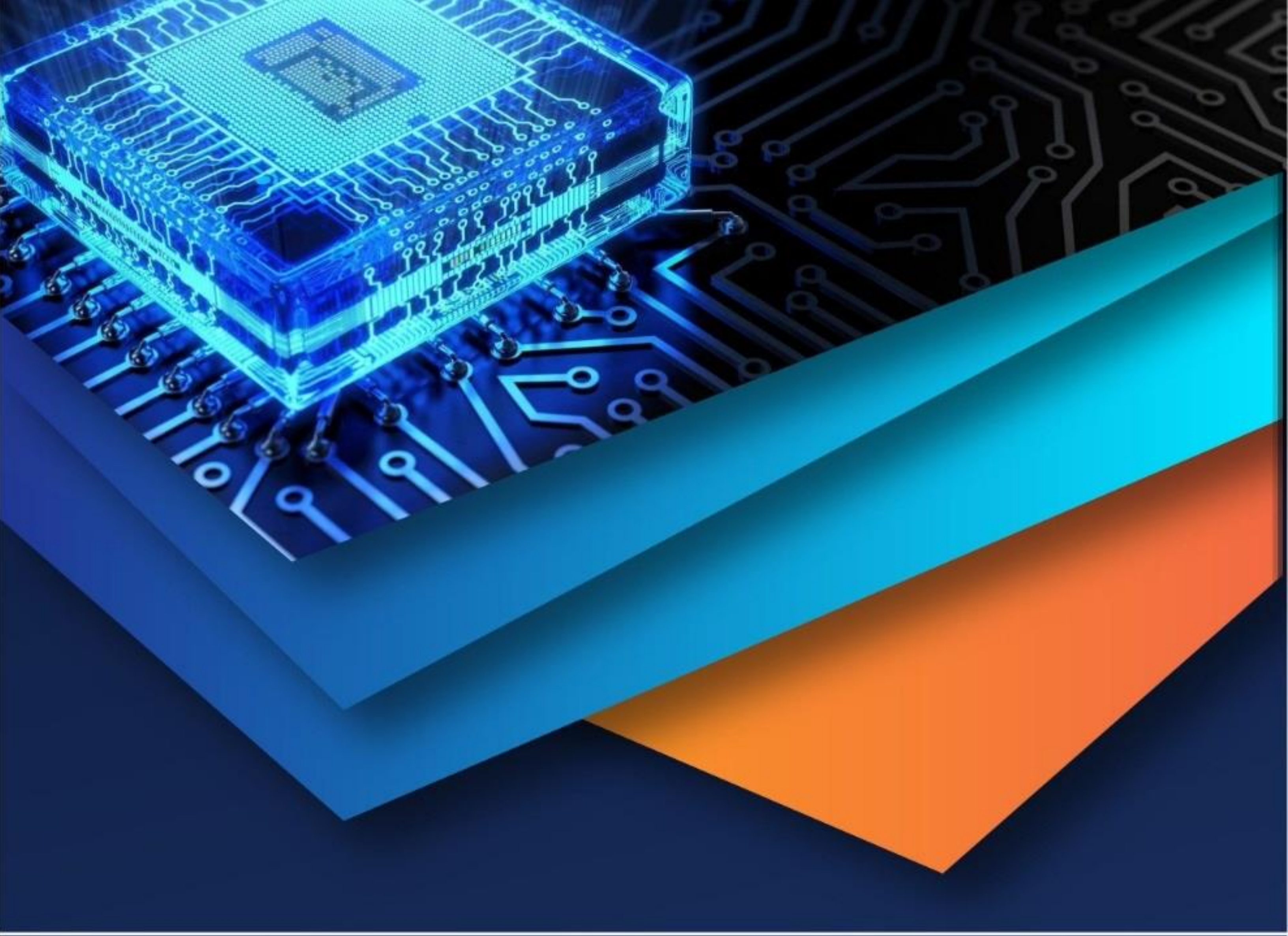

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