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EEG Signal Classification and Drowsiness Detection in Driver

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Abstract: traffic accidents are increasing due to driver's consumption of alcohol or due to drowsiness. Breathalyzers are used for the purpose of alcohol detection, these device measure the amount of alcohol rather than loss of function caused by alcohol. In this paper people were tested and determined whether they were alcoholic or not with the help of eeg data. Based on the features extracted from wavelet transform, we can classify using svm the given eeg signal contains the alcoholic content or not. Along with the alcoholic detection the condition of the driver was also monitored. I.e., the driver fatigue monitoring system using image processing algorithms such as viola-jones detection, clahe, haar wavelet. We can recognize the fatigue condition and drowsiness condition by processing on the captured images of driver's face. Depending on the eye's position or yawning of the driver we can predict that he is in drowsy state or not.

Keywords: svm,viola-jones detection algorithm ,clahe,haar wavelet transform

I. INTRODUCTION

The excessive consumption of alcoholic beverages is an important social and medical problem. This problem causes adverse social and economic effects on the individual drinker, the drinker's immediate environment and society as a whole. Indeed, other people rather than the drinker can be affected for example, by related traffic accidents or violence. Depending on the amount used alcohol can reduce coordination, slow reflexes and lead to over confidence. Alcohol also depresses parts of the central nervous system it slows down some of brain functions. Nowadays, testing for alcohol consumption is done using a breathalyzer test. Ethyl alcohol can also be measured in blood sample, urine, or in saliva.

In reality, the signals received from human brain contain information about the person's current status. The signals received from drunk people change in a certain range of frequency. Thus, alcohol's impact on human behavior can be detected much more clearly than using only breathalyzers. the measurements of the EEG signals can be made much easier and therefore much more accurate results can be obtained.

Drowsiness is transition state between awaking and sleep during which a decrease of vigilance is generally observed. Drowsy driver detection system is one of the potential applications of intelligent vehicle systems. These image-processing based methods detect eye-activity changes or Yawning and can achieve a satisfactory recognition rate.

drivers EEG signal is detected first, if EEG detection results driver is in alcoholic state then warning is given which could help to prevent many accidents and consequently save money and reduce personal suffering. if EEG detection results driver is not in alcoholic state then driver's drowsiness detection is monitored .

Recently driving safely has received increasing attention of the public's due to the growing number of traffic accidents. Drivers' fatigue has been implicated as a causal factor in many accidents because of the marked decline in the drivers abilities of perception, recognition and vehicle control abilities while sleepy. The National Highway Traffic Safety Administration(NHTSA) conservatively estimates that 1,00,000 police reported crashes are the direct results of driver fatigue each year. This results in an estimated 1550 deaths, 71,000 injuries and $12.5 billion in monetary losses.Although many governments and vehicle manufacturers try to make policies to prevent such accidents including strategies to address rates of speed, alcohol consumption, promotion of using helmets and seat belts, enhancements of vehicle structures, etc., the knowledge and technologies available today are still not yet enough to prevent the catastrophic incidents resulted from loss of alertness and lack of attentions on drivers intrinsically.

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II. EEG SIGNAL CLASSIFICATION

Through the measurement of EEG signals we can predict the condition of the person such that whether he intake any alcoholic drinks or not. This is done based on the extracted features from the EEG signals. The steps for EEG signal classification are,

Input EEG signal
Wavelet decomposition
Vector of reconstructed coefficients
Feature extraction
Classification using SVM

A. Wavelet Analysis

The signal Analysis and Image Analysis are comes under wavelet analysis. Since we are considering EEG signal as the main source. The proposed process comes under signal Analysis. The Multi-level 1D wavelet decomposition is performed using a wavelet family named Daubechies-8(db8). The output decomposition structure contains the wavelet decomposition vector C and the bookkeeping vector L.

Syntax:

[C,L] = wavedec(X,N,'wname')

It returns the wavelet decomposition of the input EEG signal X at level 8. The detail and approximate coefficients are extracted from the wavelet decomposition structure.

D = detcoef(C,L,N) computes the detail coefficients of 1-D signal

A=appcoef(C,L,’wname’,N) computes the approximation coefficients of 1-D signal.

Where,

X is the input signal
N is the number of decomposition levels
wname is the wavelet family name
C-waveet decomposition vector
L-bookkeeping vector
D-detail coefficients
A-approximation coefficients

B. Feature Extraction Using Wavelet

We extracted the features such as Gamma, Beta, Alpha, Theta and Delta from the wavelet output. we reconstruct the coefficients of a one-dimensional signal from the wavelet decomposition structure and either a specified wavelet name.

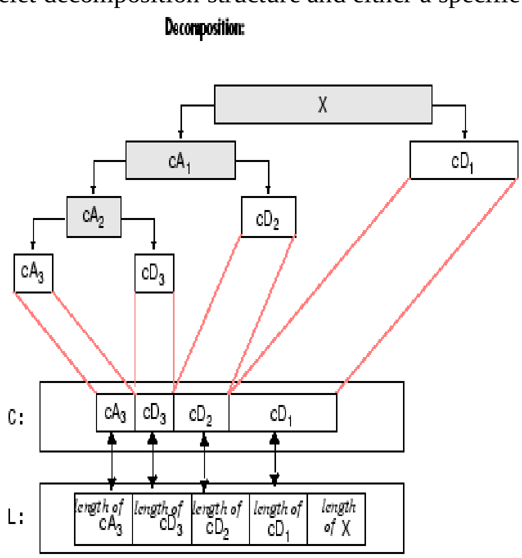

Fig 1: Multi-level 1D wavelet decomposition for 3 levels

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Syntax:

X = wrcoef('type',C,L,'wname',N)

C-wavelet decomposition vector

L-bookkeeping vector

'wname'-wavelet family name

N is the number of decomposition levels

X-vector of reconstructed coefficients

'type'-d(detail)

'type'-a(approximation)

The Fast Fourier Transform (FFT) is applied to the detail coefficient after subtracting the mean or best-fit line from the time-series object. It is usually done for FFT processing.Then the output graph is displayed between frequency in X-axis and FFT applied feature output such as Gamma, Beta, Alpha, Theta and Delta in Y-Axis.

C. Classification Using Svm Algorithm

Among the five features, Gamma and Alpha are selected as the best features. These feature values of all the EEG signals are given as the trained input. There are totally 2 Groups we are going to classify, Normal or Alcoholic person. The feature values of the selected test image are considered as the testing feature. These all three are the input to SVM classifier. SVM classifier will train the values and classify that the given EEG signal belongs to Normal Person or Alcoholic person.

III. DROWSINESS DETECTION

The drowsiness condition of the driver is detected and classified based upon the condition of the driver. The drowsiness is identified when the eyes of the driver becomes close state for more than five seconds and also if he is in yawning mode. We are giving the different images of driver as the input. Based on the extracted features, we can classify that the driver is in normal state or drowsy state. The steps are as follows,

A. Face Detection

The Face image of the driver is detected using viola-jones detection algorithm. The non-face area is not detected. Then we can extract the detected face area separately.

B. Rgb To Gray Conversion

The face image was in RGB format. The input image was converted into different channels i.e., Red band, Green band and Blue band separately. If it was in 3-channel format (24 bits/pixel) we can convert the RGB image into grayscale image using RGB to gray conversion. Image Resizing process also done if needed.

C. Image Enhancement Using Clahe

The images are noisy with rotational and translational variations. To remove these variations, it is subjected to preprocessing steps. This process is called as Image enhancement. The image is enhanced by using Contrast Limited Adaptive Histogram Equalization (CLAHE) for better visualization.

Contrast Limited Adaptive Histogram Equalization (CLAHE) is used to expand the pixel value distribution of an image so as to increase the contrast information. The histogram after the histogram equalization occupies all the range from 0 to 255 and the visualization effect is enhanced.

D. Haar Wavelet Transform (Dwt)

A signal can be deteriorated into numerous shifted and scaled representations of the first mother wavelet. A wavelet transformation can be utilized to break down a signal into part wavelets. When this is done the coefficients of the wavelets can be decimated to expel a portion of the subtle elements. Wavelets have the considerable point of preference of having the capacity to distinguish the little subtle elements in a signal. Mini wavelets will be utilized to segregate tiny points of interest in a signal, while bigger wavelets can distinguish crude points of interest. Also, there are a wide range of wavelets to look over. In the proposed algorithm we used Daubechies-1 (db1) wavelet transform which is similar to haar transforms. It selects only approximation coefficients and withdraws horizontal, vertical and diagonal coefficients. Hence reduces the converging time of tracking algorithm as shown in figure3.1. Two dimensional wavelet decomposing is shown in figure 3.2.

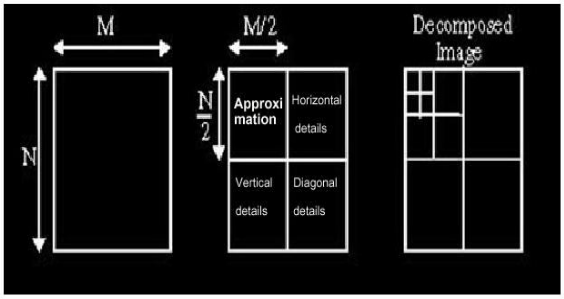

Fig 2: Wavelet Decomposition

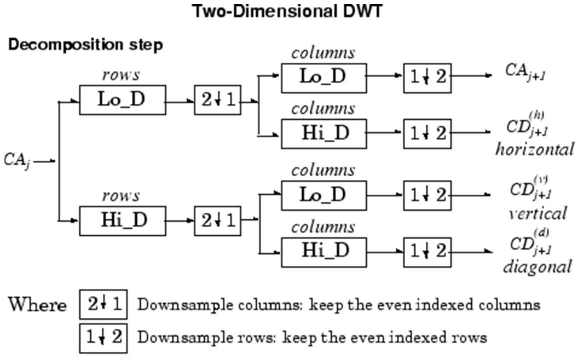

Fig 3: Wavelet Decomposing stage

E. Shape Feature Extraction

The shape properties of regions of the image are measured. Many features such as Area, Major Axis length, Minor Axis length, Eccentricity etc are extracted. Among them, the Area is selected as the best feature and it is extracted.

F. Classification

Based on the extracted feature values, the driver state is classified as Normal state or drowsy state. If the eyes of the driver are closed for more than a few seconds or if he is yawning, then it is classified as drowsy state.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The drivers EEG signal is detected first, if EEG detection results driver is in alcoholic state then warning is given which could help to prevent many accidents and consequently save money and reduce personal suffering. if EEG detection results driver is not in alcoholic state then driver's drowsiness detection is monitored.

The Input EEG signal is given ,its frequency measurement gives gamma and alpha frequencies which is trained using SVM to calssify whether the given EEG belongs to alcoholic or non alcoholic person.

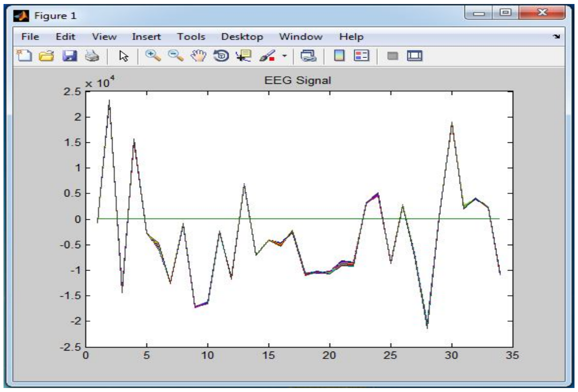

Fig 4: Input EEG signal

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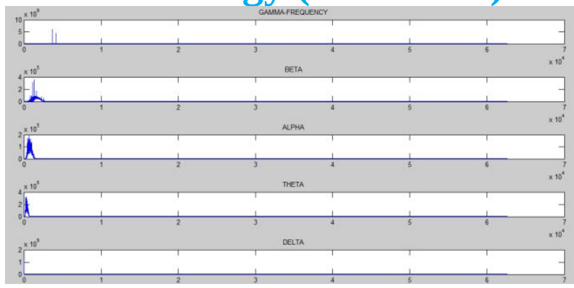

Fig 5: Frequency Measurements

Fig 6: EEG signal of a Abnormal person

The above EEG belongs to a alcoholic person .So we warn the Driver.Now,we choose EEG of a non alcoholic person so that drowsiness detection can be done.We give Driver's Face as input and by using image processing algorithm we classify whether the driver is in Drowsy state or not

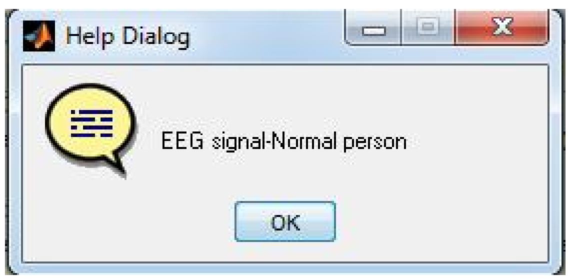

Fig 7: EEG signal of a Normal person

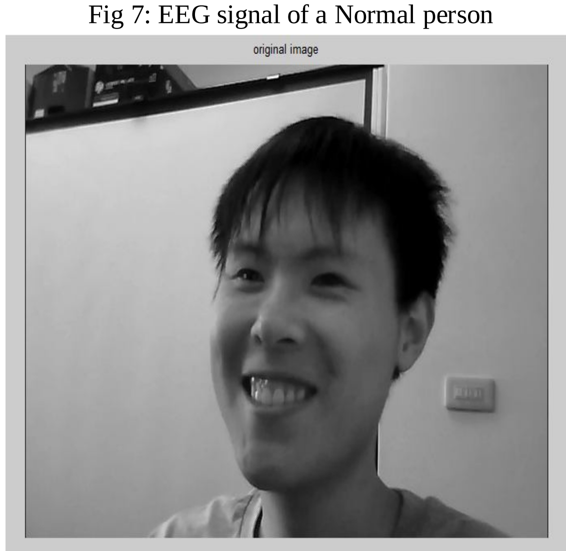

Fig 8: Input Image

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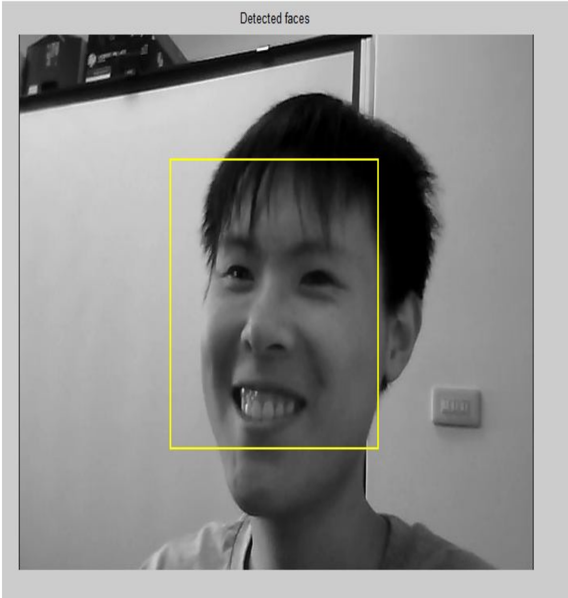

Fig 9:Face Detection

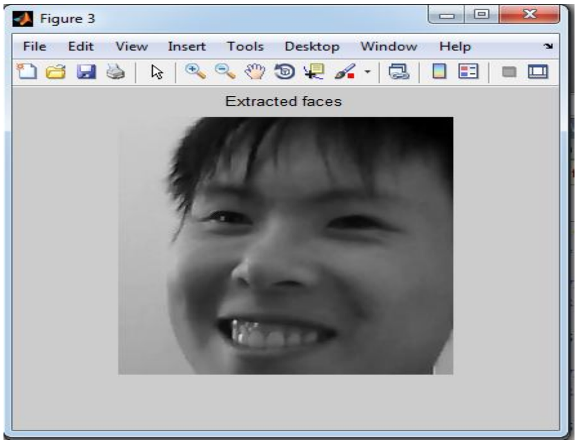

Fig 10:Face Extraction

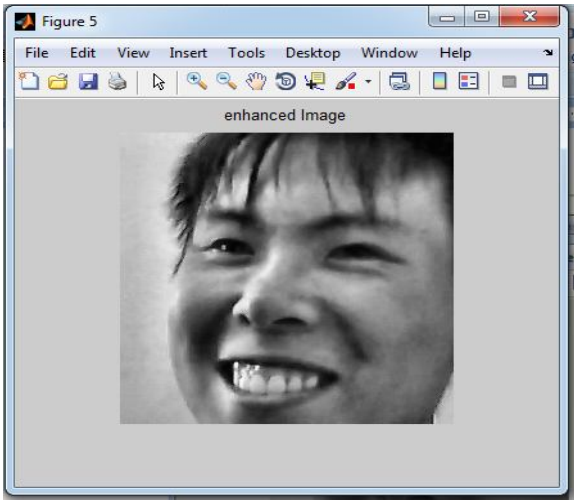

Fig 11:Enhanced Image

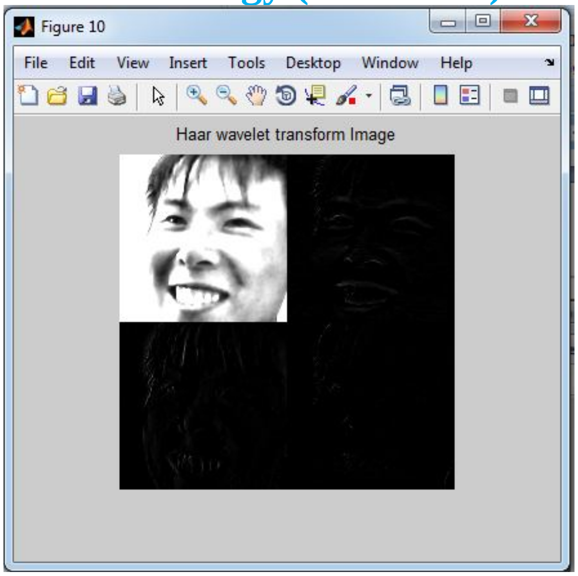

Fig 12:Haar Image

Fig 13:Driver is in Active mode

Based on the input images selected,the classification results Driver is in active or sleepy or in yawning mode.if the driver is in Sleepy and Yawning mode warning is given to avoid accidents.

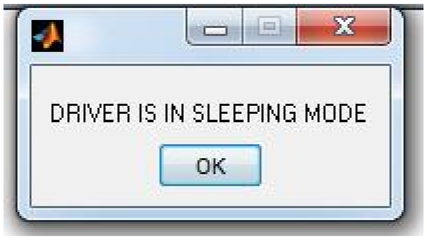

Fig 14:Driver is in Sleepy mode

V. CONCLUSION

In this presented article, we demonstrated the overall system is divided into two main modules such that Alcoholic detection using EEG signals and Drowsiness detection using driver images to control the accidents and its consequences. The processes involved are preprocessing, image enhancement, feature extraction and classification. This system has taken more advantage than the existing system such that here we are integrating the alcohol detection and drowsiness detection. Alcoholic person detection and classification of normal person and alcoholic person is done using signal processing techniques and classification of normal state and drowsiness state of driver is classified using image processing techniques

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VI. FUTURE WORK

A real-time wireless EEG-based brain–computer interface (BCI) system for drowsiness detection. The proposed BCI system consists of a wireless physiological Signal-acquisition module and an embedded signal-processing module. Here, the wireless physiological signal-acquisition module is used to collect EEG signals and transmit them to the embedded signal-processing module wirelessly. The embedded signal processing supports various peripheral interfaces, is used to real-time detect drowsiness and trigger a warning tone to prevent traffic accidents when drowsy state occurs.

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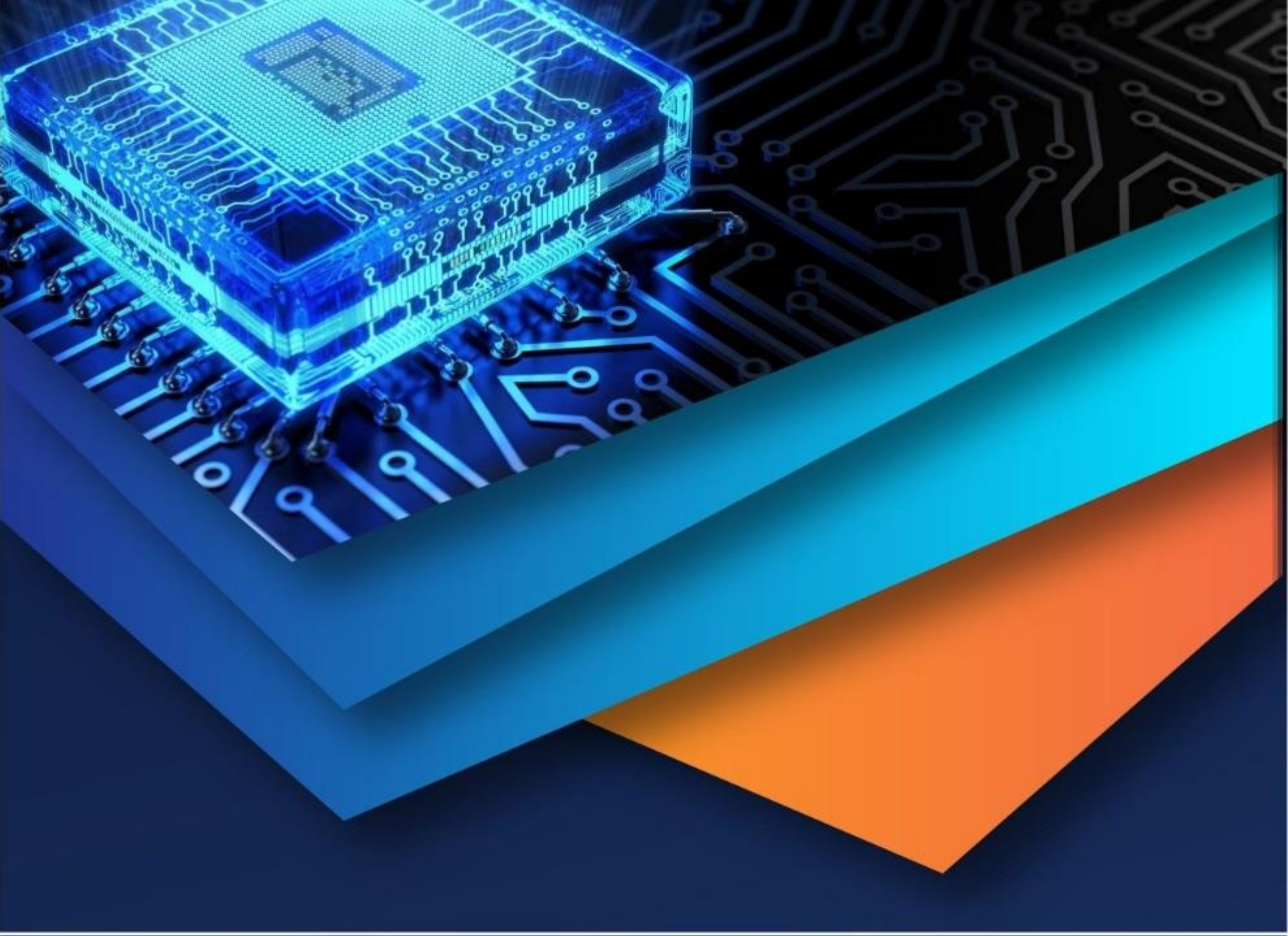

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