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Facial Expression Recognition with Appearance Based Features of Facial Landmarks

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Abstract: Artificial intelligence technology has been trying to bridge the gap between humans and machines. The latest development in this technology is Facial recognition. Facial recognition technology identifies the faces by co-relating and verifying the patterns of facial contours. Facial recognition is done by using Viola-Jones object detection framework. Facial expression is one of the important aspects in recognizing human emotions. Facial expression also helps to determine interpersonal relation between humans. Automatic facial recognition is now being used very widely in almost every field, like marketing, health care, behavioral analysis and also in human-machine interaction. Facial expression recognition helps a lot more than facial recognition. It helps the retailers to understand their customers, doctors to understand their patients, and organizations to understand their clients. For the expression recognition, we are using the landmarks of face which are appearance-based features. With the use of an active shape model, LBP (Local Binary Patterns) derives its properties from face landmarks. The operation is carried out by taking into account pixel values, which improves the rate of expression recognition. In an experiment done using previous methods and 10-fold cross validation, the accuracy achieved is 89.71%. CK+ Database is used to achieve this result.

Keywords: Facial recognition, behavioral analysis, landmarks, LBP, CK+ database etc.

I. INTRODUCTION

A person's facial expression is a visual indication of his or her affective state, cognitive activity, intention, personality, and psychopathology, and it serves as a communicative tool in interpersonal relationships. Human beings generally try to convey their emotions and feelings through their expressions. This system will be highly useful and also will be a non-verbal tool for communicating with people. The salient feature of this system is how efficiently it extracts and recognizes facial expression from the given input image. This system can be further used in Behaviomedics, Data analytics, Human-computer interaction, Implicit tagging and Deceit detection.

Humans recognize emotions with the help of the characteristic features, exhibited as a part of the facial expression. For example, happiness can be connected with a smile or an upwards movement of the corners of lips. Similarly other emotions can be characterized by the typical deformations for certain expression.

The system classifies the facial expressions into 7 types. They are happiness, sadness, anger, disgust, fear and surprise. The major goal of this system is to enable efficient interaction between humans and machines through the use of eye gazing, facial expressions, cognitive modelling, and other techniques. Facial expression detection and categorization can be used as a natural means for man and machine interaction in this case. And the intensity of the system varies from person to person, as well as with age, gender, facial size, and shape, and even within the same person's expressions do not remain consistent over time.

II. LITERATURE SURVEY

A. Facial Expression Recognition

In this paper, they have come up with various feature extraction techniques. Mainly, we have two kinds of features that we can extract from faces.

1) Geometric features and
2) Appearance features.

Geometric features show the location and shape of the various facial feature points such as nose, eyes, mouth etc. A feature vector is being formed which is the representation of face geometry by using these facial feature points. Next is extraction of appearance features. The changes in skin texture such as wrinkles are considered here. To extract the changes in appearance features we use the Gabor wavelets and these can be extracted from the total face or from specific points in a face image.

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B. Automatic Emotion Recognition Using Facial Expression: A Review

In this paper, they have come up with various facial expression recognition techniques. They are:

1) Statistical movement based
2) Auto-Illumination correction based
3) Hybrid approach
4) SVM classifier based and
5) Ada-LDA learning algorithm and MspLBP

By using these techniques, we design a system for recognizing various expressions such as anger, fear, happiness, sad, surprise, and disgust. In this system design we have various steps. First step is image acquisition where we retrieve an image from its source. After that pre-processing is done on that image where we remove noise and redundancy. Segmentation is done for various meaningful purpose. Feature extraction is being done where we take the more interested points into consideration and lastly classification is done.

III. PROPOSED SYSTEM

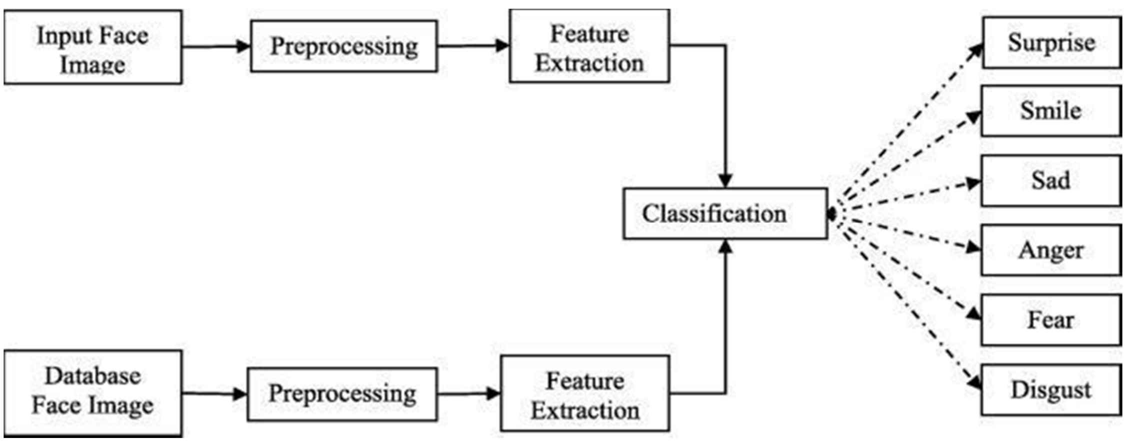

Fig: Proposed System

The suggested face expression recognition system is depicted in the block diagram above. A smart digital camera or smart video continuously records photographs of the individual. Face detection is done after the image has been captured, using a face detector to locate the face in the image. Face-detection modules are now incorporated in every smart camera. The images with recognised faces are then uploaded to the cloud. In the cloud server, the bandlet rework decomposes the image into numerous sub-bands at different scales: scale zero, scale 1, and scale 2. The dimensions of the bricks are 2x2, 4x4, 8x8, and 16x16 inches. A more complicated variation of the wavelet transform is the bandlet rework. Geometrical structures in facial expressions come in a range of shapes and sizes, and it's important to comprehend them. Standard wavelet transforms cannot adequately capture these geometrical systems. In the bandlet transform, the geometrical structures are represented by many orthogonal bandlet bases. The image is divided into small blocks, each of which can only include one contour, in order to precisely portray the geometric flow. On average, smaller blocks capture geometrical flows better than larger blocks. Wavelet bases are used to divide the photo into sub-bands of various scales, and then orthogonal bandlet bases are used to alter the wavelet bases. The next step is to divide each bandlet's sub-band image into blocks. The CS-LBP is applied to each block of the sub-band. Despite the fact that the LBP texture descriptor is a powerful and efficient texture descriptor that has been employed in a range of image-processing applications, the LBP histogram is quite huge. Noise can affect the LBP as well. The CS-LBP, which compares the grayscale brightness of center-symmetric pixels, was created to eliminate these issues. The following equation explains how to compute the CS-LBP.

$$CSLBP_{P,R} = \sum_{j=0}^{(p/2)-1} 2^j q(P_j - P_{j+(P/2)}$$

$$q(x) = \begin{cases} 1, & x \geq T \\ 0, & otherwise \end{cases}$$

The information entropy of each block determines its weight, as seen below:

$$u_m(h) = \sum_{(i,j)\in Block_m} R(CSLBP_{P,R}(i,j), h \in [0, L]$$

$$R(a,b) = \begin{cases} 1, & a = b \\ 0, & \text{otherwise} \end{cases}$$

The probability of a pixel in the m-th block appearing in the h-th bin (total bin is L+1) is Um (h). After that, the entropy is calculated as follows:

$$E_m = -\sum_{h=1}^{L} u_m(h) \mathrm{In} u_m(h)$$

The weight of the m-th block is determined as follows when the total number of blocks is n:

$$W_m = \frac{E_m}{\sum_{m=1}^{n} E_m}$$

Concatenating the weighted CS-LBP histograms from the blocks yields the image's feature vector.

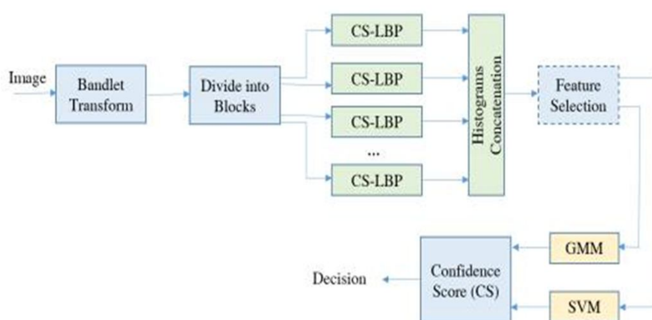

Fig: Block Diagram

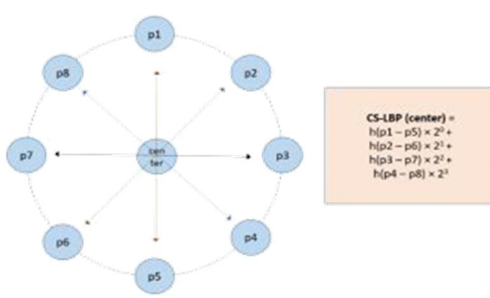

Fig: Illustrating calculations of CS-LBP

The suggested system employs two classifiers: the GMM and the SVM. We integrate the advantages of both classifiers in the proposed technique by using a weight coefficient to combine their likelihood ratings:

$$CS(c) = aL_{GSM}(c) + (1-\alpha)L_{svm}(c)$$

By using the GMM and the SVM the normalized likelihood scores of class c are LGMM(c) and LSVM(c), respectively.

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IV. ALGORITHM

Face detection is done using the Viola-Jones Algorithm. It was proposed by Paul Viola and Michael Jones in 2001. This algorithm is used to train the classifier by presenting it with a variety of faces and non-faces. In the training process, few features are extracted to know whether it's a face or a non-face. So, when an image is given, they extract the features and verify it with the training set. Then classify it as a face or a non-face. The Viola-Jones algorithm characteristics are robust, real-time and face detection. These characteristics make the algorithm a good detecting algorithm. This algorithm consists of 4 steps:

A. Haar Feature
B. Integral Image
C. Adaboost Training
D. Cascading Classifiers.

Convolution kernels are used to detect the presence of features in a given image, and Haar features are similar to them.

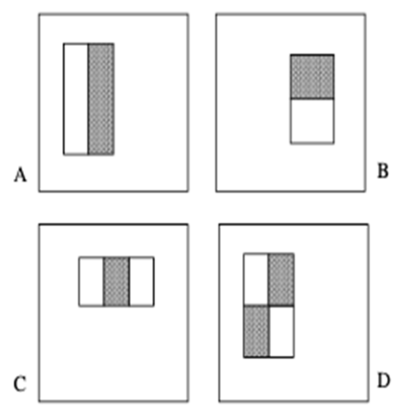

Fig: Haar Features

Integral image is also called as Summed area table. By adding all the pixels, we shall get the integral image and the pixels which are above and to left of that block. Adaboost classifier is used to select features. It selects the correct haar feature at the correct location. It creates a strong classifier by combining weighted simple weak classifiers in a linear fashion. Cascade of classifiers are used to increase detection performance.

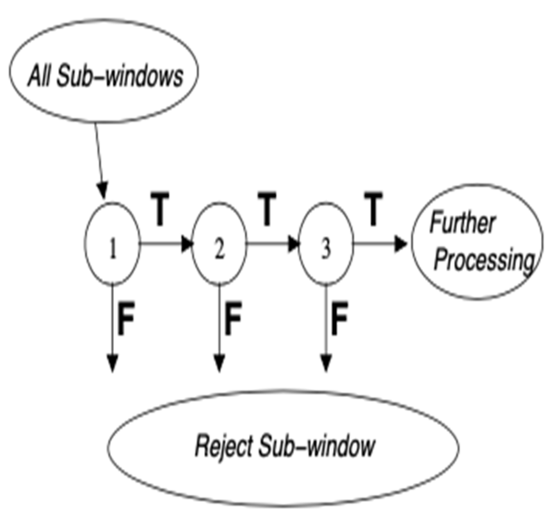

Fig: Cascade Classifiers

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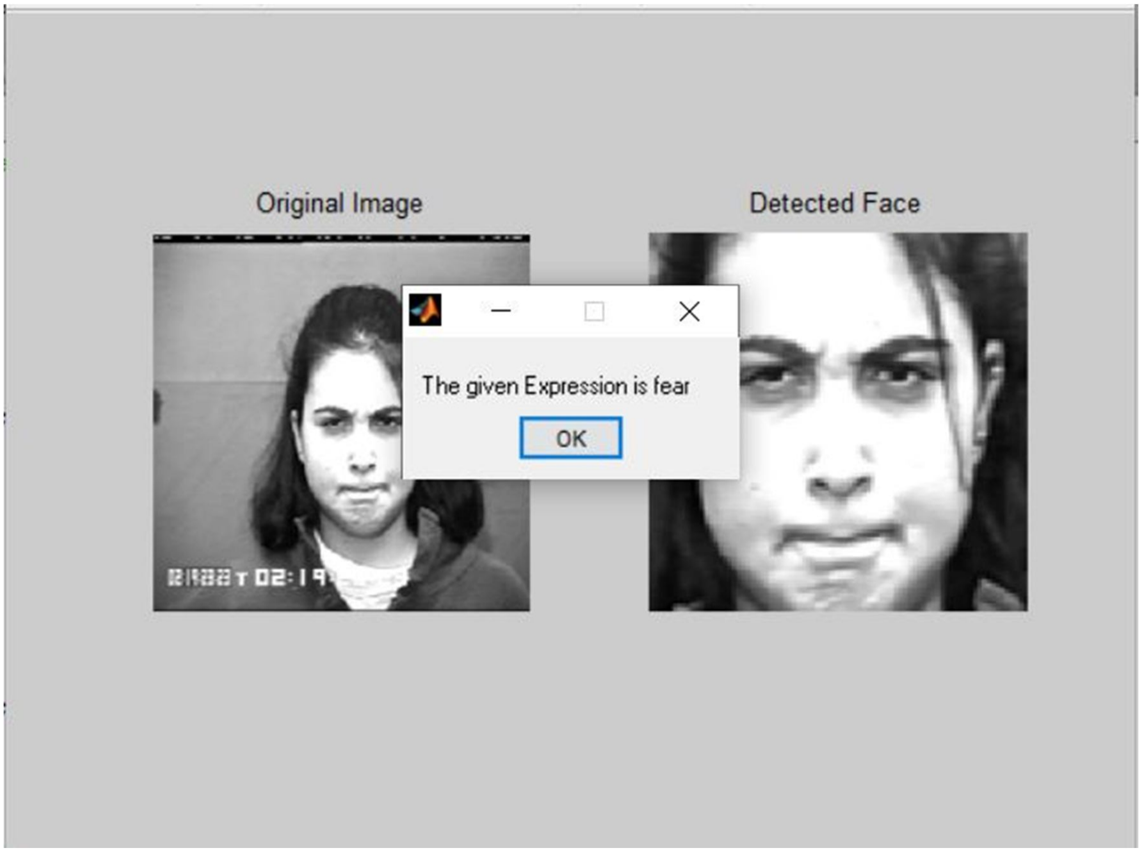
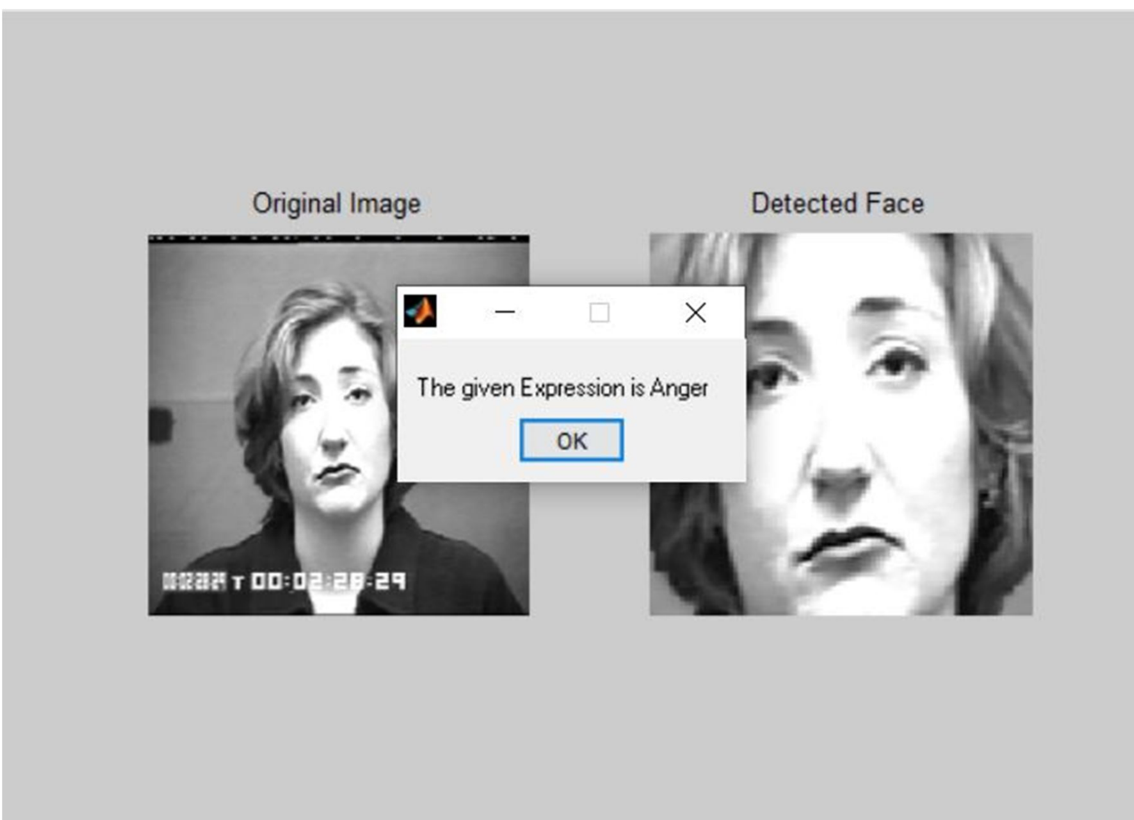
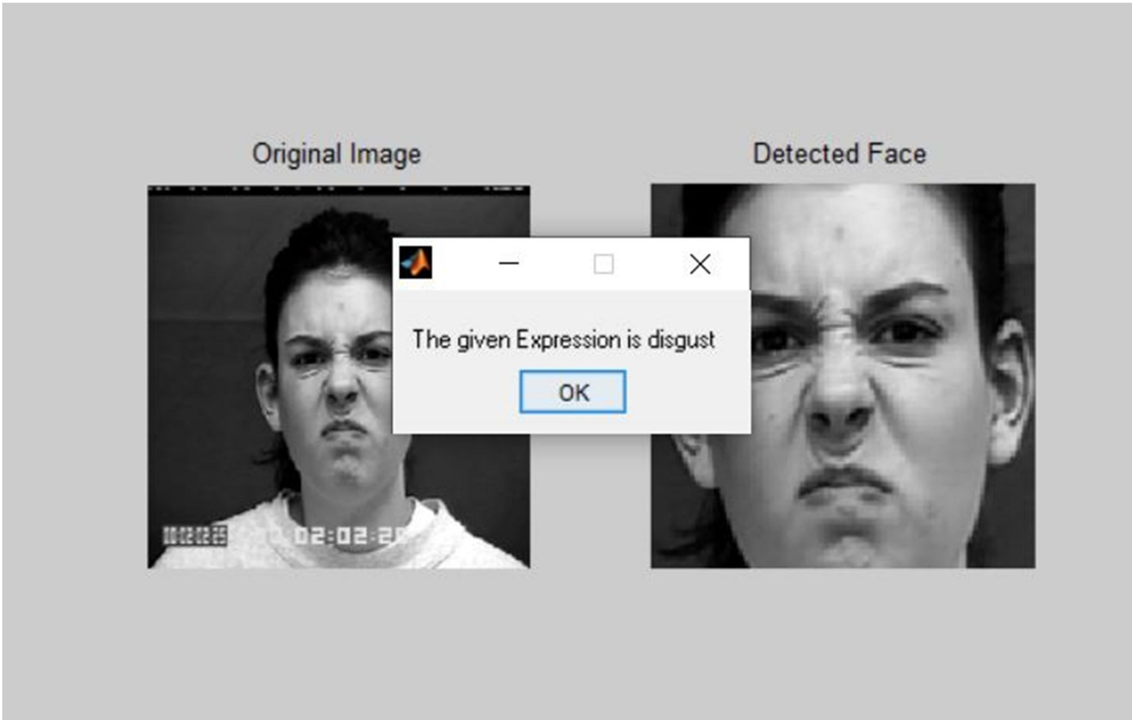
V. RESULTS







The above figures illustrate the expression of the input image after comparing it with the training set.

VI. CONCLUSION

The suggested facial-expression reputation gadget could be used in a smart health-care system. This device can be used by registered doctors and caregivers to remotely display patients' feelings and take necessary action as needed. Patients' automatic input can also be provided to stakeholders without the need to ask them for it. In the future, we can build on this work by incorporating electronic medical data into the suggested system for better health care.

VII. FUTURE SCOPE

In our research, we were able to reach an accuracy of roughly 60%, which isn't bad when compared to previous models. We'd also like to add new databases to the system to increase the accuracy of the model, but resources are a hurdle once again, and we'll have to improve in numerous areas in the future to eliminate errors and improve accuracy.

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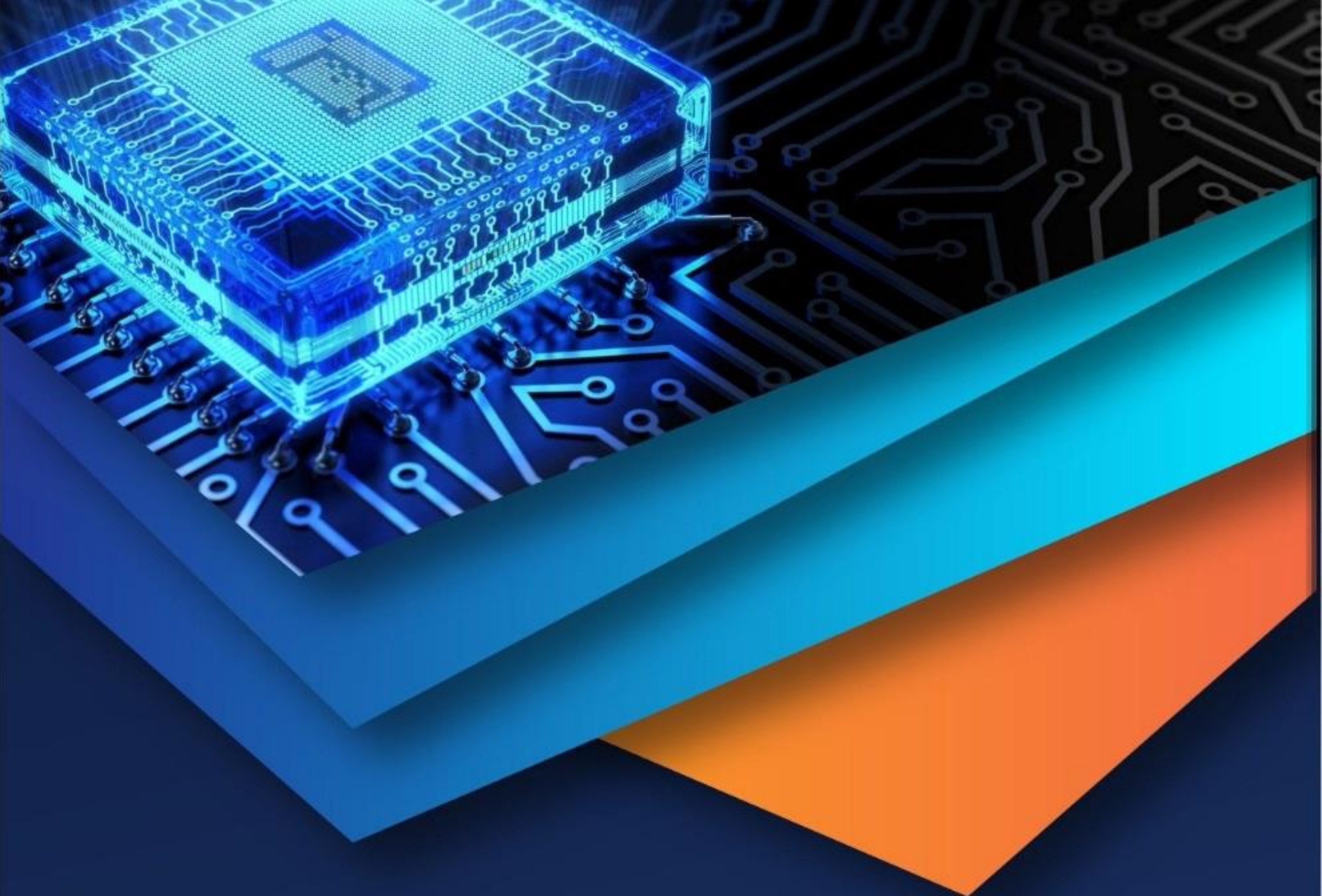

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