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Face Tracking and Recognition Using MATLAB and Arduino

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Abstract*: In this paper there will be clear a demonstration of how face is detected, how face tracking process is done and also it explains about the process involved in recognition of face. The entire aim of the paper is to develop a faster algorithm in detecting, tracking and recognising a face, which serves as an useful process in several Real time applications like security systems, video surveillance etc. The algorithm used for detection and tracking of face is Viola Jones algorithm and for face recognition it is PCA and Eigen face approach. The platforms that we used for this process are MATLAB and Arduino. The Communication established between the MATLAB and Arduino is Serial type of Communication.

***Keywords*: Human face detection, Image tracking, Arduino, MATLAB, Face Recognition**

I. INTRODUCTION

Now-a-days there is a great demand for audio and video surveillance. Therefore, it is always a challenging task to come up with an efficient and supportive algorithm for faster detecting, tracking and recognition of face. If we can achieve the task of doing faster the process of detecting, tracking and recognition of face, then it can be used in various applications like security system where limited people can be allowed to go to certain area where as others are not restricted or prohibited. The tools that we used for the process is MATLAB and Arduino. The reason for using MATLAB is due to its wide range of built in functions in Image Processing and it is also easy to interface it with Arduino. The usage of Arduino is its ability to control the movement of Motors. The communication path used while interfacing MATLAB with Arduino is Serial type of Communication. There are many algorithms that are used to detect and track a face. In this paper the algorithm used for detecting and tracking of face is Viola Jones algorithm. The methodology used for face recognition is PCA (Principle Component Analysis) and Eigen face approach. The detail explanation is given in Section 4. In this paper, Section 2 describes about proposed algorithm whereas Methodology, Simulation and Results and Conclusions are explained in Section 3, 4, 5 respectively.

II. PROPOSED ALGORITHM

First the camera position is configured by the Arduino to the initial position. Then the camera provides the video input to the MATLAB. The MATLAB detects the face and sends the co-ordinates of the face to the Arduino. Basing on the principle of centroid the Arduino tracks the face. During tracking the face of the person that is detected is captured as an image by the MATLAB and the MATLAB uses face recognition algorithm for recognising the face detected. If there is a match then it shows the output as matched else it shows as not matched. The block diagram of proposed algorithm is shown in figure 1.

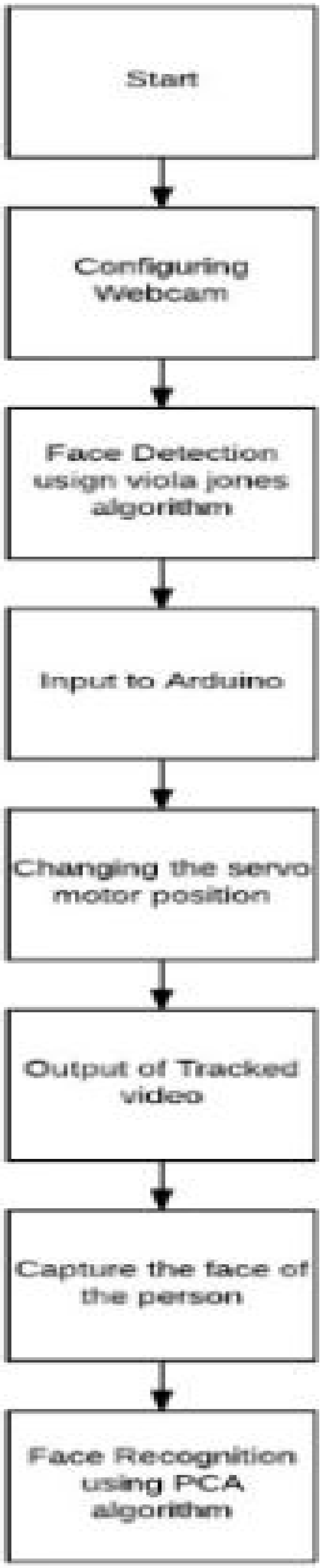

Start
Configuring Webcam
Face Detection usign viola jones algorithm
Input to Arduino
Changing the servo motor position
Output of Tracked video
Capture the face of the person
Face Recognition using PCA algorithm

Fig. 1 Flow Chart of Proposed Method

III.METHODOLOGY

The algorithm used for human face detection is described below. It consists of four important steps, they are given below

A. Haar features

Images are classified mainly on feature based systems because in feature based systems the computations required is less. For detection of face mainly two-rectangular features, three rectangular features and four rectangular features are used. These features are called HAAR features and are shown in figure (2). The features are calculated by simple addition and subtraction operation. The features are computed as the difference of sum of pixels in the black portion to the sum of pixels in the white portion. For any rectangular HAAR feature the features are calculated in the above procedure. This procedure is repeated for different types of HAAR rectangular masks and also by varying the size of the mask.

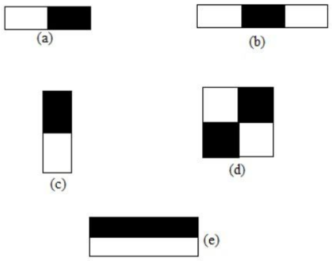


Fig. 2 Haar Features

B. Integral Image

Rectangular features of an image are best described by its intermediate form which we call it as an integral image. The formula for calculating the integral form of an image is given by,

$$qq(a,b) = \sum_{a' \le a, b' \le b} q(a',b')$$

This can be explained by taking the below image

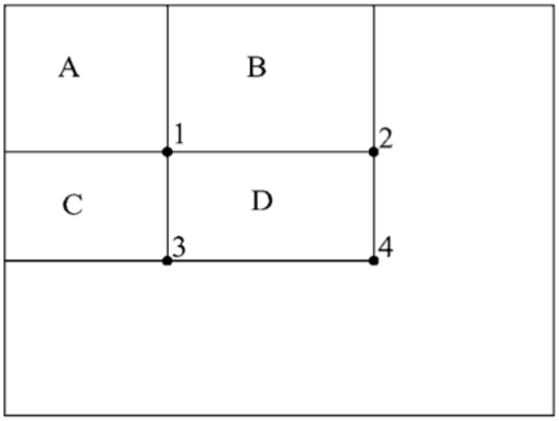


Fig. 3 integral image

In the above diagram, point 1 describes the total sum of pixels that are present in region A. For point 2, gives the sum of pixels of the regions A and B. Similarly, for points 3 and 4 sum of pixels in the region (A, C) and (A, B, C, D).

Where qq(a,b) is an integral image and q(a',b') is the original image. Using the following formula,

$$P(a,b) = p(a,b-1) + q(a,b)$$
$$qq(a,b) = qq(a-1,b) + p(a,b)$$

Where p(a,b) is the cumulative row sum p(a,-1) = 0 and qq(-1,b)=0

C. Ada Boost

During the extraction of the features from the image, the features obtained are nearly 160,000 in an image. It is very complex and expensive to check all the features to find the face features from the image, for this purpose AdaBoost technique is used. Out of all the features obtained some number of features are selected to make an efficient classifier, for this purpose the AdaBoost adapts threshold levels such that to make a strong classifier from all the weak classifiers obtained.

Let $c_j(x)$, f_j, phij and p_j denotes the classifier, feature, threshold and parity respectively indicating the direction of inequality where x is a 24x24 pixel sub-window of an image.

$$c_j(x) = \begin{cases} 1 & if\ m_j f_j < m_j \varphi_j \\ 0 & otherwise \end{cases}$$

For initial classifiers, they have a less error rate of 0.1 to 0.3 and also less complex, further the complexity increases and has an error rate of 0.4 to 0.5. AdaBoost runs for rounds starting from t=0,1,2…T, for every round it generates and calls the classifiers and distribution of weights wt is done which determines the importance of image in the data set for classification. For each round the weight of the incorrect classified image is increased and weight of the classified image is decreased such that the next new classifier focuses on the incorrectly classified images. The procedure for boosting is given below,

1) Given example images (x_1, y_1) ……. (x_n, y_n) where $y_i = 0$ for negative and $y_i = 1$ for positive examples.

2) Initialize weights w (1, i) =1/2u,1/2v for y_i= 0,1 respectively where u and v are the number of negatives and positive respectively.

3) For t=1, ……., T:

4) Normalize the weights, so that w_t is a probability distribution.

5) For each feature, j, train a classifier tj which is restricted to using a single feature. The error is evaluated with respect to w_t,

$$\varepsilon_j = \sum_i w_i |c_j(x_j) - y_j|$$

6) Choose the classifier, tt, with the lowest error

7) Update the weights:

$$w_{t+1} = w_{t,i} \beta t^{1-ei}$$

where $e_i = 0$ if example xi is classified correctly, $e_i = 1$ otherwise, and formula

$$\alpha_t = log\left(\frac{1}{\beta_t}\right)$$

8) The final strong classifier is:

$$c(x) = \begin{cases} 1, & if\ \sum_{t=1}^{T} \alpha_t c_t(x) \geq (1/2) \sum_{t=1}^{T} \alpha_t \\ & 0, otherwise \end{cases}$$

D. Cascading

The positive and negative parts of an image are segregates using the classifier i.e., simple classifier. Weak classifiers are nothing but simple classifiers. Complex classifiers are strong classifiers in which it will take the output from the previous classifier and it will take as present input in which it may reject or accept that particular window. To achieve the accurate output for the detection this process goes on. The sub band need to pass all the intermediate classifiers in order to get the detected output otherwise the sub band window will be rejected in the path. This overall form of detection as a degenerate tree is known as cascading. Using AdaBoost technique, stages in the cascade using training classifiers are constructed. To get the minimum false negatives default AdaBoost threshold values are designed and to yield low error rates. But at lower threshold it gets higher detection as well aa higher false positive rates. The accuracy in classifiers decreases if we reduce the computation time. So there is a tradeoff between accuracy and speed. To limit this one a two-feature strong classifier is constructed which is known as first stage classifier. In this we can detect 100 percent of the faces with a false positive rate of 40 percent by adjusting the threshold. The second classifier goes through more difficult task then the first. The complete idea is to remove the unnecessary areas and to increase the probability of face detection in the starting stages only. So that there will be a gradual increase in the probability in further stages. The cascading is shown below in the figure (4).

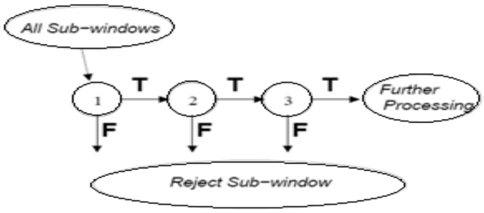


Fig. 4 cascading

E. Tracking of face

Initially the camera position is set and considered it as origin. Now after running the Viola Jones Algorithm the face is detected in the real-time video which is taken from the camera and sends the coordinates of the face for tracking. Now initially the video input is given to the MATLAB for face detection and inserts a bounding box around the face. The algorithm detects the face from the video and calculates the coordinates of the centroid of the box. These coordinates from the face are sent as input to the Arduino Uno board. The camera is connected to two servos for pan and tilt of the camera. These servos are connected to the digital outputs of the Arduino board and coordinates are given as input. The camera set position is taken as origin and four quadrants are formed. If the coordinates are in a quadrant the Arduino board sends signals to the servos such the coordinates are again come back to the origin position. If the coordinates are on positive x-direction then the servo pans to the negative x-direction makes the coordinates to the origin. Similarly, for tilting also, if the coordinates have varied x and y values then both pan and tilt servos work simultaneously to get the face in range. Thus, the tracking of image takes place by using the coordinates of the face sent by the MATLAB.

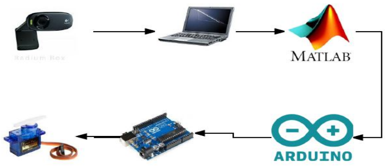


Fig. 5 Tracking of Face

F. Recognition of face

Face recognition is the main step for this paper because it really contributes a greatest part in the surveillance application. Without Recognition it is simply not useful when it comes to surveillance application. In order to recognize a face, we used the following approach, Face is a completely a complex multidimensional structure. Therefore, there is a need to compute better recognition techniques. Out of which we follow some approaches to process face recognition. They are Principle Component analysis (PCA) and Eigen face approach. These are explained below,

1) *PCA:* It is a variable reduction method of an image. The method can be described below,

a) The given image is converted into gray scale images because it is easier for computation.

b) The converted gray scale image is scaled to particular size because the input images that we collect are of different size.

c) Therefore, we develop a training set where we have for different conditions. We have images of different sizes, illuminations, expressions etc. for face recognition.

d) Testing Conditions: If there will be a change in expression or illumination or size of image or the recognition procedure may change

2) *Eigen Face Approach:*Face Image Testing: An example image is tested for recognition by comparing with stored data set.

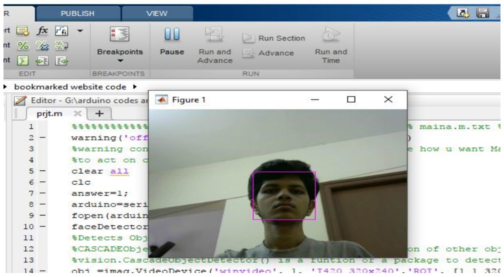
Mean Face: Mean face is given by,

$$\Psi = \left(\frac{1}{M}\right)\sum_{i=1}^{M} T_i$$

Eigen Face: The Eigen vectors corresponding to covariance matrix gives the Eigen Face, which appears like a ghost face and a match is found if this new face is close to this image.

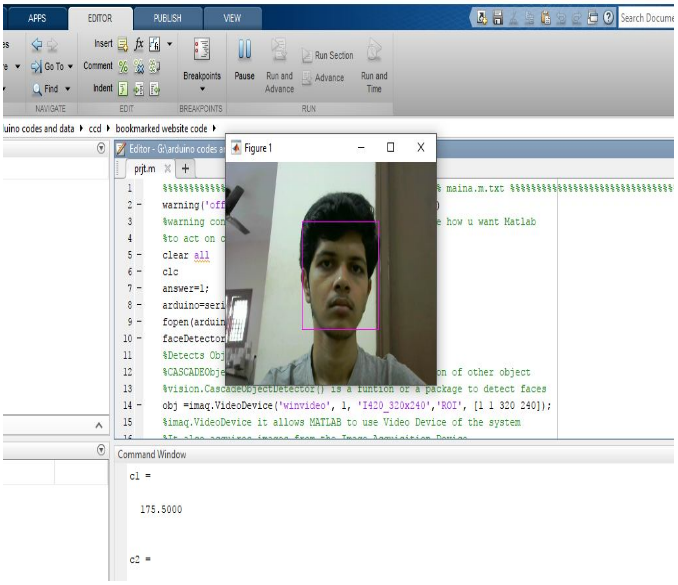
IV. SIMULATION AND RESULTS

The Figures 6, 7, 8 shows the detection, tracking and recognition of the face using MATLAB and Arduino



```
%%%%%%%%%%%%%                                         % maina.m.txt %
warning('off                                          )
%warning con                                          e how u want Ma
%to act on c
clear all
clc
answer=1;
arduino=seri
fopen(arduin
faceDetector
%Detects Obj
%CASCADEObje                                          on of other obj
%vision.CascadeObjectDetector() is a funtion or a package to detect
obj =imaq.VideoDevice('winvideo', 1, 'I420_320x240','ROI', [1 1 32
```

Fig. 6 Detection of Face



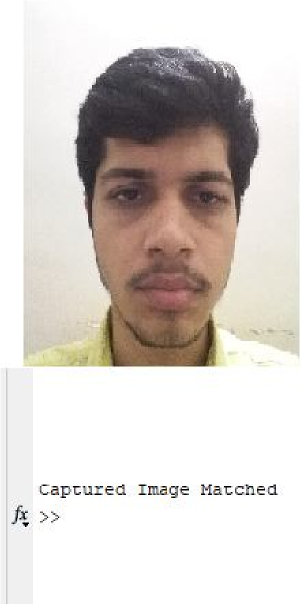
```
%%%%%%%%%%%%                                % maina.m.txt %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
warning('off                                )
%warning con                                e how u want Matlab
%to act on c
clear all
clc
answer=1;
arduino=seri
fopen(arduin
faceDetector
%Detects Obj
%CASCADEObje                                on of other object
%vision.CascadeObjectDetector() is a funtion or a package to detect faces
obj =imaq.VideoDevice('winvideo', 1, 'I420_320x240','ROI', [1 1 320 240]);
%imaq.VideoDevice it allows MATLAB to use Video Device of the system
%It also acquires images from the Image Acquisition Device
```

```
c1 =

  175.5000


c2 =
```

Fig. 7 Tracking of Face



```
Captured Image Matched
fx >>
```

Fig. 8 Recognition of Face

Figure 9 shows the setup for the implementation of the face detection and tracking using MATLAB and Arduino.

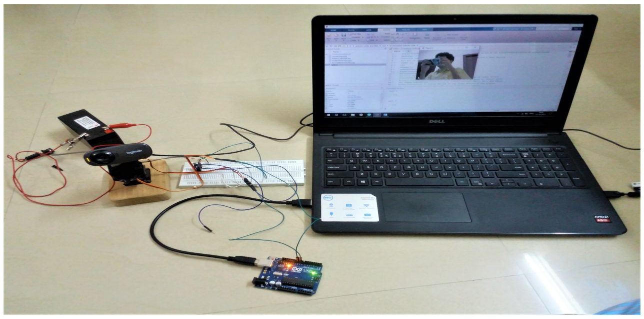


Fig. 9 Hardware Setup

V. CONCLUSIONS

In our work, the face detection and tracking is mainly based on the facial features. The algorithm used for face detection and tracking are Viola Jones algorithm. It is an efficient and fast algorithm when compared to other algorithms. It is done by using MATLAB code, where Camera detects the face and tracking is done through the movement of camera using a Microcontroller called ARDUINO. Next step is face recognition, where the detected and tracked face is recognized and it is matched it with available database- where set of images are already available with different expressions and conditions. If the match appears between recognized image and image available in database then it will display capture image is matched else it gives capture image is not matched. We can implement this method in various places where security and video surveillance is highly essential. In this paper we are restricted with basic laboratory conditions where the application part can be done with high costs.

VI. ACKNOWLEDGMENT

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REFERENCES

[1] P.Viola and M.Jones,"Rapid Object Detection using a Boosted Cascade of Simple Features",conf. on comp. vision and pattern recognition 2001.

[2] Jatin Chatrath, Pankaj Gupta, Puneet Ahuja, Aryan Goel and Shaifali M.Arora,"Real Time Human Face Detection and Tracking",International Conf. on Signal Processing and Integrated Networks

[3] J. Connell, A.W. Senior, A. Hampapur, Y-L Tian, L. Brown, and S. Pankanti," Detection and Tracking in the IBM PeopleVision System",IEEE ICME, June 2004.

[4] Edgar Osuna, Robert Freund, and F. Girosi," Training support vector machines: an application to face detection.",In Proceedings of the IEEE Conf. on Comp. Vision and Pattern Recognition, 1997.

[5] C. Wren, A. Azarbayejani, T. Darrell, and A. Pentland,"Finder: Real-time tracking of the human body", IEEE Trans. Pattern Analysis and Machine Intelligence, Vol.19, 1997, pp. 780-785.

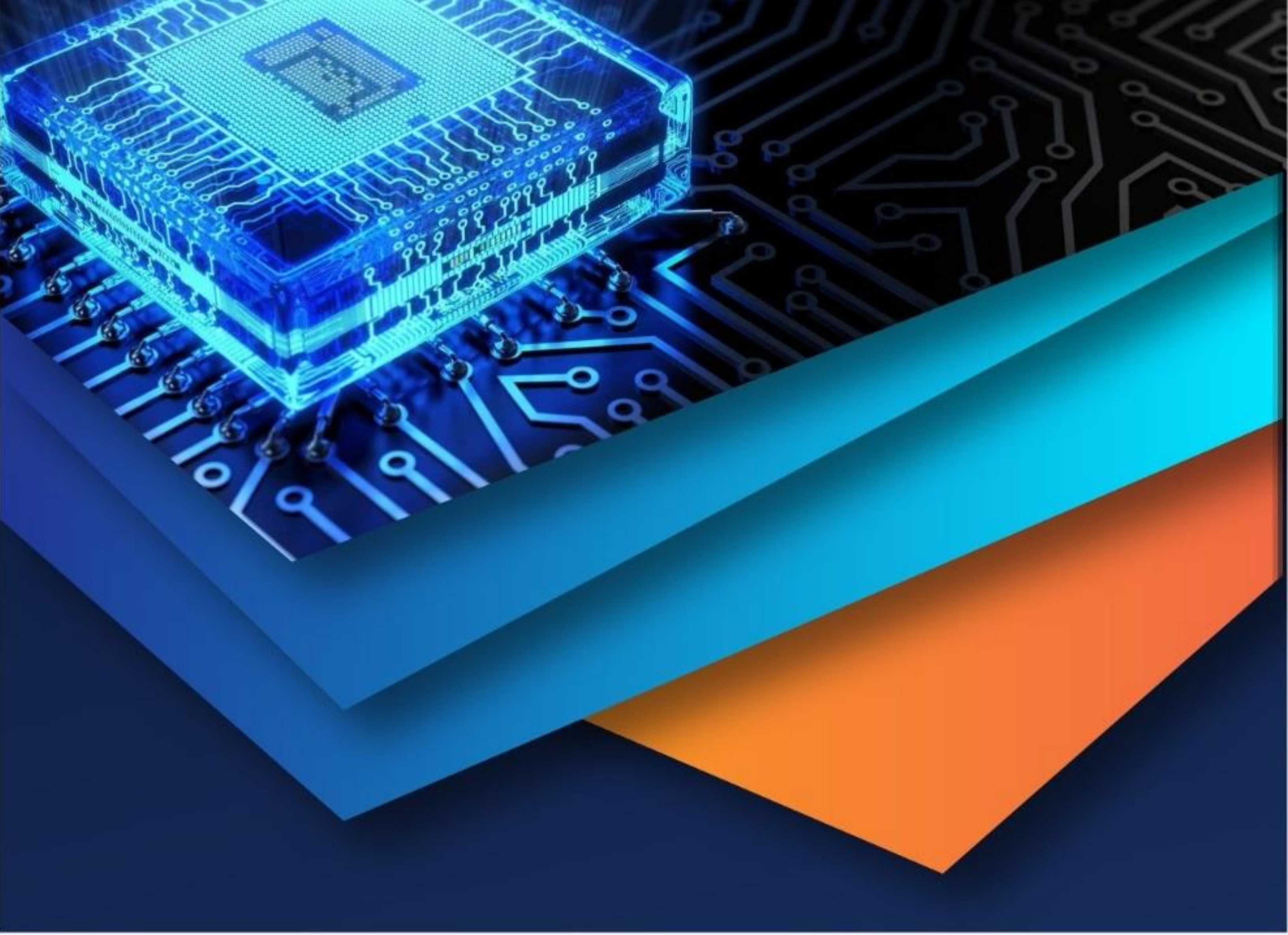
[6] D.Mikhaylov, A.Samoylov, P.Minin and A.Egorov,"Face Detection and Tracking from Image and Statistics Gathering",IEEE Conf. on Signal-Image Tech. and Internet-Based Systems.

[7] Yang, Jian, et al.," Two-dimensional PCA: a new approach to appearance-based face representation and recognition", IEEE transactions on pattern analysis and machine intelligence, Vol.26.1, 2004

[8] Ahonen, Timo, Abdenour Hadid, and Matti Pietikainen," Face description with local binary patterns: Application to face recognition", IEEE transactions on pattern analysis and machine intelligence, Vol.28.12, 2006

[9] Belhumeur, Peter N., Joo P. Hespanha, and David J. Kriegman," Eigenfaces vs. fisherfaces: Recognition using class specific linear projection",IEEE Transactions on pattern analysis and machine intelligence, Vol.19.7, 1997

[10] Gottumukkal, Rajkiran, and Vijayan K. Asari," An improved face recognition technique based on modular PCA approach", Pattern Recognition Letters, Vol.25.4, 2004



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