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A Novel Approach for Tracking Effectiveness and Potential of E-Teaching/Learning using Python Programming

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Abstract: ***E-teaching/learning has played an important role in the education system worldwide. Students are attending the lectures online without actually going to schools or colleges. Attendance is a crucial part of both online and offline teaching and usually it is recorded manually in most of schools in India. Now this manual attendance recording can lead to wastage of time and resources like paper and pen, human errors. Considering the drawbacks of this manual attendance system, an automatic attendance system was developed. This system records attendance using face recognition based on grayscale image processing. Face features extraction was done using the Haar Cascade algorithm and face recognition was done with the help of LBPH algorithm using histograms. Django was used for framework.***
Keywords: Image processing, Haar Cascade, LBPH, face recognition, histograms.

I. INTRODUCTION

Education is the reason for the growth of the society and attendance plays a major part in this education system. Over the years, the attendance was recorded using paper and pen by the teachers. This manual attendance system had problems like wastage of time and resources, human errors which directly affected the efficiency of the education system. To solve these problems and to increase the efficiency of education system, we developed a face recognition based attendance system using python programming language which marks attendance using image processing. We selected face recognition as our biometric technology as it is contact less technology and it is more secure than other technologies like fingerprints, palm prints, iris, etc. The system process starts by capturing images of the candidates/students and storing it into the database. Before storing, these images are converted into grayscale using a python module called ImageOps. RGB coloured images contains a lot of unnecessary data which is not required for image processing. Hence conversion of captured images from colour to grayscale helps to eliminate this unnecessary data. It also helps to decrease the complexity of image processing. These images are captured through webcam of the student's computer using a python library called OpenCv. These grayscale image samples and trainer.yml file will be further used to train the system for pattern matching and recognition. Face features extraction is done when the model is being trained and Haar Cascade algorithm is used for it. Linear Binary Pattern Histogram (LBPH) algorithm creates histograms which are used for face detection and recognition. Once the model is trained, the system recognizes student's face and marks the attendance. Django is an open source framework for python and it helps to improve the overall efficiency of the application. Hence, we have used Django framework for our project which itself creates and maintains the database of the students. The system generates a pdf of the attendance report. It contains a faculty section too where the faculty can login themselves and can access the records. The faculty can manually record attendance of students who didn't marked their attendance due to technical issues.

II. OBJECTIVE

The main objective of the system is to perform face detection and recognition, database maintenance efficiently which will eventually enhance the quality of E-Teaching/Learning.

III.METHODOLOGY

The system flow begins with registration. All the students need to register themselves by entering the required details. Further images of these registered students are captured through their webcam. These images are converted into grayscale and stored into a folder. The system is trained with these images so that it recognizes the faces of the students. Once trained, the system detects and recognizes the faces with the help of face features extracted during training process. The system contains a faculty section too where the professors has to register themselves.

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Once the professor is logged in, he has the access for manual attendance. We have added this function in our system to record attendance of the students who were not able to mark their attendance themselves due to technical issues. Django accelerates the build process and hence we have used Django framework in our project. Django creates the database of the students and also looks after its maintenance. The system generates attendance report which can be downloaded into respective systems in pdf format. The system flow is given below,

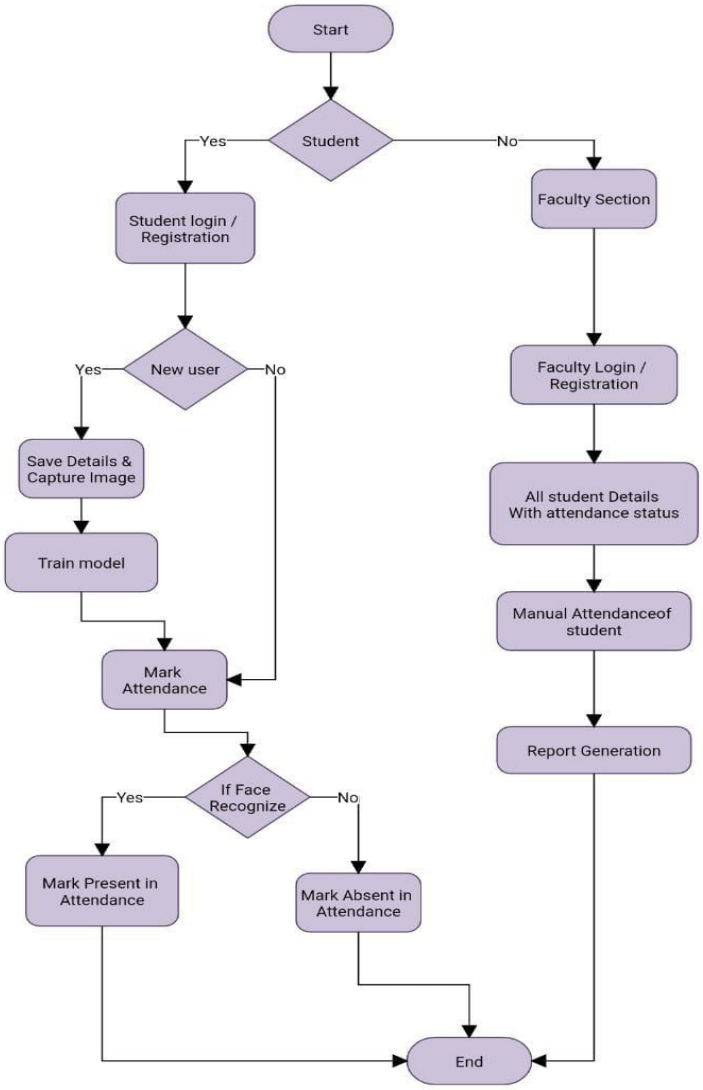


Figure 1: System flow

The whole system process can be divided into 6 parts:

A. Student Registration And Dataset Collection

A student new to the system has to register by entering the details required. This entered information about the student is recorded in a common student's excel file called 'StudentDetails.csv'. Now this file contains data of registered students. This data includes name, enrolment number, email Id, branch, year, division and password. Once the registration is done, the images of registered students are captured through the webcam. A fixed number of image samples with different angles and expressions are captured which will be further used for training and face feature extraction process. These image samples undergo pre-processing which includes cropping of these image samples to get the Region of Interest (ROI). Further these RGB coloured images are converted into grayscale and saved as name and enrolment number of respective student in a common 'Training Image' folder.

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B. Grayscale Conversion

A RGB image has data which may not be useful for image processing. A RGB image has 3 layers which are R, G, B and hence it is three dimensional. Whereas a grayscale image is two dimensional as it has 2 layers only. Unless the project is RGB coloured based, using a RGB image for image processing will just increase the complexity of the process. Hence to eliminate the unnecessary data and to decrease the complexity of image processing, we converted the coloured image samples to grayscale. For this conversion we used an open source python library PIL (Python Imaging Library). PIL has an interpreter with image editing abilities. Specifically we used ImageOps module for the grayscale conversion. ImageOps.grayscale() converts coloured image to grayscale.

C. Model Training

These set of grayscale images are analysed to train the model. This dataset is given to the face recognizer which is further trained with the help of recognizer.train() function. Histograms are created once the recognizer is trained. These histograms are stored in "Trainner.yml" file using function recognizer.write(). These histograms created plays an important role in the concept of face recognition. When the model is being trained, face features are extracted from dataset stored. This face feature extraction is done using Haar Cascade algorithm. This algorithm uses lines and edges for the extraction process.

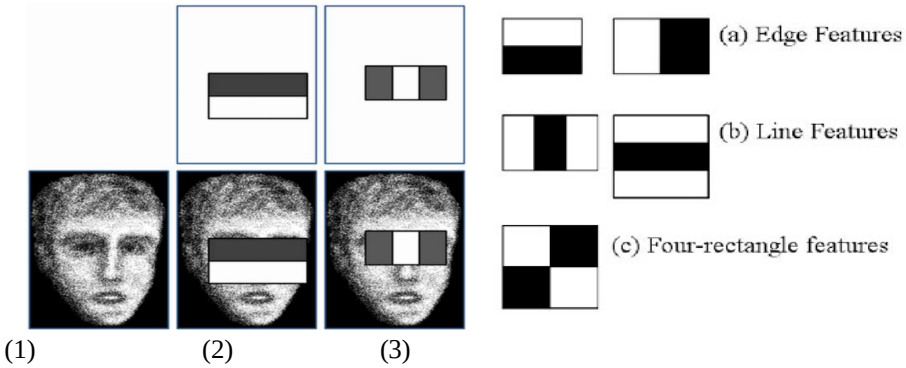


Figure 2: Use of edges and lines for face features extraction

Basically features are calculated by the formula, features = sum(pixels in dark portion) – sum(pixels in bright area)

Now Figure 2 shows how edges and lines are used for face feature extraction. Image (1) is a grayscale image whose features are to be extracted. Image (2) shows that two thick lines are placed on the face. One is grey while the other is white. Now on the basis of their positions, we can conclude that the grey line represents the eyes of the person. In case of Image (3), there are three thick lines in which two of them are grey and the remaining one is white. Here we get that the two grey lines represents the two eyes and the white one shows the presence of nose. So from Image (3) get can derive more information as compared to Image (2). Hence, in this way Haar Cascade algorithm uses edges and lines to get maximum features from a particular face.

D. Face Detection and Recognition

After the model is trained, histograms of previously stored images are created in the trainer.yml file. These histograms are used for comparison between the available dataset and images captured during face recognition based attendance. Here Linear Binary Pattern Histogram (LBPH) algorithm is used for creating histograms from recently captured images. This algorithm further compares these histograms with previously stored histograms in the trainer.yml file. Based on the result of this comparison, face recognition is done. The system successfully recognizes if the histograms are similar to each other.

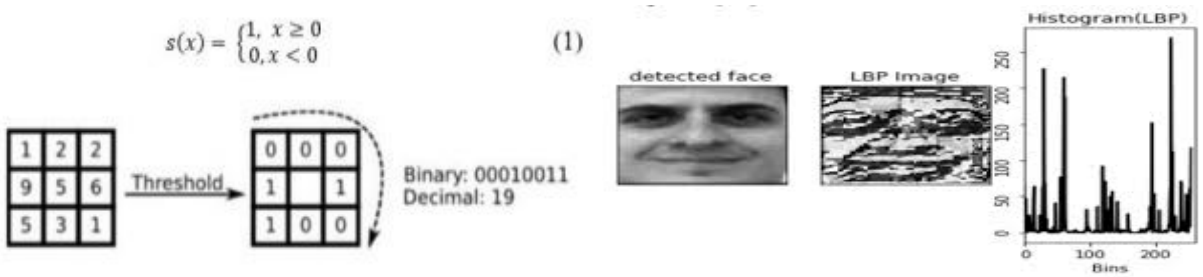


Figure 3: LBPH Algorithm

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This algorithm carries out LPB operation which involves comparison of intensity value of each pixel with its nearest 8 pixels. Now if the neighbouring pixel value is greater than the centred pixel value then the algorithm assigns 1 to that neighbouring pixel or else 0. The decimal value of the 8-bit pixel value string generated is called the LBP value.
In this algorithm, every image is divided into sub parts where each sub part undergo LBP operation to get LBP value of each sub part. Histograms are created using these LBP values which are further used for comparison.

E. Attendance Database Management

Attendance of a particular student is recorded once the system recognizes his/her face. We have included Django framework in our implementation which boosted the performance of our system. Django is responsible for creation and maintenance of student database system. It marks present if the system recognizes the student otherwise marks absent for that particular session. The application has a "Reports" section too where reports are generated which be downloaded into our systems in pdf format. Smtplib is used to mail these reports to any recipients.

F. Faculty Section

In this section, the faculty members can register/login themselves to gain access for manual attendance. We have included the functionality of manual attendance in our system to give the faculty the ability to mark attendance of students which were not marked present by the application due to technical errors. If such a condition happens, the student can communicate with respective faculty member and ask them to mark their attendance. Other than this, the faculty has the access to the database of the students where he can get any student's information such as name, year, branch, class, div, attendance, etc.

IV. RESULTS AND DISCUSSION

We used two major algorithms in our project which are the Linear Binary Pattern Histogram (LBPH) and the Haar Cascade Algorithm. Haar Cascade was used for extracting face features and LBPH was used for face recognition. They are other algorithms for face recognition like Eigenfaces. Now Eigenfaces uses Principal Component Analysis (PCA) for extracting face features from a particular image sample. To find eigenvector, eigenvalues of image samples were calculated. Every image sample was divided into small dimensions which were further trained to calculate eigenvectors. Based on these eigenvectors, face recognition was performed. This algorithm reduces the amount of space required by training image samples but still fails in low lighting conditions and with different face angles. This would affect the overall performance of the application and hence we used LBPH algorithm for face recognition which has higher recognition success rate than the Eigenface algorithm. The graphical comparison between both the algorithms is given below,

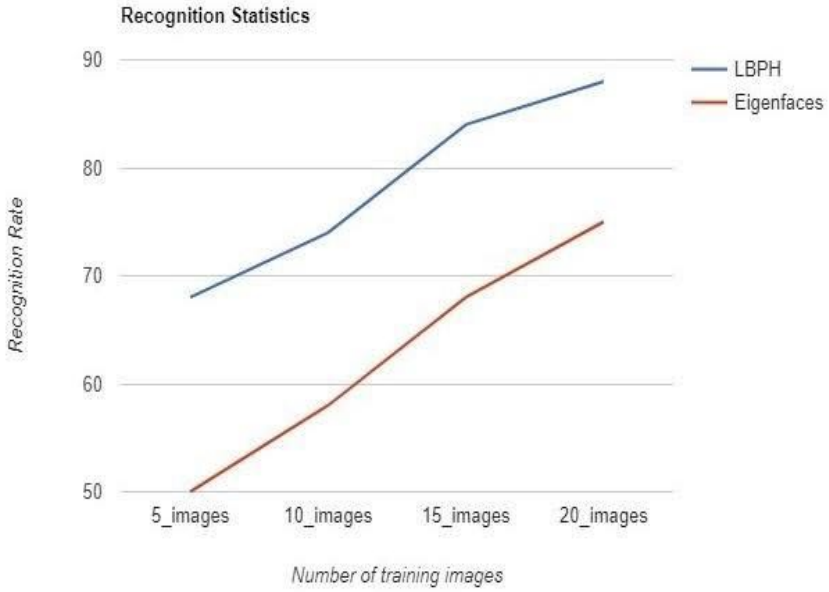


Figure 4: LBPH vs. Eigenface Algorithm

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The application contains login system for both students and the teachers where both can login themselves to access all the functionalities of the application. Users new to the application has to register first whose data will be stored in the database.

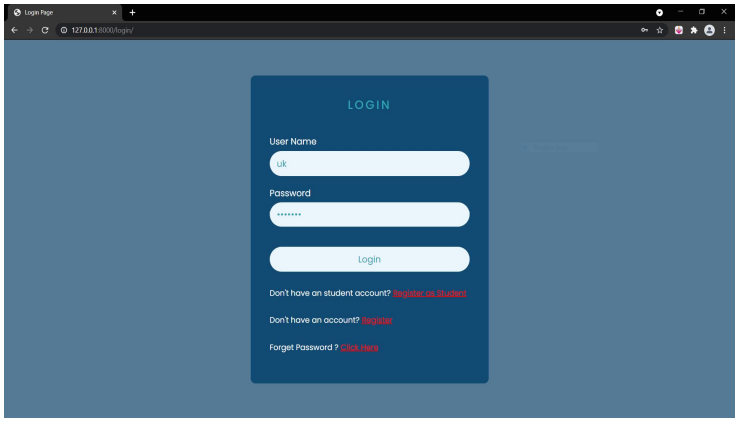


Figure 5: Login page

Once logged in the dashboard, the user can save his images for face recognition based attendance. The model can be trained with those images and user can mark his attendance too.

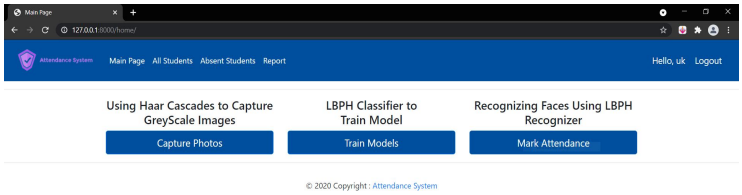


Figure 6: Dashboard

Images are captured through the webcam and are converted into grayscale format which will further used for training purpose.

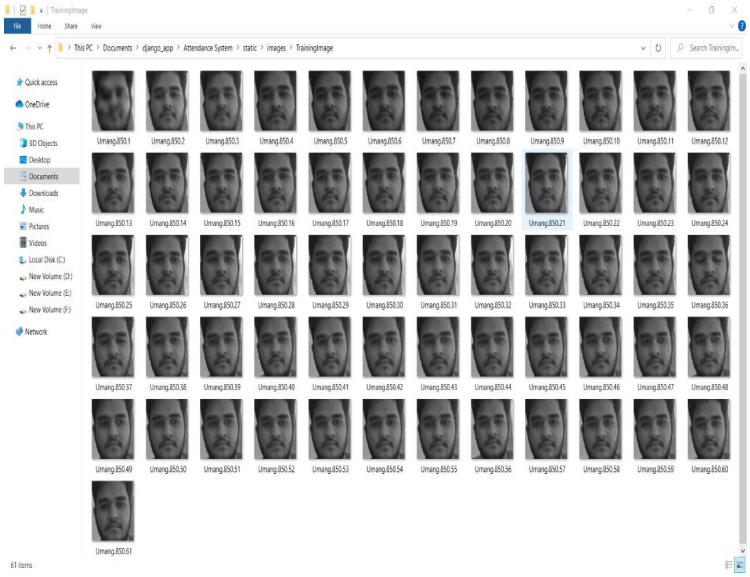


Figure 7: Saved Images

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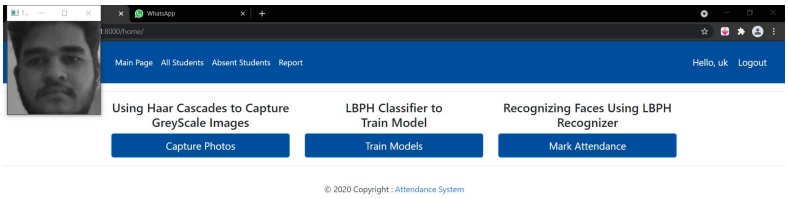


Figure 8: Model Training

Once the model is trained, the system recognizes the faces by comparing live image samples with previously stored image samples. If the face is recognised, that particular student is marked present or else absent.

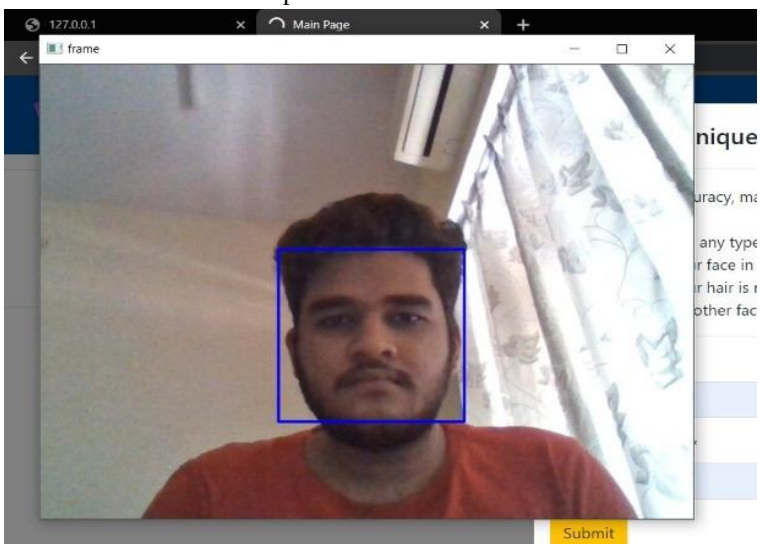
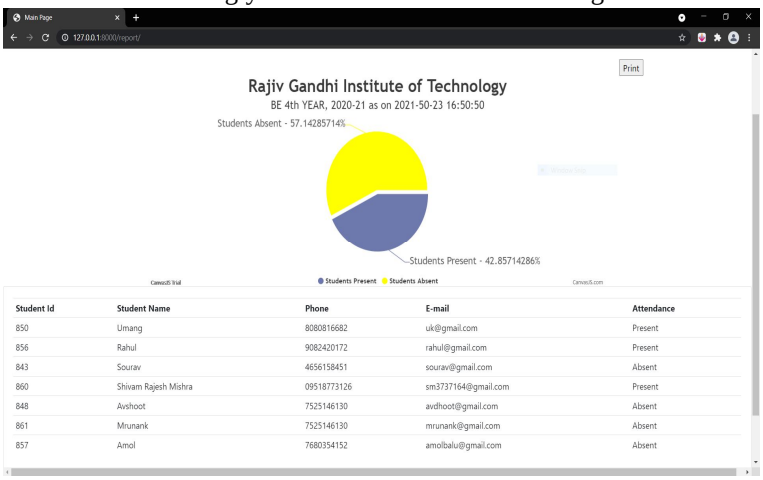


Figure 9: Face Recognition

The system creates a database of the attendance status of all the students which can be accessed from the faculty section. It generates a report too which we can analyse and work accordingly for the betterment of E-learning.



Student Id	Student Name	Phone	E-mail	Attendance
850	Umang	8080816682	uk@gmail.com	Present
856	Rahul	9082420172	rahul@gmail.com	Present
843	Sourav	4656158451	sourav@gmail.com	Absent
860	Shivam Rajesh Mishra	09518773126	sm3737164@gmail.com	Present
848	Avshoot	7525146130	avdhoot@gmail.com	Absent
861	Mrunank	7525146130	mrunank@gmail.com	Absent
857	Amol	7680354152	amolbalu@gmail.com	Absent

Figure 10: Attendance Report

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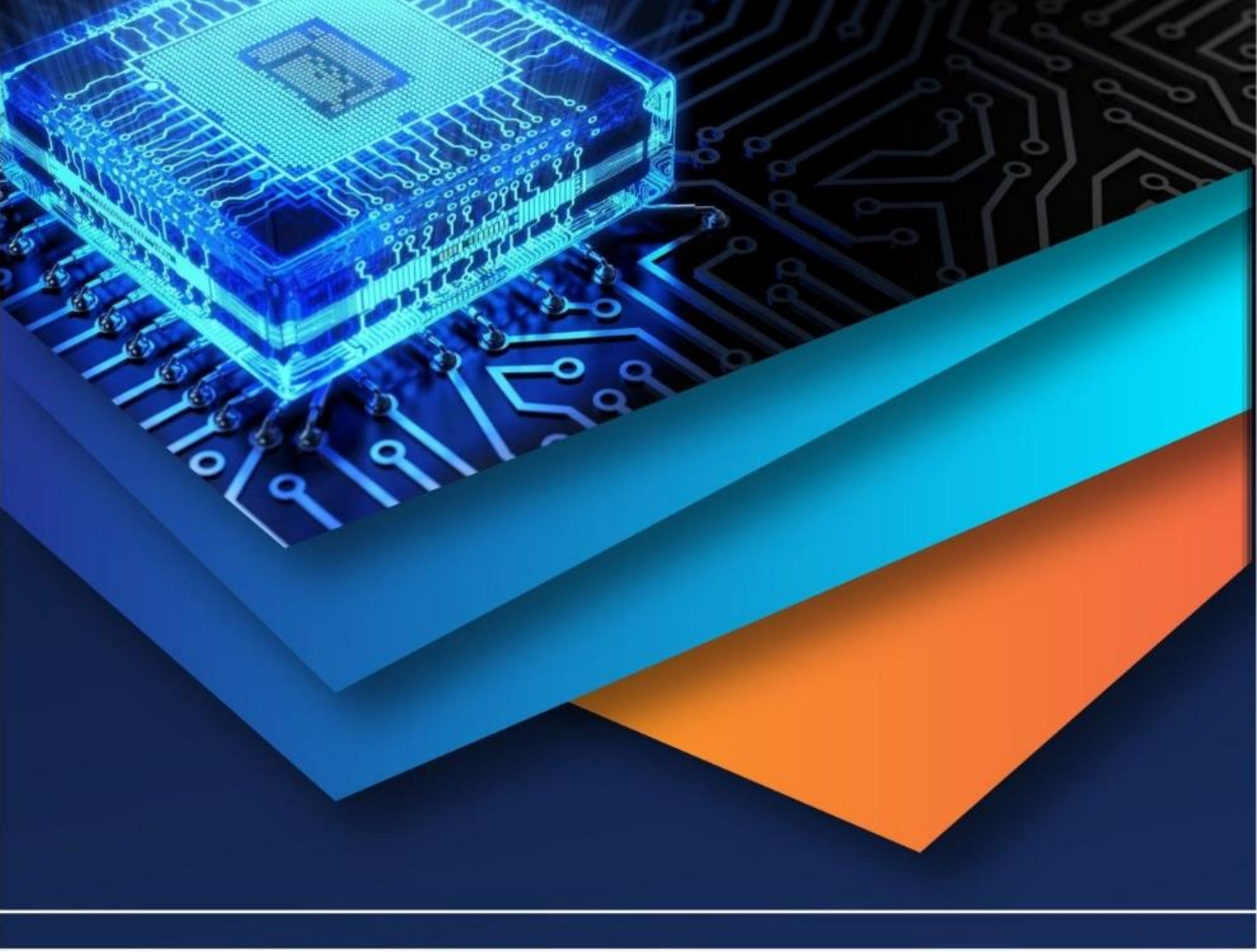
V. CONCLUSIONS

This system aims to enhance the quality of E-Teaching by introducing an effective face recognition based attendance system. This application uses Linear Binary Pattern Histogram (LBPH) and Haar Cascade Algorithms majorly for face detection and recognition. The system uses Django framework which is able to record attendance on the basis of recognition. It maintains the database and generates reports.

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