ATTENDANCE SYSTEM USING VIDEO-BASED FACE RECOGNITION

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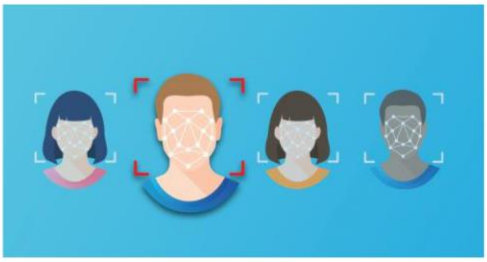
***Abstract*—The main aim of this project is to create a new attendance system for educational institutions, which will rely on facial recognition technology. The objective is to upgrade the current attendance system and make it more efficient and effective than it currently is. The current system is outdated and unclear, leading to inaccurate and inefficient attendance tracking. When the authorities cannot enforce the rules that are existing under the previous system, several complications develop. The face recognition system will be the technology at work. A person's face is a distinctive feature that can be used to identify them. Since faces are unique and cannot be easily duplicated, they are commonly used for identification purposes. In this project, face databases will be created to provide data for the recognition algorithm. During attendance recording, the faces of individuals will be compared against the database in an attempt to identify them. If a match is found, the individual's attendance will be automatically recorded, and the necessary information will be added to an Excel spreadsheet. Tracking student attendance in virtual educational institutions is a difficult task, particularly when done manually, as it consumes a lot of time and effort. Furthermore, due to the absence of a reliable attendance system, false attendance is common. Since a person's face is the most distinguishing characteristic, this paper discusses the innovation of a real-time attendance system based on face detection using the frontal face recognition approach. The paper also outlines a powerful algorithm that uses Haar cascade and an open-source image processing framework called OpenCV.**

Keywords—LBPH, Haar Cascade, Attendance, Face Recognition, Database.

I. INTRODUCTION

The personnel staff should have a suitable system in place for regularly approving and keeping the attendance record in order to validate the student attendance record. The two main types of student attendance frameworks are the Automated Attendance System (AAS) and the (MAS). Practically speaking, in MAS, the faculty may have trouble constantly reviewing and maintaining every pupil's record in a classroom. Marking each student's physical and cumulative attendance becomes a very dull and laborious task in a classroom with a high teacher-to-student ratio. As a result, we can implement a workable framework that will use face recognition to automatically record students' attendance. The managerial job that employees at AAS do might be reduced. To create an attendance system that utilizes Human Face Recognition (HFR), the students' facial images are usually captured either as they enter the classroom or after everyone has taken their seats. There are typically two techniques used to address HFR: the feature-based method and the brightness-based method.

The landmarks of the faces, such as the eye, nose, mouth, edges, or other features, are used in the feature-based methodology. In this manner, only a portion of the previously extracted picture is covered during the process. For Face recognition variety of methods like Eigen face, Haar cascade and LBPH algorithms are required.



II. RELATED WORK

A. *A.R.Mitra, S.Lukas, D.Krisnadi and R.I.Desanti proposes the use of biometric authentication is prevalent in today's applications, including network security, door access control systems, human-computer interface, and video monitoring/surveillance systems. They proposes a technique for classifying face objects in a classroom using numerous facial photos to manage students attendance. 174 out of 205 faces could be recognized successfully in the trials, which involved 19 kids in a classroom setting. About 85% of people can be recognized.*

B. *S.Patil, J.Chaudhari, P.Wagh, S.Patil proposes a facial recognition system is a computer vision and image processing application that can identify and confirm a person from a database of still or moving images, which is one of its two main functions.*

Different methods, including Illumination Invariant, Histogram equalisation, and PCA, are employed to resolve these problems. After comparing the recognised face with the original Eigen database in the Exel sheet coupled with Matlab GUI, the system automatically updates the attendance.

C. *M. J. Jones, Pau, and Viola research presents a system for face detection that can analyze photos very quickly and achieve excellent detection rates. Three major contributions are present. The initial contribution involves creating a new representation of pictures by focusing only on essential visual features. The third contribution is a technique for combining classifiers in a "cascade" which allows for speedy elimination of background areas in the image, while directing more computational resources towards potential face-like regions. The field of face detection has a series of experiments that are presented. The system's face detection performance is on par with that of the most effective earlier methods .Face detection operates at 15 frames per second when used on a standard desktop.*

III. METHODOLOGY

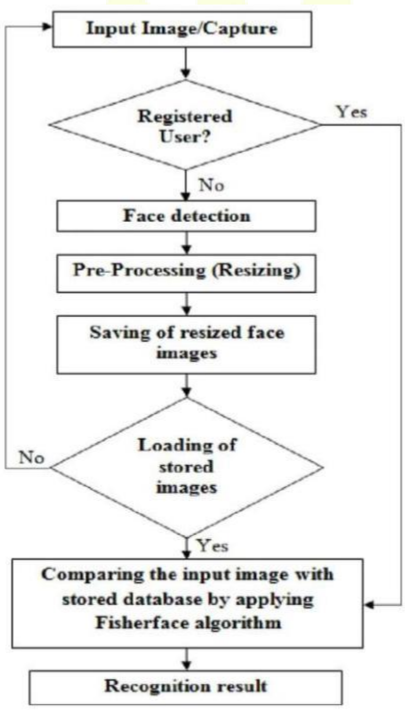


Fig.1: The above block diagram depicts the proposed system.

A. *Enrolment*

The student is added to Face Detection

We will use the 68 markers stated above that are present on a person's face to identify faces. The Viola and Jones algorithm [9] will be applied based on these facial landmarks for face landmark recognition, constrained local model-based face tracking, and face bounding box detection. It is also known as the face detection AdaBoost algorithm. We shall proceed to the next phase as soon as the detecting portion has been successfully finished. Face Recognition will be the system's subsequent stage.

Fig 2: Face Recognition UI

B. Face Recognition

Using the Principle Component Analysis, we will incorporate facial recognition into this model (PCA). A technique called PCA is used to reduce the number of variables used in face recognition. Each image in the training set is represented by an eigenfaces-based linearly weighted eigenvector in PCA. This method reduces faces to a condensed set of fundamental characteristics called eigenfaces, which make up the main structural constituents of learning pictures. An individual is ordered by comparing their current position in eigenface space with the positions of known people after recognition is implemented by expecting another picture in the eigenface subspace. The key advantages of adopting PCA for facial recognition are its simplicity, quickness, and incapability to adjust its conclusions in response to changes in the human face. In order to enter the classroom, the pupils' faces that are captured on the camera outside the classroom must be identified. Provided that the face of the student is present in the appropriate database, they will be permitted to enter the classroom. If the image of the student's face is not present in the database, the system will request that the student register in the student database before allowing access to the classroom.

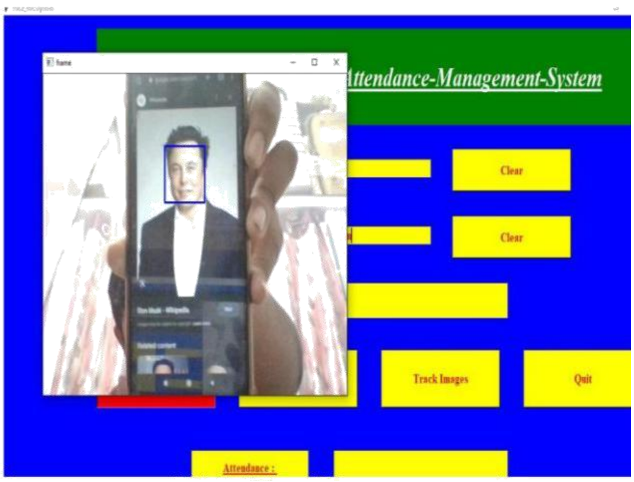


Fig 3: An image of a face is being captured

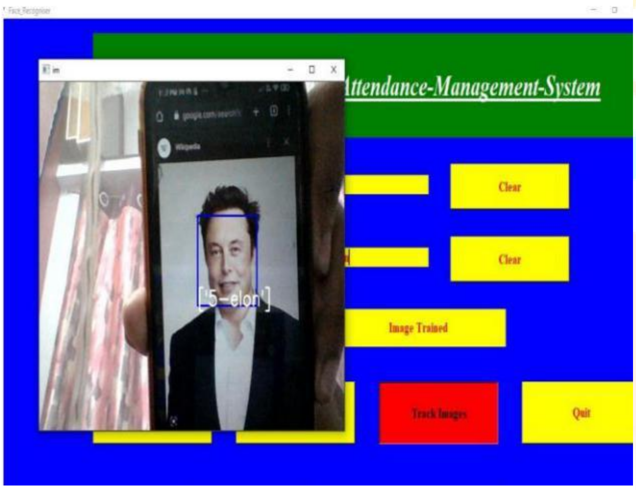


Fig 4: Face is Identified

C. *Confirmation by the camera*

After a student's face has been recognized and granted access to the classroom, another camera will be positioned inside the classroom to ensure that all students are visible during the lecture. The aim of this is to confirm the presence of the identified student in the classroom. and to prevent any potential proxy attendance.

D. *Attendance Marking*

The classroom camera will be utilized to produce a list of the pupils present in the room after the lectures are over. This will enable the attendance database to record attendance for that lecture.

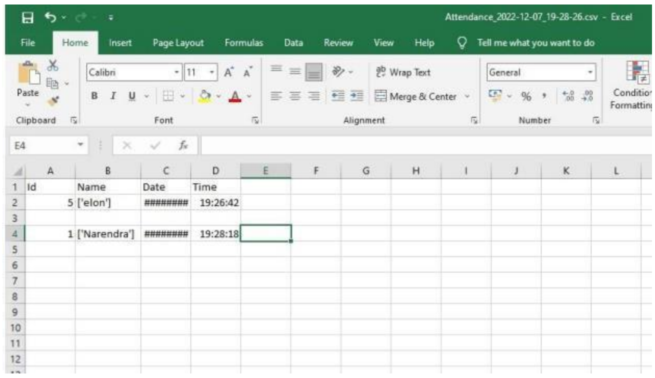


Fig. 5: An Excel sheet is used to keep track of attendance along with the time.

IV. PROPOSED METHOD

When the program is executed, a window that requests the user's ID and name opens. We must click the Capture Photographs button after providing the appropriate information in the name and ID columns. By pressing the Take Pictures button, a camera on a computer that is already running is opened and begins taking person image samples. The Student Details folder has this Id and Name, and the file name is Students detail.

It gathers 50 photographs when the camera is ON and saves them in the folder "Training Image." It alerts you that the faces are stored after completion. After taking photographs, we must click on the Train Image button to train the stored images. The machine is now trained for the images in a matter of seconds, and a Trainer file is created and stored in a folder. All default settings have now been completed. After taking and training photographs, we must click the button labeled "Track Images" to begin tracking faces. The ID and name of the person are displayed on the image if the camera recognizes the face of a certain student. Hit Q to close this window (or just Q). The attendance of a particular person is saved in a folder with comma separate value file with name, date, and time after exiting, and it is also viewable in the window.

A. *Haar Cascade Algorithm*

In spite of their size and location in the image, objects can be found in photographs using the Haar cascade technique. This algorithm can function in real-time and isn't overly complicated. A haar-cascade detector can be trained to recognize many different items, including automobiles, bikes, structures, fruits, etc.

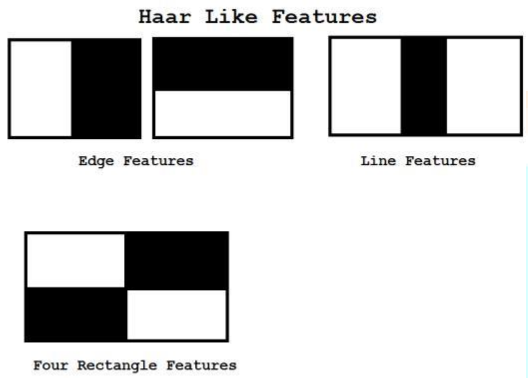
A positive example pertains to a type of classifier that is taught using various instances of a specific object, such as a vehicle or a human face. The classifier is built using a cascade of boosted classifiers that utilize haar-like features. When this classifier is trained using these types of variables, it can recognize and classify virtually anything. To illustrate, if you want your classifier to detect faces, you need to teach it using a substantial amount of images containing faces. These images are referred to as positive photos because they display the thing you are attempting to identify. Similarly, the classifier must also be taught using negative images, or images that feature items that are not relevant to your search. An example of a negative image would be a picture that does not contain a face when the objective is to find one. By contrast, positive images are those that include at least one face.

After the classifier has undergone training, it gains the ability to scrutinize a specific portion of interest within an input image and generate an output of either 1 or 0 based on whether the region is deemed to be potentially containing the object.

Face detection will be used in this situation. To train the classifier in the cascade function, it requires a set of images containing faces as well as other types of images. (images without faces). After that, we must extract features from it. We use the Haar characteristics in the figure below for this.

They have a similar structure to our

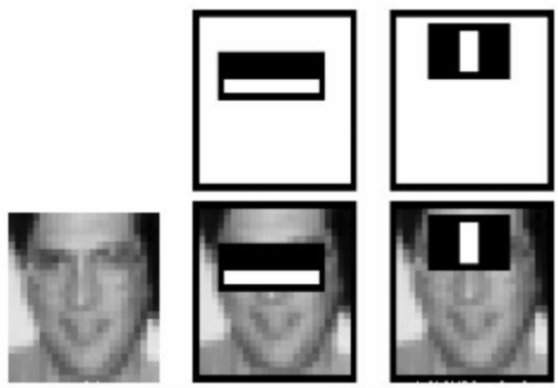
convolutional kernel. One possible interpretation of this statement is that the two rectangles are being used to segment or isolate different regions or objects in the image/matrix, and the sum of the pixels under each rectangle represents a measure of the intensity or the magnitude of the values within that region. The fact that the sum of the pixels under each rectangle adds up to one value for each feature may suggest that the two regions are complementary or mutually exclusive, and together they cover the entire range of values for that feature.



All potential sizes and positions of each kernel are now employed to calculate a large number of features. (Just consider the amount of calculation required. In a 24x24 window alone, there are more than 160000 characteristics.

We must determine the total number of pixels under the white and black rectangles in order to calculate each feature. They introduced the integral image to move past it. The calculation is based on the image's size if No matter how big your image is, it just need four pixels to calculate a specific pixel. Isn't it nice? That speeds up everything.

But according to our calculations, the majority of these traits are irrelevant. For instance, think about the photo below. There are two excellent characteristics on the top row. The first feature focuses on the eye area, which is often darker than the face and nose areas. The second characteristic emphasizes the fact that the eyes are frequently more shaded than the nasal bridge. But, from what you can see in the picture, it doesn't matter if it was put on the cheeks or any other area. Out of more than 160000 features, we choose the top features using Adaboost.



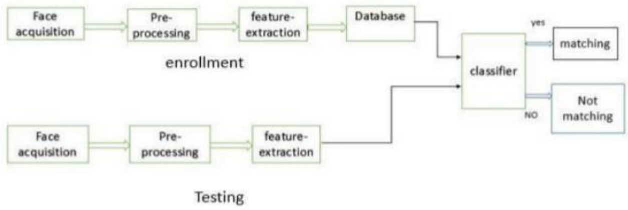
The training images must all have each feature applied in the same manner. It determines the ideal cutoff for every attribute that will categorize faces as positive or negative. There will undoubtedly be mistakes or incorrect categorization. Because these traits are the ones that provide the most precise classification between images of faces and those without., we only choose the features with the lowest error rate. (The procedure is not this easy. At first, each and every image is assigned the same weight. There will be a change in weights following each categorization, increasing the weights of incorrectly categorized photographs. The process is then repeated. New error rates and weights are calculated and the process is repeated until the desired accuracy, error rate, or number of features is achieved.

The final classifier is obtained by weighting together these weak classifiers. Despite its name, the weak classifier is capable of successfully classifying an image when combined with other classifiers.

B. LBPH (Local Binary Pattern Histogram) Algorithm

a) To detect faces, the Local Binary Patterns Histogram Algorithm (LBPH) is employed, which is a textural descriptor based on the local binary operator and has proven to be highly effective. Due to the demands of modern life, facial recognition systems have become increasingly necessary, being employed in applications such as unlocking smartphones, access control, and surveillance systems. With LBPH, we will extract features from a test image and compare them with faces stored in the system's database in this post.

b) Steps involved in LBPH:



Let's assume we have an image with dimensions N x M. To process every region in the image, we need to divide it into smaller regions with identical height and width, resulting in regions with dimensions of m x m. Within each of these regions, we use the Local Binary Pattern operator, which is defined within window size.

$$LBP(x_c, y_c) = \sum_{p=0}^{P-1} 2^p s(i_p - i_c)$$

The central pixel with intensity 'Ic' is denoted as '(Xc, Yc)', while the intensity of the neighboring pixel is denoted as 'In'.

The Local Binary Pattern operator works by comparing a pixel to its eight closest neighbors, using the median value as the threshold.

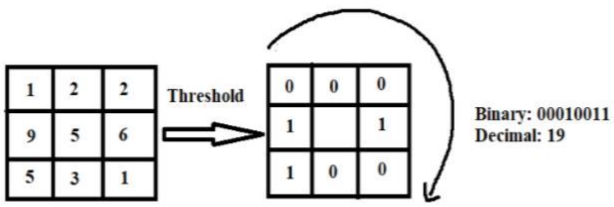
$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases}$$

1. If a neighboring pixel is equal to or greater than the value of the central pixel, it is assigned a value of 1; otherwise, it is assigned a value of 0.

2. We obtain eight binary values in total by performing this process on each of the eight neighboring pixels.

3. These eight binary values are then combined to create an 8-bit binary number, which is converted to a decimal number.

4. This decimal number, which ranges from 0 to 255, is known as the pixel Local Binary Pattern value.



- After the creation of the LBP value histogram, the number of similar LBP values in each part of the image is counted to construct the histogram for that region.
- After generating a histogram for each region, the histograms are merged to form a unified histogram. This unified histogram is commonly referred to as the image feature vector.

- Next, we compare the histograms of the test image with those of the images in the database, and we return the image that has the most similar histogram to the test image.

- There are various methods available to calculate the distance between two histograms, including the Euclidean distance and others.

- The calculation of the Euclidean distance between the features of the test image and those of the dataset is used to establish the matching rate. By identifying the image in the dataset with the smallest distance to the test image, the matching rate can be determined.

$$d(a,b) = \sqrt{\sum_{i=1}^{n} |a_i - b_i|^2}$$

- When the test image is recognized, the ID of the corresponding image from the database is returned as the output. LBPH has superior adaptability compared to other methods due to its ability to differentiate between side and front faces, as well as being resistant to changes in lighting conditions.

V. RESULTS AND DISCUSSIONS

Performance Evaluation	percentage
Student Recognition Rate	79%
FP rate(students)	25%
Unidentified person Recognition Rate (existing model)	65%
Unidentified person FP Rate (existing model)	34%
Unidentified person Recognition Rate (proposed model)	65%
Unidentified person FP Rate (proposed model)	14%

Fig 6: PERFORMANCE EVALUATION

We established a recognition distance of 4 feet for objects in our study. The results above show that the face recognition rate is 79%, and the FP rate is 25%. This system is capable of recognizing students even when they have beards. The face recognition rate for unidentified persons is 65% for both the pre-existing and intended models. This is primarily due to the face detection algorithm erroneously identifying random objects in the background as a person's face. The FP rate for unidentified persons is 14% for the intended model and 34% for the existing model. The threshold value has an impact on the FP rate for unidentified persons. In the existing system, if a person in a video turns their head slightly, the confidence value for that frame may surpass the favorable filter value of 50, and the person in the frame is labelled as an unknown person. In contrast, the intended system only labels a person as unidentified if their confidence level is higher than 50 and 95, and their image is saved as an unknown person.

VI. CONCLUSIONS

A system has been implemented to track student attendance using Python as the programming language. Face recognition technology is employed for this purpose, which helps to reduce time and effort in cases where a large number of pupils have indicated attendance. Additionally, this system's attendance records can aid in identifying which students are present or absent and addressing exam-related issues. Further tasks are required to complete the project, such as installing the system in classrooms, which can be achieved using a camera and computer.

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