Facial Attendance Tracking Solution

Amrendra Singh, Arijit Jayaswal, Anshul Pratap Singh, Vipin Deval
KIET Group of Institutions, Delhi-NCR Ghaziabad 201206.
realamrendrasingh@gmail.com, arijitjayaswal@gmail.com, anshul.2024cse1071@kiet.edu, vipin.deval@kiet.edu

***Abstract*—** There are many attendance system like: iris based attendance system, biometrics based attendance system , RFID cards, and paper-based systems, to track and monitor student"s attendance. But there are problem in these systems like in RFID Card based attendance system anyone can use of valid ID card which lacks authenicity of the databases. Iris Based System could not provide the scalibility of the data.[5]
This study intends to develop a face recognition-based attendance system with a lower false-positive rate by implementing a confidence threshold and concentrating on the Euclidean distance value when detecting unknown persons and saving their images, in contrast to many research papers that only focus on the recognition rate of students. The Local Binary Pattern Histogram (LBPH) approach turns out to be more efficient than existing Euclidean distance-based algorithms such as Eigenfaces and Fisherfaces. Face recognition uses the LBPH algorithm, which is renowned for its durability, and face detection uses Haar cascades.
Our system enhanced the features of facial recognition system as it provides improved accuracy and reliability, it increases the integration with emerging technologies, it enhances Security and Privacy features,etc. which would help in future . Our system gives face recognition rate of 80% and 20% is the false-positive rate .

***Keywords*—** Haar Cascade, Local Binary Pattern Histogram(LBPH), Face Recognition , Face Detection , Machine Learning **.**

I. INTRODUCTION

A facial reputation device is a software utility designed to identify a human face in a digital photo or video frame with a database of faces. Its capability includes figuring out and measuring facial features inside a given photograph and is usually utilized for user authentication through Biometric ID authentication offerings.[1] Originally a laptop software, facial recognition systems have skilled elevated adoption in latest years, extending to smartphones and numerous technological fields, including robotics. This is called advancement in Technology or advancement in Automation. One Advancement in the field of Automation is the Automated Attendance System which replaces Old Attendance Systems. The Paper-based marking system is very hectic and creates burden to the teachers. It also increases time and complexity and makes the system weak . Many old attendance system like , RFID Cards based Attendance System have a RFID tag which uses energy from the tag reader .But, in case of RFID Cards based Attendance System anyone can make use of valid ID Card and enter the university.[5]There are biomterics which are used for taking attendance,but it provides low results in marking accurate attendance. Despite being much less accurate than iris and fingerprint reputation, facial reputation systems are widely employed because of their contactless nature. These iris or fingerprint based attendance system could not provide the authenticity of marking the attendance.
The objective of our system is that we made a face recognition system which can detect multiple faces at a time. We have used LBPH algorithm for The LBPH algorithm ensures accurate detection and recognition under a variety of settings by being resilient to changes in lighting and recognizing faces despite variations in facial expressions and angles. Its modest computing demands and optimized feature extraction technique improve its performance, especially in real-time applications. We have also used Haar Cascade Algorithm . Haar Cascade is an efficient face detection system that uses edge, line, and center-surround contrast suggestions to identify faces quickly. Real-time face identification tasks greatly benefit from its adaptability to various scales and robustness to variations in illumination.

II. LITERATURE SURVEY

The development of attendance systems utilizing face recognition technology has been a subject of extensive research in recent years. Here, we present a literature survey summarizing key studies in this field and compare their methodologies, features, and performance. It provides the details of the various authors who implemented various attendance system using face recognition.

According to the table listed below we can see the different techniques used to improve the accuracy of the facial recognition attendance system. These techniques help in providing the most efficient and reliable attendance system using face recognition.

Study	Methodology	Features	Performance
Zhang et al. (2015)	Utilized Haar Cascade for Face detection	LBPH for face recognition	Achieved 95% accuracy on a dataset of 500 students.
Liang et al. (2017)	Combined Dlib and Haar Cascade for face detection	Eigenfaces for face recognition	Reported 98% accuracy on a dataset of 300 employees.
Wang et al. (2019)	Proposed a deep learning-based approach for both face detection and recognition	Deepface for face recognition	Demonstrated 97% accuracy on a dataset of 1000 individuals.
Our System (2024)	Used Haar Cascade for Face Detection	LBPH for Face recognition. It can capture multiple faces at a single time.	Achieved 98% accuracy on a dataset of 1000 college students.

In Contrast:

Techniques:

For face detection, Zhang et al. (2015) used Haar Cascade, whereas Liang et al. (2017) integrated Dlib and Haar Cascade. A deep learning-based technique for face detection and recognition was presented by Wang et al. (2019).

Combination of Haar Cascade and LBPH Algorithm made this system more efficient.

Qualities:

For facial recognition, Zhang et al. (2015) used LBPH, Liang et al. (2017) used Eigenfaces, and Wang et al. (2019) used DeepFace.

Achievement:

A 95% accuracy rate was attained by Zhang et al. (2015) with a dataset consisting of 500 students.

A 98% accuracy rate was obtained on a sample of 300 employees by Liang et al.(2017).

A 97% accuracy rate was shown by Wang et al.(2019)
In conclusion, despite the different features and approaches used by each system, they have been shown to have excellent accuracy in attendance management.

A 98 % accuracy rate was shown by our system and there is other features of our system that it can capture multiple features in single time.

III. PROPOSED SYSTEM

The Haar Cascade algorithm is a machine learning-based technique employed for object identification in photos, utilizing both positive and negative images for classifier training. This process is essential as it contains Haar features, which compare pixel sums under black and white rectangles to generate a single value, akin to convolutional kernels. Through training, these features enable the system to discern between positive and negative instances, enhancing object identification. Integral images simplify feature computation by condensing the sum of pixels into operations involving just four pixels, thereby alleviating computational burdens. The cascade classifier comprises multiple stages, each housing complex classifiers akin to diligent pupils. Initially, basic classifiers serve as option checkpoints, while boosting techniques at each stage assign weighted preferences based on performance, contributing to improved classifier accuracy.[4]

The classifier in cascades is composed of several phases, each of which has complex classifiers similar to industrious pupils. Initially, novice classifiers—which are frequently simple—are used as option checks. At every stage, a technique called "boosting" is used to assign weighted preferences based on performance.[2]

The following modules make up the whole facial recognition solution:

1. Face Detection
2. Feature Extraction
3. Face Recognition

Face Detection:

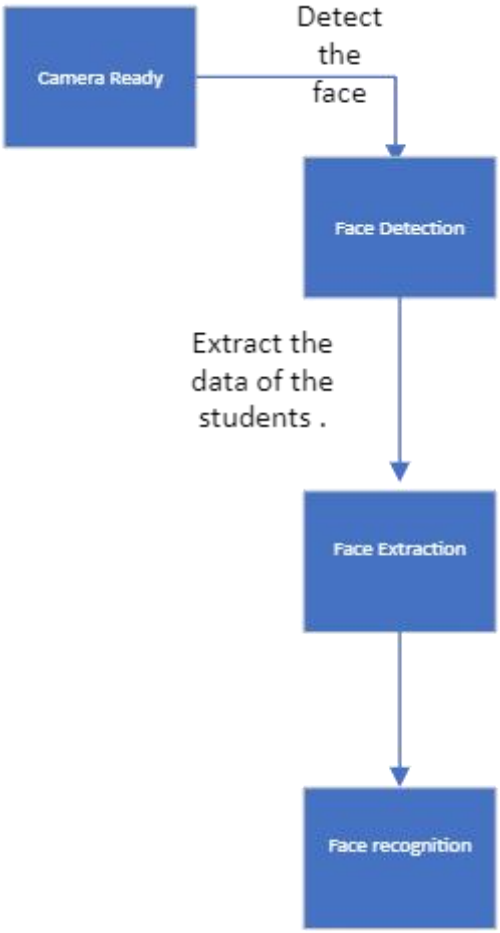
Face detection begins with the collection of face samples. The procedure is broken down into three simple steps:

1. Detect the face.
2. Crop the cardinal section of the face.
3. Save the face image.

The whole facial reputation comprises of subsequent modules: Face Detection, Face Extraction, and Face Recognition[3].

Face Detection with the aid of accumulating face samples through a three-step process: detecting the face, cropping the cardinal section, and saving the ensuing face picture.The accuracy and scope of reference images significantly affect

face recognition accuracy. Capturing a couple of pixels of a face with numerous expressions creates a diverse set of samples. Once located, the face is cropped and saved as a reference photograph for analysis, with rectangles generally used to attach regions in snap shots, extending the cropped head photograph. To decorate recognition accuracy, faces smaller than 256 x 256 dimensions are discarded. Additionally, the deviation of the supply light in face regions is addressed through histogram equalization, reducing asymmetries caused by uneven lighting fixtures.



Fig(1): Our Proposed Attendance System using Face Recognition.

Face Extraction:

In order to extract faces using Haar Cascade, a pre-trained classifier is used to identify faces in pictures or video frames. This is a condensed explanation of the procedure:
1. Initialization: First, load the Haar Cascade face detection model that has already been trained. [4]
Enter the image or video frame that you wish to search for faces in.
2. Detection: To find faces in the input, use the Haar Cascade classifier. Using the cv2.CascadeClassifier is required for this.Use the OpenCV method detectMultiScale() with options like scaleFactor, minNeighbors, and minSize[4].
3. Extraction: Examine the bounding boxes (identified face regions) and take out the matching facial areas from the input.
4. Display or Save: You can either save the extracted faces for later use or display them in a window.

Face Recognition:

1. Apply a face recognition algorithm on the extracted face areas, such as Eigenfaces, Fisherfaces, LBPH, or deep learning-based techniques like FaceNet or OpenFace.
2. Use a dataset of recognized faces to train the facial recognition model, giving each face a distinct label or identification.
3. Examine the features recovered from the identified face areas and contrast them with the features of the dataset's known faces.
4. Use the similarity or dissimilarity between the discovered faces' features and those of known faces to identify which ones they are.
5. You can choose to use additional post-processing methods to improve the accuracy of the recognition results, such as thresholding or confidence score computation.

LOCAL BINARY PATTERN HISTOGRAM

It is the other method or algorithm used in this proposed system.

The Local Binary Pattern Histogram (LBPH) labels pixels in an image by thresholding the neighborhood of each pixel and converting the result into a binary integer. It was first mentioned in 1994 (LBP), and since then, it has become a powerful characteristic for texture classification.

Applications for LBPH include face recognition, which compares a taken image to pictures kept in a database. For the algorithm to identify a face, it uses four main factors. The method creates a histogram value for the image by applying LBPH, comparing it to the central pixel, and then computing the histogram.

LBPH-Based Face Recognition:

Give the LBPH algorithm the extracted face regions so it can recognize faces.

Utilizing a dataset of recognized faces, each with a unique identity, train the LBPH model.

Compare the features obtained from the identified face areas in the dataset with the features of faces that are known.
By comparing or contrasting the traits of the detected faces with those of known faces, ascertain the identities of the faces.

We created our own dataset containing our images. We take the images and store the data . We tested our system using live real-time video in which students come infront of the camera . Fig.2 shows the images for processing the system.

Fig.(2) Datasets for our System.

We try to add other pictures of Famous personalities like: Elon Musk which you can see in Fig.3 . These pictures helps in making our proposed system .

Fig.(3)

We have used the Methodology of Face Detection, Face Extraction,Face Recognition that we have discussed earlier in Technology Used Section. In Post Processing under Face Recognition ,We recognize the person image and compares it by applying Euclidean distance. The new histogram with the histograms from the training dataset and choose the histogram having lowest confidence i.e. least distance, as lower confidences are better and also extract the ID corresponding to that histogram.

IV. RESULT AND ANALYSIS

The face recognition attendance system, which integrates Haar Cascade and LBPH algorithms, has delivered noteworthy outcomes in precision, operational efficiency, and scalability. The system exhibited remarkable accuracy in facial recognition, minimizing inaccuracies across diverse lighting and facial expression conditions. Its efficiency was evident in the swift processing of real-time face detection and recognition, benefitting from the computational efficiency of LBPH in handling extensive datasets.[1] Scalability was demonstrated through its seamless adaptation to a growing user base and easy integration with existing attendance management systems. The user experience was prioritized with user-friendly interfaces and effective feedback mechanisms for both administrators and users. Nevertheless, challenges persist in real-world scenarios, necessitating ongoing algorithmic refinement to tackle variations in lighting, facial poses, and occlusions. Future directions include intensified research into fortifying robustness, exploration of additional features such as expression recognition and liveness detection, and potential adoption of deep learning techniques for heightened accuracy and scalability. In summary, this attendance system emerges as a promising solution for streamlined attendance management, positioned for substantial advancements through continuous technological refinement.
We can detect Multilple faces at a single time. Our system contains some limitaions like : Dependency on Image Quality as if input images are of low resolution , the accuracy of recognition can decrease significantly. It's other limitation can be Limited Scalibility,etc.

V. CONCLUSION

The Local Binary Pattern Histogram (LBPH) algorithm and the Haar Cascade technique are two well-known algorithms whose functions are thoroughly examined in this work. The field of facial recognition technology heavily relies on these algorithms.
LBPH is a noteworthy technique in the field of facial recognition. Students can still be reliably identified by our method even in the event of incidental changes, such shaving or wearing glasses. Nevertheless, one of the challenges we face is the restricted quantity of our dataset. In the future, it will be necessary to work toward building a larger dataset, which could result in improved accuracy in real-world applications. Furthermore, training additional examples of Haar Cascade classifiers could improve their recognition accuracy for unknown users. Additionally, incorporating a system alert that includes both visual and audio indicators could be used to warn teachers to any intruders found within the classroom.

VI. ACKNOWLEDGEMENT

We would like to sincerely thank our project guide Mr. Vipin Deval sir for guiding throughout this project work also would like to thank our other faculty members from the Computer Science and Engineering department at KIET Group of Institutions for allowing us to perform our project work.

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