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Fingerprint and Face Recognition Based Attendance System for Exams

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Abstract

In educational institutions, managing attendance efficiently and accurately is pivotal for ensuring academic integrity and administrative effectiveness. Traditional attendance tracking techniques, including human roll calls or barcode scanning, are laborious, error-prone, and vulnerable to fraud. Traditional methods of keeping track of attendance, including sign-in sheets and physical roll calls, are often time-consuming, prone to errors, and lack the security measures needed in many contemporary settings. Modern biometric technologies have made it possible to integrate a more secure, accurate, and efficient attendance management system in answer to these difficulties. Radio-frequency identification (RFID)-based attendance system: Students will be given an RFID tag, which they must show to the RFID reader in order to participate. But in order to use these strategies, students must stand in line every time they visit the office, which takes time. The proposed system integrates state-of-the-art biometric authentication techniques to provide a robust and reliable solution for automating the attendance process. Overall, the fingerprint and face recognition–based exam hall attendance system outlined in this paper offers a comprehensive solution for addressing the challenges associated with traditional attendance tracking methods by leveraging cutting-edge biometric technologies, the system enhances efficiency, accuracy, and security, ultimately contributing to the integrity and credibility of the examination process in educational institutions.

Keywords: Fingerprint recognition, authentication, face recognition, attendance system, live face detection

INTRODUCTION

Introduction of a smart attendance system using face detection and fingerprint technology represents a significant leap forward in the realm of attendance tracking and workforce management. Conventional techniques for recording attendance, such as manual roll calls and sign-in sheets, are frequently laborious, prone to mistakes, and devoid of the security precautions required in a variety of modern environments.

In response to these challenges, the integration of cutting-edge biometric technologies has paved the way for a more efficient, accurate, and secure attendance management system. Radio-frequency identification (RFID)-based attendance system in which pupils will receive an RFID tag; to participate, they must present the tag in front of the RFID reader Peruser. However, using these

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methods requires students to wait in line for a considerable amount of time each time they enter the office [1]. A mobile communication device with a GSM (global system for mobile communications) capability is utilized in addition to RFID capabilities to notify parents of their children's absence. One other function they offer is the ability to update attendance on a web server, which allows an administrator to view attendance on an hourly basis. Wireless local area network (WLAN) technologies can also be used to track attendance by identifying the phones of individuals who have a fingerprint-based unique barcode authentication. The creation of an Android app that allows students to access homework, videos lectures, and pictures from significant occasions is an example of how modern technology is evolving and advancing toward intelligence [2–7].

The current works are inaccurate and in need of more upkeep. A minor amount of modification must be made to the current system in order to increase accuracy for that. The database must hold the biometric information of each individual student and employee, which is crucial to the identification and verification processes. Humans have unique biometric potentials like the iris, which improves authentication and ensures individual identity. These two procedures compare an individual's biometric feature with a template that was previously stored and taken at the time of enrollment [1, 8, 9].

Humans can provide their stride, eye, hand geometry, iris, signature, voice, and fingerprints as biometric templates for identification. The effectiveness of face recognition can be increased by using a variety of machine learning algorithms for classifiers and support vector machines. Statistical techniques are also utilized to create face templates. Most firms find it challenging to manage their workforce, and keeping an accurate record of attendance is crucial to this process. Keeping track of student attendance and recording daily attendance are important tasks for academic institutions. Every academic organization has requirements for students' attendance in class. The majority of higher education institutions base exam eligibility on the completion of a minimal lecture attendance requirement. For this reason, maintaining precise records of student attendance is crucial.

TECHNIQUES FOR RECOGNITION

There are many algorithms and methods used in fingerprint authentication and face recognition. In this paper we have compared algorithms and methods.

Dynamic Time Warping

Dynamic time warping (DTW) is a technique for measuring similarity between two time-variable sequences that can change speed or vary in time, in applications ranging from speech recognition to signature verification (and, yes, from there to fingerprint authentication).

Applications to Fingerprint Authentication: In a fingerprint system, DTW can be used to compare two fingerprint “blobs” by aligning them along the time axis to compensate for differences in how the fingerprint was captured (palm pressure, finger rotation, etc.) [10].

How It Works: DTW finds the best match between two sequences by stretching or squishing the time axis. It calculates a distance score which tells us how similar two sequences are. Lower is better.

Unsupervised Clustering Algorithm

Unsupervised clustering (USC) algorithm is an unsupervised machine learning algorithm for clustering (grouping together) data points into natural clusters without a labelled training data set.

Applications in Face Recognition: In face recognition systems, the USC algorithm is used to group face images into clusters of faces that are similar in terms of facial features, colors, textures, and patterns.

In USC, things begin with arbitrarily assigning clusters to points in the data and use them iteratively to improve the clusters, moving points from one cluster to another to minimize some criterion (often Euclidean distance from points to centers) [11].

Eigenfaces (Principal Component Analysis)

Eigenfaces are a popular way to recognize faces. The process of shrinking the amount of the facial picture data is based on principal component analysis (PCA). Use in face recognition: Eigenfaces are used to represent faces as linear combinations of elementary face components ("eigenfaces"). The covariance matrix of the training set of face photos yielded these eigenfaces, which are the primary elements.

How It Works: Eigenfaces takes a set of face images, calculates their average, and then performs a PCA to find the principal components (eigenfaces). The face image is represented by each of these eigenfaces. During detection, new faces are compared by projecting them into this eigenface space and measuring the distance [12].

Convolutional Neural Network

Convolutional neural networks (CNNs) are deep learning algorithms particularly effective for picture evaluation obligations, which include face recognition.

Usage in Face Recognition: In face recognition, CNNs are trained on massive datasets of face pictures to research functions at various stages of abstraction, from simple edges to complicated facial functions.

How It Operates: Convolutional, pooling, and totally linked layers are among the two layers that make up a CNN. Convolutional layers follow filters to input pics to extract capabilities. Fully linked layers then carry out classification primarily based on these capabilities [13].

METHODOLOGY

The working description of a smart attendance system using face detection and fingerprint technology involves several steps and processes to accurately and securely track attendance. For face detection, individuals' facial features are captured and processed to create a unique facial template. For fingerprint recognition, individuals' fingerprints are scanned and converted into a unique fingerprint template. For face detection, a camera captures the individual's face, and the system matches the captured face with the enrolled facial template. For fingerprint recognition, a fingerprint scanner captures the individual's fingerprint, and the system matches it with the enrolled fingerprint template. the working description of a smart attendance system using face detection and fingerprint technology involves enrollment, database storage, real-time matching, security measures, integration with other systems, contactless features, and real time reporting. The system aims to provide an accurate, efficient, and secure method for tracking attendance across diverse organizational settings. We used the Haar cascade algorithm in this project.

Haar Cascade Algorithm

The Haar cascade algorithm is primarily based on machine learning techniques and is in particularly well-suited for real-time item detection. It uses a cascade of classifiers trained with a large quantity of high-quality and bad samples to discover items of interest in photos.

Fingerprint Authentication

Based on the unique patterns seen in each fingerprint, fingerprint authentication is a biometric authentication technique. The system includes taking pictures and photos of the fingerprint, extracting its capabilities, and evaluating them against a stored template for authentication.

Face Recognition

Face recognition is another biometric authentication method that identifies or verifies individuals primarily based on their facial functions. It includes detecting faces in pictures, extracting facial functions, and matching them against a database of recognized faces.

Combining the Haar cascade algorithm with fingerprint authentication and face popularity can enhance the security and accuracy of biometric authentication systems. By leveraging the robust object detection capabilities of the Haar cascade set of rules, these structures can effectively find and extract fingerprints or faces from photographs, enabling accurate authentication.

LITERATURE REVIEW

As per Ikuomola et al.'s [14] article "Fingerprint-Based Authentication System for Time and Attendance Management" fingerprint authentication has been put to the test and shown to be a reliable technique for attaining the necessary automation. The findings indicate that utilizing the manual attendance register and eduTAM takes an average of 23.66 and 6.65 seconds per student, respectively.

As per Mekala et al. [15], in addition to helping to prevent human mistakes and proxy punching, the developed system has shown to offer an alternate method for more effectively and efficiently documenting the attendance of the pupils. It has eliminated the laborious task of keeping an attendance logbook and, at the same time, saved 10 to 15 minutes that would have been needed to take attendance during lecture hour.

FLOWCHART

Flow of information is shown in Figure 1.

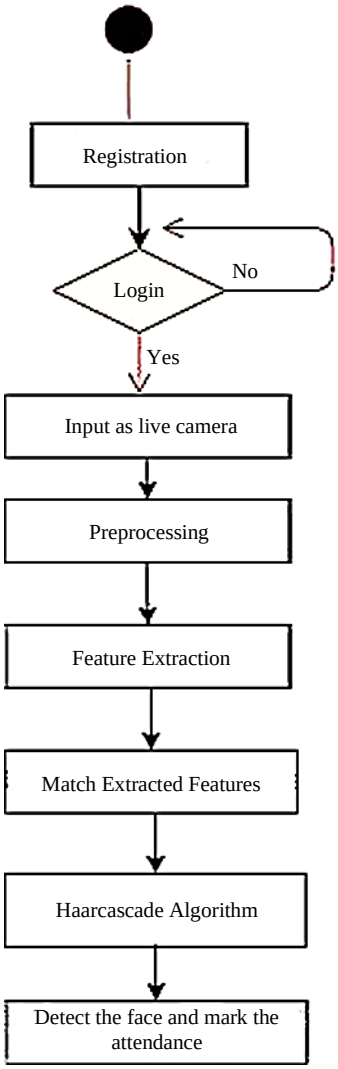

Figure 1. Flow of information.

Registration

This is likely the initial step where a user registers their facial data with the system. This could entail filming or photographing the user's face in order to preserve its distinctive features.

Login

After registration, a user must log in. The flowchart indicates a decision point here with a "yes" or "no" outcome. If the login is not successful ("no"), the process seems to loop back to the login step. If the login is successful ("yes"), the process moves forward.

Input as Live Camera

Once logged in, the system takes input from a live camera, which is presumably capturing the user's face in real time.

Preprocessing

The live camera input undergoes preprocessing, which might include steps like normalizing lighting conditions, aligning the face to a standard orientation, or cropping the image to focus on the face.

Feature Extraction

The preprocessed image is then used to extract facial features. This can entail recognizing prominent features on the face, like the mouth, nose, eyes, and jawline.

Match Extracted Features

The extracted features are compared with the registered features to find a match. This is an essential step in confirming the user's identification.

Haar Cascade Algorithm

In order to identify objects in an image or video, this phase uses the machine learning object identification technique known as the Haar cascade algorithm. In this context, it is used to detect the user's face.

Detect the Face and Mark the Attendance

Finally, once the face is detected and matched with the registered features, the system marks the attendance for the user.

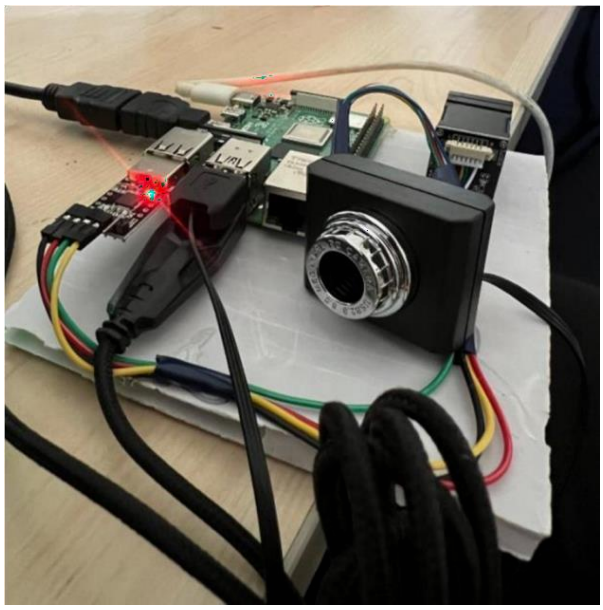

Figure 2. Hardware developed.

RESULTS

The hardware developed and the actual setup is shown in Figures 2 and 3, respectively while results showcasing face identified and output window are shown in Figures 4 and 5, respectively. Face scanning through camera and result detected as face identified are shown in Figures 6 and 7, respectively.

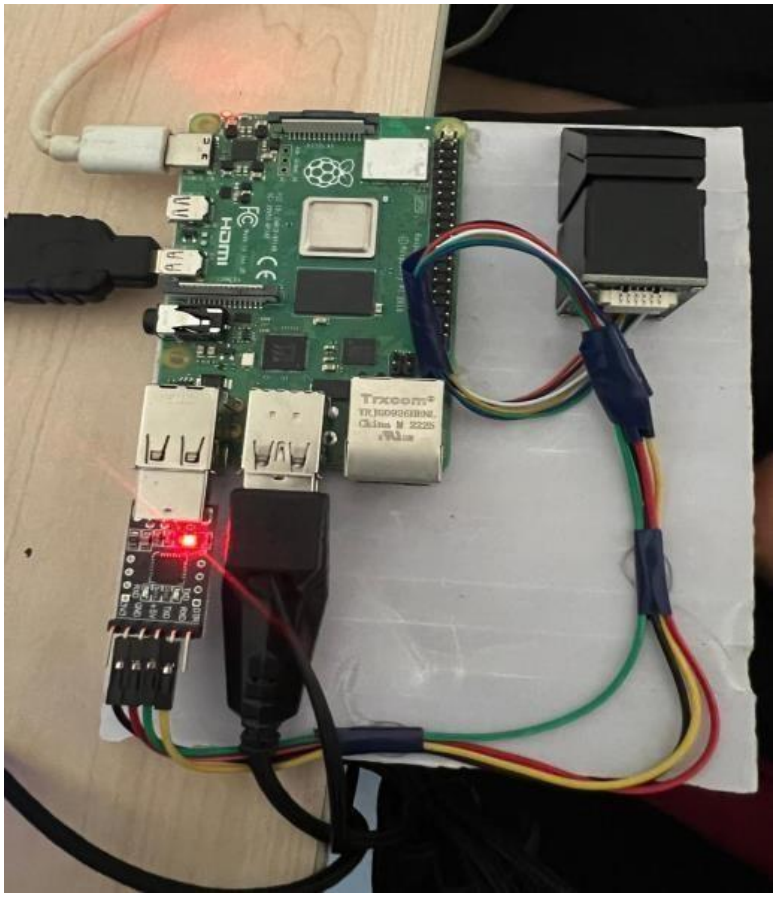

Figure 3. Actual setup.

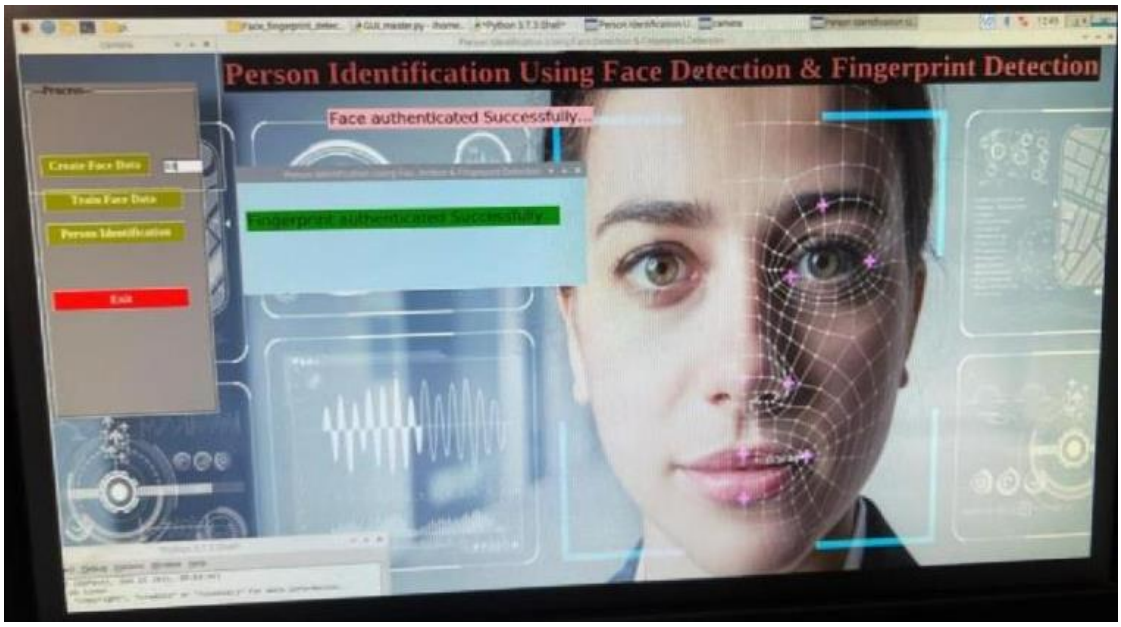

Figure 4. Result showcasing face identified.

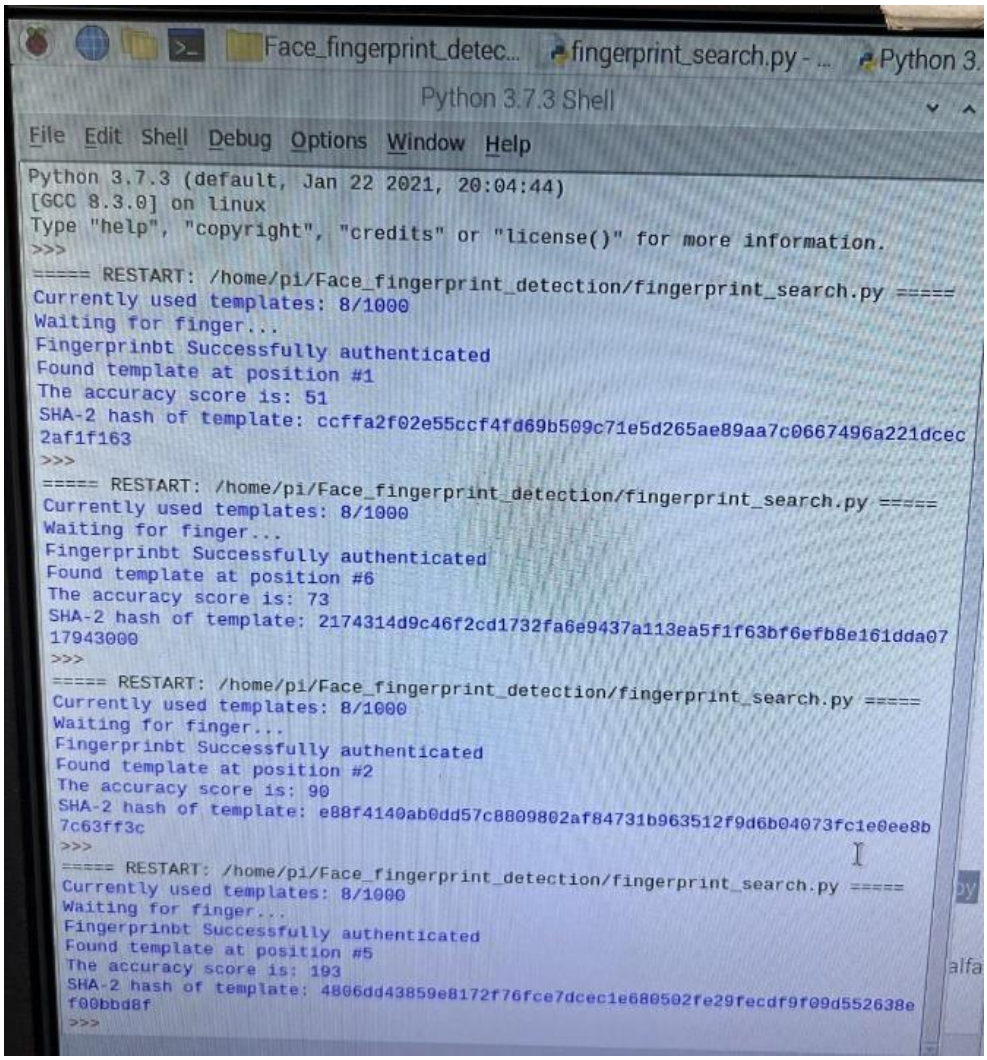

Figure 5. Output window.

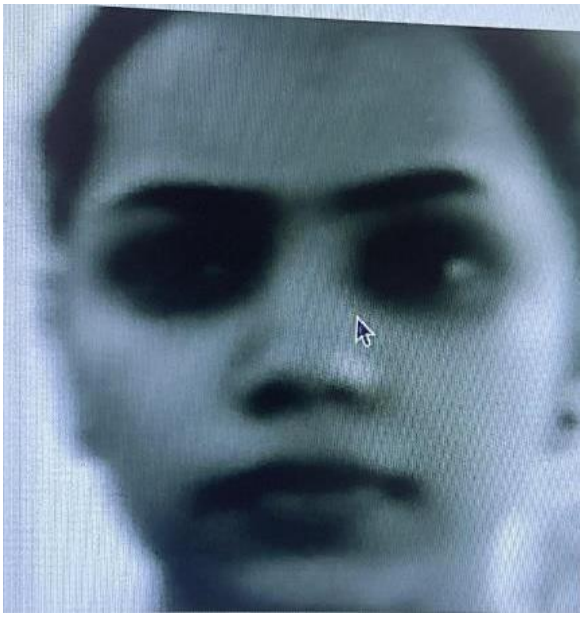

Figure 6. Face scanning through camera.

Figure 7. Result detected as face identified.

CONCLUSION

This project focuses on developing an automated system for attendance. It saves a lot of time and work, particularly when there are many people involved. It can be used in conjunction with video surveillance to identify individuals in busy places like bus stops, theaters, and train stations. Facial recognition technology can be used to identify the offenders in these situations. In the realm of computer vision, face recognition is a difficult problem that has drawn a lot of attention recently due to its numerous applications in a variety of domains. While a lot of research has gone into this field, producing mature face recognition systems that can function in limited environments, the goal of having these systems function well in all the different scenarios that real-world applications frequently encounter is still far off.

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