Face Recognition Based Attendance System

A real time face recognition system for attendance

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***Abstract*—In today's digital age, facial recognition is pivotal across sectors. Despite lower accuracy than iris or fingerprint recognition, its non-invasive nature drives its widespread use. It serves security, authentication, and identification purposes. Additionally, it facilitates attendance marking in schools, colleges, offices, etc., though proxy attendance risks persist, amplifying the need for reliable systems. Continuous advancements aim to enhance accuracy and security, ensuring the effectiveness of facial recognition technology in diverse applications.Traditional methods employed in many institutions, such as manual name calling or paper sign-ins, are both time-consuming and insecure. Implementing an automated attendance system utilizing real-time facial recognition technology presents a practical solution for colleges to efficiently track the attendance of both employees and students. This Smart Attendance system streamlines everyday tasks associated with managing personnel. By leveraging a trained database and analyzing multiple texture-based features, the system accurately detects and recognizes multiple user faces.**

Keywords-face recognition , detection , monitoring , openCv

I. Introduction

This project proposes an innovative facial recognition attendance system to streamline tracking in educational institutions. Unlike traditional methods, it seamlessly integrates with teaching activities, reducing disruptions and ensuring accuracy. Facial recognition offers passive identification, enhancing efficiency while maintaining privacy. Leveraging machine learning and high-quality cameras, the system automates attendance marking by comparing captured images to a database of student reference images. By overcoming the limitations of other biometric methods, such as RFID cards or fingerprint recognition, facial recognition ensures reliable attendance tracking without compromising privacy. Advanced algorithms detect and recognize faces, utilizing techniques like Viola Jones, CNNs, and deep learning for accurate identification. Ethical considerations and regulatory frameworks guide the responsible deployment of face recognition technology.

Identify applicable funding agency here. If none, delete this.

This facial recognition system minimizes time-consuming processes like manual sign-ins or RFID card checks, reducing errors and enhancing administrative efficiency. Its ability to operate within complex environments and distinguish individuals despite variations in appearance ensures reliable performance in real-world applications beyond attendance tracking.

II. Related Work

In recent years, a number of face recognition based attendance management system have introduced in order to improve the performance of students in different organization. In [4] Jomon Joseph, K. P. Zacharia proposed a system using image processing, PCA, Eigen faces, Microcontroller, based on Matlab. Their system works only with front face images and there is need of a suitable method which works with the orientation of the system. Ajinkya Patil with their fellows in [5] proposed a face recognition approach for attendance marking using Viola jones algorithm, Haar cascades are used to detect faces in images and recognition performs through Eigen face method. Another approach of making attendance system easy and secure, in [6] the author proposed a system with the help of artificial neural networks, they used PCA to extract face images and testing and training were achieved by neural networks, their system performs in various orientation. A 3D face recognition approach for attendance management system was proposed by MuthuKalyani.K, VeeraMuthu.A [7] has proposed, they marked attendance with monthly progress of each student. There is need for an alternative algorithm which can enhance the recognition on oriented faces. Efficient Attendance Management system is designed with the help of PCA algorithm [8], the have achieved accuracy up to 83 percent but their system performance decreases due to slightly changes in light condition. An eigen face approach along with PCA algorithm for marking face recognition attendance system have introduced by author in [9], they mention comparison of different face recognition algorithm in their paper. Overall it was good approach to maintain record of attendance.

III. Methodology

We propose a cost-effective solution for recording student attendance through face detection technology, named IBAS (Image Based Attendance System). Our method comprises four stages: image acquisition, face detection, attendance registration, and monitoring, aimed at boosting staff productivity and accuracy in attendance records. Unlike traditional methods like fingerprint or retinal scans, our approach employs face recognition techniques, specifically utilizing Haar cascades and the LBPH algorithm for efficient face identification. Haar cascades offer rapid face detection, with separate cascades generated for each user and trained using positive face-containing photos.

1) Image Acquisition: Collect video frames for two seconds to detect faces. Convert each frame to grayscale images.
2) Face Detection: Utilize Viola and Jones face detection algorithm for 150 frames. Apply wavelet transform and integral images to compute Haar features, enabling rapid and accurate face detection.
3) Database Creation: Extract faces from photographs and record them as grayscale images with dimensions of 200x200. Label each image with a unique ID (Student ID and USN) to establish identity. Train faces under various conditions to enhance recognition accuracy.
4) Face Recognition: Store faces of all members in a dataset and train them using NumPy arrays. Save the trained classifier file to label faces in the test dataset obtained from the class. Use local binary pattern histogram (LBPH) for face recognition, assigning each identified face a Student ID label for attendance tracking.
5) Attendance Marking: Upon successful recognition of a face, mark the attendance of the corresponding individual. Associate each recognized face with a unique identifier (e.g., student ID) to track attendance records accurately.

Integrating Haar Cascade classifiers into a face detection system provides a robust and optimal solution, especially for scenarios where real-time processing and simplicity are prioritized. However, it's important to note that Haar Cascade classifiers may have limitations in terms of accuracy, especially in challenging conditions such as varying lighting or occlusions.Depending on the particular specifications and limitations of the system, additional techniques like deep learning-based approaches may be considered for enhanced performance.

LBPH offers a robust and efficient approach to face recognition by capturing and comparing the texture information of facial images. By leveraging LBP and histogram analysis, LBPH can effectively identify individuals based on their facial appearance, making it a valuable tool in various applications requiring accurate and reliable face recognition.

IV. System Design and Implementation

This paper delineates a system with two primary components: the camera acquisition terminal and the server computing terminal. The camera acquisition terminal is stationed within the classroom and is tasked with capturing real-time videos of students' faces. These videos are then transmitted to the server via a connection line for storage and subsequent processing. On the other hand, the server's primary function involves segmenting the video data to extract human images, isolating individual frames, and further segmenting these frames for facial recognition purposes. To refine the recognition accuracy, the server utilizes multi-frame images and filters to enhance the recognition outcomes. It relays these results back to the terminal, which, in turn, governs the terminal's movement and focus adjustments to capture additional video footage of areas with suboptimal recognition, thereby improving overall accuracy.

Fig. 1. Diagram of the Overall Framework

Before initiating any facial recognition processes, the development of a comprehensive face database is paramount. This database serves as a repository against which the system can compare when attempting to identify individuals. During the image retrieval process, the system initiates a prompt requesting the user to input their ID number. Subsequently, the entered input is validated, and the system checks for any duplications within its records. To proceed, the entered ID must consist of precisely 12 digits and must not already be registered within the system to ensure uniqueness. Following validation, the system creates a directory for each individual, wherein their portraits are stored. It is obligatory to store between 10 to 30 portraits per person within this directory. Prior to storing these images, they undergo preprocessing procedures to enhance quality and consistency.

The primary technology utilized in the implementation approach is the open-source computer vision library, OpenCV. OpenCV aims to offer a user-friendly infrastructure for computer vision tasks, enabling the rapid development of sophisticated vision applications. With over 500 functions spanning various vision areas, OpenCV serves as the cornerstone for face recognition technology.

In the system's operation, users position themselves in front of the camera, maintaining a minimum distance of 50cm, and their images are captured. The captured image undergoes preprocessing: the frontal face is extracted, converted to grayscale, and stored. Principal Component Analysis (PCA) is then applied to these images, and the resulting eigenvalues are stored in an XML file.

During recognition requests, the system extracts the frontal face from the captured video frame via the camera. The eigenvalue is recalculated for the test face, and a comparison is made with the stored data to find the closest match.

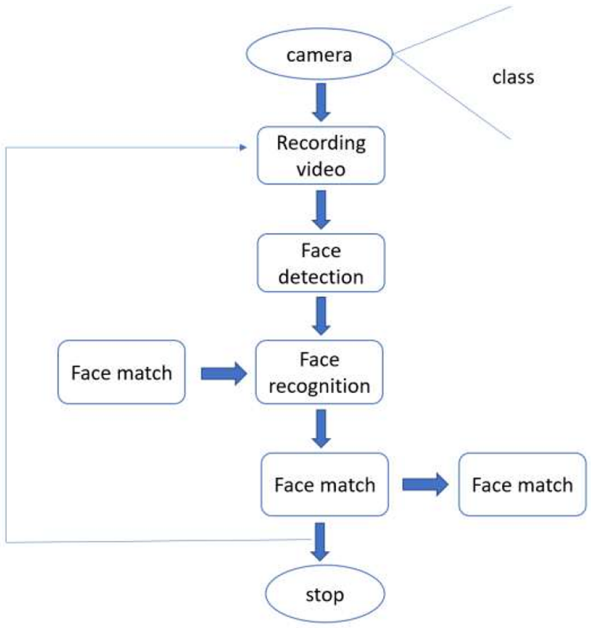

Fig. 2. Face recognition attendance system flow diagram

V. EXPERIMENT AND RESULT

Experiment Steps:

1) Face Detection: Begin by capturing images through the web camera on the client side. Pre-process the captured image and extract the face image. Calculate the eigenvalue of the captured face image and compare it with the eigenvalues of existing faces in the database. If the eigenvalue does not match with any existing ones, save the new face image information to the face database (XML file). If the eigenvalue matches with an existing one, proceed to the recognition step.
2) Face Recognition: Utilize the PCA algorithm for face recognition with the following steps: Find the face information of the matched face image from the database. Update the log table with the corresponding face image and system time, indicating the completion of attendance for individual students. This section presents the results of experiments conducted to capture the face into a grayscale image of 50x50 pixels.

A. Results

- Face Detection Accuracy: The face detection algorithm demonstrated high accuracy, successfully detecting faces in the majority of test images. However, performance degraded with increasing face angles relative to the camera.
- Recognition Rate: The recognition algorithm exhibited promising performance, accurately identifying individuals in most cases. However, recognition accuracy decreased with non-frontal face angles and variations in lighting conditions.
- Attendance Logging: The system efficiently logged attendance records in real-time, providing a reliable means of tracking individual participation.

VI. FUTURE PROSPECTS

In addition to the aforementioned directions, further enhancements will focus on optimizing system scalability and reliability to accommodate growing organizational needs and ensure uninterrupted operation. This entails exploring advanced cloud-based solutions that offer elastic computing resources and robust disaster recovery mechanisms. Moreover, the system will undergo continuous refinement to adapt to evolving industry standards and emerging technological trends, such as edge computing and artificial intelligence-driven analytics. Efforts will also be directed towards fostering a culture of innovation within the organization, encouraging cross-functional collaboration, and fostering partnerships with leading technology providers to leverage cutting-edge solutions and drive continuous improvement.

Additionally, the system will prioritize user-centric design principles to deliver an intuitive and seamless experience, catering to the diverse needs and preferences of stakeholders. Through these multifaceted initiatives, the face recognition-based attendance system aims to position itself as a cornerstone of organizational efficiency, security, and innovation, driving tangible value and competitive advantage in the ever-evolving landscape of workforce management.

VII. CONCLUSION

The face detection and recognition-based attendance system represents a significant advancement over traditional methods, employing cutting-edge technologies like computer vision and facial recognition algorithms. One key advantage is its ability to reduce errors and prevent fraud, providing a reliable and tamper-proof method for accurately identifying individuals. Additionally, the system streamlines administrative tasks and saves valuable time for both administrators and attendees by automating attendance tracking processes. Its accuracy is notable, even in challenging conditions such as crowded environments or varying lighting. However, privacy considerations are paramount, requiring the implementation of proper protocols to safeguard individuals' privacy rights.

Furthermore, while facial recognition technology has made significant advancements, there may still be instances of inaccuracies, especially in recognizing individuals with certain facial features or in challenging environmental conditions. Thorough testing and validation are imperative to secure the system's dependability and efficiency in real-world scenarios.Ultimately, the face detection and recognition-based attendance system project holds immense potential for revolutionizing attendance tracking processes across various settings. Its advantages in reducing errors, saving time, and improving accuracy are undeniable.With proper safeguards in place, this innovative technology can undoubtedly streamline attendance tracking and enhance efficiency in diverse organizational contexts.

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