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Attendance System using Facial Recognition

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Abstract:

This project proposes an automated attendance system using facial recognition to address the challenges of manual attendance marking. It aims to streamline the process, saving time for both instructors and students. By utilizing facial detection and recognition algorithms, the system identifies individuals and updates attendance records seamlessly.

Keywords **— Attendance, Facial recognition and detection, Haar cascade, LBPH, OpenCV-Python.**

I. INTRODUCTION

This Currently, facial recognition and image processing are captivating areas of study that have barely scratched the surface. Facial recognition, in particular, is rapidly emerging as a preferred biometric method, surpassing traditional options like fingerprints and RFID. Facial recognition systems capitalize on unique facial features, making them a promising avenue for various applications.

This proposed project aims to leverage facial recognition technology to develop an efficient attendance system, addressing the shortcomings of traditional methods such as pen and paper. These conventional methods not only consume time but are also vulnerable to proxies and manipulation. Our objective is to streamline the attendance process, eliminate opportunities for proxies, and reclaim valuable lecture time. The inspiration for this project arose during class discussions, where we observed the significant time devoted to attendance-taking and the lax attitude of students who had already marked their attendance, causing further delays. Recognizing the potential of facial recognition technology in addressing this issue, we decided to explore this field for our project. We believe that delving into areas like image processing and recognition will not only hone our skills but also prepare us for future challenges in this dynamic field.

II. RELATED WORK

Several existing systems closely related to the proposed concept of using facial recognition for attendance marking in classrooms have been examined through a literature survey. The case study was structured around relevant sources focusing on facial recognition and image processing. A descriptive framework was developed based on various design approaches.

One system utilizes Deep Neural Networks (DNN) for face detection, while employing Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) algorithms for image matching. Additionally, a Support Vector Machine (SVM) classifier and Convolutional Neural Networks (CNN) were utilized, achieving an accuracy of 86% with an eleven-image database obtained from video recordings.

Another system implemented on a Raspberry Pi platform utilizes a camera module to capture images. Local Binary Pattern (LBP) algorithm is applied for image comparison, with a servo motor controlling door access based on image matches. This system achieved a high accuracy of 95% with an eleven-image dataset.

In another study, OpenCV 2.4.8 was employed to develop a facial recognition algorithm as part of an attendance system. Eigenface algorithm outperformed Fisherface with an accuracy ranging from 70% to 90% similarity for genuine faces, as evaluated using a Receiver Operating Characteristic (ROC) curve.

A method proposed for enhancing facial recognition involves reducing the candidate gallery set and employing facial component classification. Experiments conducted on the CMU-PIE image database using Principal Component Analysis (PCA) yielded a success rate of 91.7%, focusing on reducing processing time.

In another approach, Convolutional Neural Networks (CNN) were used to detect and extract features from facial images, which were then classified using a Support Vector Machine (SVM) classifier. This method achieved an impressive accuracy rate of 95%.

An application developed for mobile terminals utilizes GPS location along with other functionalities to mark attendance and facilitate interaction. Research conducted on the impact of distance and slope between facial features on recognition showed that an increase in facial features improved recognition accuracy, reaching up to 94.60% with a Multilayer Perceptron (MLP) classifier.

Other systems integrate Near Field Communication (NFC) cards with mobile devices to mark attendance, capturing images of students present. Additionally, systems incorporating Eigenface database with Principal Component Analysis (PCA) were developed to address issues related to image quality and varying light intensities. Furthermore, a facial image recognition system utilizing a correlation image sensor and differential geometry to locate key facial points was developed, culminating in a real-time 3D facial imaging system.

III. EXISTING SYSTEM

Conventional methods of marking attendance, such as pen and paper or signing sheets, are susceptible to manipulation and fraud. Students often exploit these methods by providing proxies or falsifying signatures, giving rise to unfair advantages. However, a facial recognition system presents an impregnable solution to this issue. Each individual possesses a distinct set of unique facial features that cannot be replicated or altered. Therefore, the integrity of attendance records is ensured, as physical presence in the lecture hall is the sole criterion for attendance marking.

Table 1. Existing systems and their limitations.

Existing system	Limitations
Pen and paper	False signatures and proxies
RFID tags	Can be used by anybody, no guarantee
Biometric, fingerprint	Is a costlier approach

IV. RELATED WORK

This section focuses on the proposed techniques, methodologies, and concepts relevant to facial recognition and image processing, specifically tailored to a single process utilizing facial recognition algorithms and image processing techniques.

The proposed project comprises four sequential phases: capture, detection, image matching, and attendance marking.

IV.I Primary Database Creation and Training

The initial database containing student images is generated by capturing a live real-time video of the students. This video is then segmented into thirty frames, converted to grayscale, and only the facial regions are extracted and stored as images. Subsequently, these images undergo training using the LBPH (Local Binary Patterns Histograms) algorithm. During this training process, histogram values corresponding to each image are stored. Later, the stored and trained images are compared against the captured images to mark attendance.

OpenCV software is employed for splitting the video into frames.

IV.II Image Capture Phase

In this phase, the professor utilizes their mobile device equipped with the DroidCam application to capture real-time video footage of the classroom or lecture hall. DroidCam facilitates the connection between the mobile device and the laptop, enabling the use of the mobile camera to capture students present in the classroom. Access to the system is granted to professors through the laptop, where all data is stored.

IV.III Image Detection Phase

During this phase, as the video capturing begins, the Haar Cascade algorithm is simultaneously applied to identify individual faces of students. Key facial features such as eyes, nose, ears, and lips are obtained using line and edge features. The Haar cascade algorithm focuses on detecting the Region of Interest (ROI) of the face, discarding unnecessary regions to streamline image processing and matching. Detected faces are then extracted and stored.

IV.IV Image Matching Phase

This critical phase involves comparing captured images against stored images in the database to recognize students. The LBPH (Local Binary Pattern Histogram) algorithm is employed for this purpose. Each stored image in the database undergoes histogram value calculation, which is then cross-checked against the histogram value of images extracted from the captured video feed. The student's name appears above the detected face, with the confidence level indicating the accuracy of recognition.

IV.V Proposed Architecture

During the Attendance Marking Phase, the system records attendance by comparing uploaded images with those stored in the database. If a match is found, the student is marked present for the lecture, and the attendance record is saved. However, if a student is not recognized, their image is stored in a secondary database, and an alert is generated for the administrator.

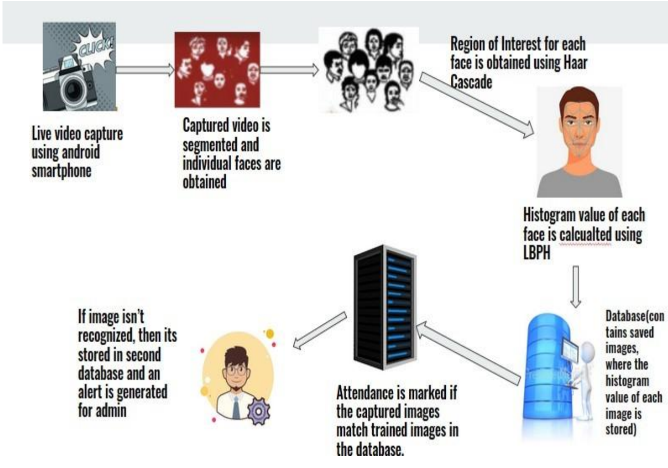

Fig. 1. Proposed workflow and architecture

IV.VI Proposed Architecture

The architecture of the proposed system is designed to be straightforward and user-friendly. It enables easy access for faculty to check and maintain student attendance. The DroidCam app facilitates live video feed capture from the classroom while simultaneously performing recognition for students. OpenCV-Python is utilized to access the Haar Cascade and LBPH algorithms necessary for training, recognition, and matching.

Algorithms Used:

4.6.1 Haar Cascade

The Haar Cascade algorithm utilizes a set of classifiers for object detection, employing a machine learning-based approach with positive and negative images for training.

4.6.2 Local Binary Pattern Histogram

This algorithm is used for face recognition, comparing captured images against those stored in the database. It calculates the histogram value for Local Binary Pattern images and compares it with pre-processed histogram values of stored images.

IV.VII Benefits of the Proposed System

4.7.1 Foolproof
The system eliminates the possibility of false proxies, as it relies solely on the faces of students for attendance marking.

4.7.2 Time Saving
By automating attendance marking, the system prevents disruptions and saves time that may otherwise be lost.

4.7.3 Efficiency
Teachers no longer need to manually update attendance records, as the system performs this task automatically, enhancing efficiency.

V. FURTHER ENHANCEMENTS

To enhance the functionality and reliability of the system in the future, the following improvements could be implemented:

Implementation of a self-generating defaulter list: This feature would automatically generate a list of students with attendance below seventy-five percent after a predetermined amount of time has elapsed.

Differentiation between recognized and unrecognized faces: The system would be equipped to distinguish between recognized and unrecognized faces, storing unrecognized faces in a secondary database for further review.

VI. CONCLUSIONS

This paper presents a straightforward yet effective method for calculating attendance in a classroom using facial recognition techniques. The system's output can be summarized as follows:

As depicted in Fig. 6, the system successfully detects not only individual faces but also multiple students simultaneously. By extension, the system's capacity to handle three faces at once suggests it can accommodate more than fifteen faces simultaneously.

Furthermore, the system accurately recognizes and records the attendance of detected students.

Our aim is to implement a system that is efficient, time-saving, and user-friendly, benefiting both faculty and students alike.

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