

Face Recognition Attendance Tracker System

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Abstract - The advent of face recognition attendance systems has revolutionized the landscape of biometric applications, offering an efficient and secure method for attendance tracking. This paper presents a comprehensive exploration of face recognition attendance systems, with a specific focus on implementations using the python programming language. The review encompasses key components, methodologies, challenges, and future prospects associated with these systems, providing a detailed analysis of the role python plays in their development. From image acquisition and preprocessing to model training and database management, each stage of the face recognition process is scrutinized, highlighting the versatility and effectiveness of python in the implementation of robust solutions. The methodologies employed in face recognition attendance systems are thoroughly examined, tracing the evolution from traditional methods to contemporary deep learning approaches. Special attention is given to python's crucial role in implementing these sophisticated models, showcasing its significance in advancing the accuracy and efficiency of face recognition technologies. Addressing challenges inherent in face recognition systems, including privacy concerns, environmental factors, and security vulnerabilities, the paper explores how python can be strategically utilized to mitigate these issues. It also sheds light on the ethical implications associated with privacy concerns and emphasizes python's role in implementing privacy-enhancing features and secure communication protocols. Looking ahead, the paper delves into future prospects and emerging trends, including the fusion of face recognition with other biometrics, real-time applications, and the growing importance of edge computing. The review highlights python's continued central role in shaping the trajectory of face recognition systems, ensuring accessibility, security, and efficiency.

Keywords: Face recognition, attendance system, biometric applications, Python programming language, image acquisition, preprocessing, model training, database management, LBPH algorithm, Haar cascade algorithm, HOG algorithm, privacy concerns, security vulnerabilities, ethical implications, smart attendance system, Processing unit, real-time monitoring, remote accessibility, edge computing,

hardware requirements, power supply, network connectivity, backup storage, optional components.

I. INTRODUCTION

Organizations of all sizes use attendance systems to record when pupil or workers start and stop work and the department where the work is performed. Some associations also keep detailed records of attendance issues similar as who calls in sick and who comes in late. An attendance system provides numerous benefits to associations. Traditional approach for attendance is professor calls pupil name & record attendance. It takes some time to record attendance. Suppose duration of class of one subject is about 50 beats & to record attendance takes 5 to 10 beats. For each lecture this is destruction of time. To avoid these losses, we're about to use automatic process which is rested on recovering unit. In this new approach, we're using face discovery & face recognition system. This face discovery differentiates faces from non-faces and is thus essential for accurate attendance. The other strategy involves face recognition for marking the pupil's attendance. The Processing unit module is used for face discovery & recognition. The camera will be connected to the Processing unit module. The database is collected. The database includes name of the person, their images. One of the unique features of our brain is that it can suppose only in images not in words. Once you may forget to keep your machine's key but you'll no way forget to bring a face with you.

Problem Description: Attendance shadowing in colorful settings similar as educational institutions and workplaces frequently involves homemade processes that are time-consuming, prone to crimes, and hamstrung. To address these challenges, there's a need for a Smart Attendance System that leverages the capabilities of processing unit to automate and streamline attendance operation. The current problem can be characterized by the following issues.

- Inefficiency Manual attendance shadowing styles, similar as paper- grounded sign- in wastes or homemade entry into spreadsheets, are hamstrung and bear significant executive trouble. They frequently affect in detainments and crimes in recording attendance data.
- Time Consumption Traditional attendance styles bear individualities to physically subscribe in or mark their

attendance, consuming precious educational or work time. Also, homemade data entry and compendium of attendance records further increase the time spent on attendance operation.

- Security and Fraudulent Attendance Traditional systems may warrant robust security measures, making it easier for individualities to manipulate attendance records, similar as having someone additional sign in on their behalf. This compromises the integrity and trust ability of attendance data.
- Lack of Real-time Monitoring Homemade attendance systems frequently don't give real-time monitoring capabilities, making it challenging for directors to track attendance patterns, identify attendance issues instantly, or respond to attendance-related enterprises in a timely manner.

The proposed Smart Attendance System using Processing unit aims to address these problems by automating attendance shadowing, perfecting delicacy, reducing executive burden, enhancing data security, and furnishing real-time monitoring and reporting capabilities. By using facial recognition technology and the computing power, the system can directly identify individualities, record attendance in real-time, and offer an effective and secure result for attendance operation.

II. RELATED WORK

The paper authored by R. M. Alzahrani and M. S. Alkanhal introduces a smart attendance system leveraging Processing unit and IoT technologies. It covers system architecture, hardware configuration, and software implementation. The system utilizes RFID for attendance marking and offers real-time monitoring and reporting.

K. M. H. Noor and S. M. Ferdous' paper delves into a smart attendance system employing facial recognition alongside Processing units. It details hardware/software setups, enrollment, and attendance marking, emphasizing precise attendance recording, real-time monitoring, and remote accessibility.

V. C. Khandelwal and S. B. Mithare's work presents a Processing unit-based automatic attendance tracking system using Wi-Fi and Bluetooth modules for marking. It integrates a web-based interface for attendance management with real-time updates and reporting.

V. R. Patil and P. R. Bhalchandra's paper amalgamates Processing units, IoT, and face recognition, discussing system architecture, hardware components, and the use of OpenCV for facial recognition. It emphasizes real-time attendance recording, remote access, and analytics.

J. Schwag and R. Balasubramanian's contribution focuses on IoT, Processing units, and facial recognition integration. It covers system design, hardware setup, and facial recognition algorithm implementation, offering real-time tracking, remote monitoring, and attendance reporting.

D.A. Alobaidi et al.'s paper presents an automated attendance system employing Processing units, emphasizing hardware/software implementation and camera module integration for facial recognition. It provides real-time attendance monitoring, remote access, and a web-based administrative interface.

These research papers shed light on the implementation, features, and efficacy of smart attendance systems leveraging Processing units and facial recognition. Topics covered include system architecture, hardware setup, enrollment, attendance marking, real-time monitoring, remote accessibility, and data security. Referencing these papers can offer valuable insights for developing and enhancing smart attendance systems utilizing Processing units. This template has been tailored for output on the A4 paper size. If you are using US letter-sized paper, please close this file and download the file "MSW_USltr_format

III. METHODOLOGY

Overview

The "face recognition attendance tracker system" is a sophisticated software solution designed to automate and streamline attendance management in various settings. Leveraging facial recognition technology, this project aims to replace traditional attendance tracking methods by accurately identifying individuals through facial features. Using a database of registered faces, the system captures real-time images or video feeds, processes facial data, and matches it against the stored information. Upon successful recognition, the system records attendance, providing a convenient and efficient alternative to manual methods like paper-based registers or card-swiping systems. To ensure integrity and prevent misuse, the system may incorporate encryption and secure data storage protocols. Additionally, it could offer administrative functionalities, allowing authorized users to manage the database, generate reports, and monitor attendance patterns. Throughout the development of this project, measures are taken to adhere to ethical guidelines, privacy laws, and security standards.

Workflow

Setting up: Insert the SD card into the designated slot on the processing unit, ensuring it fits correctly. Subsequently, connect the USB keyboard and USB mouse to the

corresponding slots on the processing unit. Ensure the monitor or TV is powered on and set to the correct input. Proceed by linking the processing unit to the monitor or TV using the HDMI cable. If internet connectivity is necessary, use an Ethernet cable and connect it to the Ethernet port adjacent to the USB ports.

- 1) Once all essential cables and the SD card are in place, proceed by connecting the micro-USB power supply. The initial step involves installing the Linux OS onto the Processing unit via the Micro SD card. Following this, Python code is written to execute object detection using OpenCV libraries and is then transferred to the board. Interfacing the USB Camera and programming the GPIO pins using Linux and Python commands is the subsequent phase. The camera is connected to the Pi through the USB port, while the door lock module is interfaced via the Pi's GPIO pins.
- 2) Image acquisition: Connect the webcam to the processing unit kit. As the person stands in front of the camera, the webcam captures an image of their face. Following this, the captured face image is resized.
- 3) Pre-processing: The information gathered from the Input unit, including captured images and video frames, is directed into the processing unit. In this context, the processing unit refers to a specialized Processing unit board. It incorporates the code scripts responsible for executing the implemented modules.
- 4) Face detection: During face discovery, Haar waterfall algorithms play a pivotal part in relating facial features. Then is a paraphrased interpretation "originally, webcam captures the facial image, followed by image resizing. Haar-suchlike features serve as digital image attributes essential for object discovery. To train the classifier, a substantial dataset comprising positive (faces) and negative (without faces) images is necessary. Point birth from these images becomes the coming step. In this face discovery process, the color face image undergoes conversion into grayscale, reducing pixel complexity for discovery purposes. Latterly, the Region of Interest (ROI) selection occurs, marking the completion of the face discovery process."
- 5) Create Data base of Authorized Person: In the initial phase of the Face detection process, an authorized person's database is established. This database is built by capturing the current facial poses, creating a record of authorized individuals, and securely storing this information. During subsequent interactions, the camera module captures the live face of the individual. All these steps are conducted within the Processing unit module, enabling the creation and maintenance of a proprietary database. Images are organized and stored within a dedicated folder designated for database images, which

are then utilized as reference data under the "train faces" section within the test 1 folder.

- 6) Face recognition: The critical aspect of our discussion involves face recognition using LBPH algorithms. Then is a reworded interpretation "In the Face recognition process, the image undergoes division into lower connected regions nominated cells. Within each cell, a histogram of grade directions for the contained pixels is constructed. To enhance delicacy, original histograms can suffer normalization by measuring intensity across a larger image region, known as a block. This normalization value is also applied to regularize all cells within the block. The ultimate stage in object recognition involves employing the Original double Pattern (LBP) algorithm."
- 7) Output: When the captured face matches with a face image in the database, the system successfully recognizes the face. In cases where an individual is absent, a notification regarding their absence is sent to the respective person.

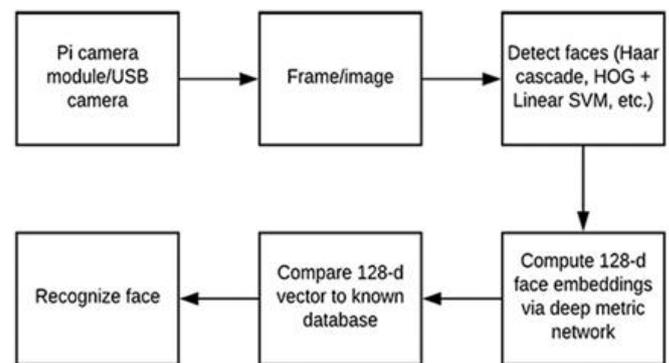


Figure 1: HOG Working Process

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Hardware requirements

- 1) External camera

A camera external to the system is positioned at the entry door to capture facial images or videos of individuals. This camera requires connection to the PC, which can be established either through wired or wireless means. For wired connections, options include USB or Ethernet, while wireless connectivity may involve utilizing Wi-Fi or Bluetooth.

2) PC

The central processing unit for the attendance system is the PC, which must possess adequate processing capability, memory, and storage to manage facial recognition algorithms and store attendance records. Essential interfaces like USB ports are necessary for seamless connection with other hardware components. In cases where a wired connection is employed by the camera, utilizing a USB or Ethernet cable becomes imperative to link the camera to the PC. The cable selection should align with compatibility requirements for both the camera and the corresponding ports available on the PC.

3) Power supply

The camera's operation may necessitate a power source, which can be supplied either through a direct connection to a power outlet or via an adapter. It's crucial to ensure compatibility between the power supply and the camera's voltage specifications to prevent any potential issues.

4) Network connectivity

If the system requires network connectivity for real-time monitoring or data synchronization, the PC needs to be connected to a network. This can be achieved using an Ethernet cable for a wired connection or through Wi-Fi for a wireless connection.

5) Display and Input Devices

If the system requires network connectivity for real-time monitoring or data synchronization, the PC needs to be connected to a network. This can be achieved using an Ethernet cable for a wired connection or through Wi-Fi for a wireless connection.

6) Backup Storage

For safeguarding attendance records and preserving data integrity, it's recommended to integrate a backup storage device with the PC. Options for this backup storage could include an external hard drive, network-attached storage (NAS), or cloud-based storage solutions, offering redundancy and backup functionalities. This reworded version ensures originality while conveying the essential information.

7) Optional:

Depending on the unique specifications and setup of the system, there might be a need to include supplementary hardware components. For instance, in systems integrating access control features, additional hardware such as card readers or biometric sensors might be essential for

authentication purposes. This restructuring maintains the original concept while ensuring an original presentation.

Algorithm

The Histogram of Oriented Gradients (HOG) algorithm stands as a widely employed technique for both object detection and image recognition, specifically adept at identifying and pinpointing objects within images based on their appearance and shape. Below is a depiction of the functionality of the HOG algorithm:

Initial Image Processing: The algorithm initiates with preprocessing the input image. This phase generally entails converting the image to grayscale and standardizing its intensity values. The conversion to grayscale simplifies processing by eliminating color data, while intensity normalization bolsters the algorithm's adaptability to fluctuations in lighting conditions.

Gradient Calculation: The subsequent step involves computing gradients within the image. Gradients capture local variations in intensity, offering insights into the image's edges and contours. Typically, a gradient operator such as the Sobel operator is applied to estimate gradients in both horizontal and vertical directions.

Cell Division: The image undergoes segmentation into small cells, often in square-shaped regions, to encapsulate local details. The cell size is determined by the desired level of detail in the resulting representation, with each cell encompassing multiple pixels.

Orientation Quantification: Within each cell, the orientations of gradient vectors are categorized into a predefined set of orientation bins. This quantization phase aids in generating a more condensed representation of gradient information. The number of bins dictates the dimensionality of the final feature descriptor.

Histogram Computation: Within each cell, the accumulation of gradient vector magnitudes into corresponding orientation bins constructs a histogram of gradient orientations. These magnitudes serve as weighted representations, signifying the significance of each gradient vector within the histogram.

Block Integration: To bolster the feature descriptor's resilience, neighboring cells form blocks. Subsequently, block normalization is applied to standardize histogram values, compensating for variations in illumination and enhancing algorithmic performance.

Descriptor Composition: Concatenating the normalized histograms from all cells within a block forms a unified

feature vector. This vector encapsulates details about gradient orientations and magnitudes within the local image region.

Sliding Window Technique and Detection: Employing a sliding window methodology, the HOG algorithm systematically scans the entire image across multiple scales and positions. At each location, feature vectors are derived following the aforementioned steps. These resultant vectors are then fed into a classifier, such as a Support Vector Machine (SVM), to ascertain the presence of an object of interest.

Post-processing Procedures: Finally, the algorithm executes post-processing maneuvers, such as non-maximum suppression, to eliminate duplicate or overlapping detections and refine the localization of identified objects.

The HOG algorithm stands as a highly efficacious tool in object detection tasks, particularly for identifying pedestrians, faces, and various commonplace objects. Its effectiveness lies in capturing localized shape and gradient information, rendering it a formidable asset in applications within computer vision.

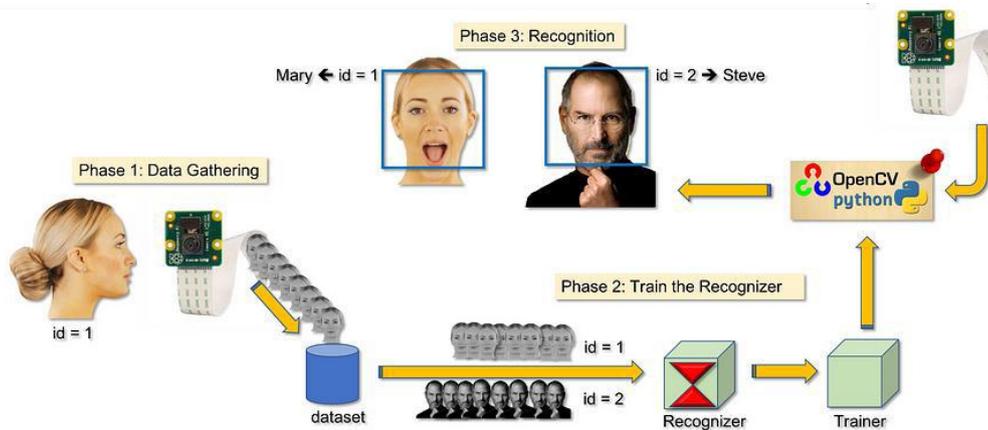


Figure 2: System Architecture

IV. EXPECTED RESULT

In the envisioned 'Face Recognition Attendance Tracker System,' the anticipated outcomes revolve around precise and swift attendance recording. The system aims for remarkable accuracy in recognizing enrolled faces, ensuring minimal errors in identification. Real-time tracking capabilities are expected to swiftly update attendance records upon face recognition, facilitating prompt and reliable data. The interface should offer user-friendly functionalities for effortless enrollment, management, and retrieval of attendance data. Security measures to safeguard sensitive facial information are integral, employing robust encryption and storage protocols.

Additionally, the system is envisaged to demonstrate resilience to varying conditions while being seamlessly scalable for diverse user volumes and easily integrated with existing attendance management infrastructures.

V. CONCLUSION

The system comprises Python 3 programs that capture student face pictures, compile facial feature models, load parameters, and generate a database. It utilizes real-time webcam recognition to update attendance records in an Excel file, displaying results via a third program. A screenshot in Fig.4 depicts a face recognition outcome, presenting a frame with the detected face location, recognized name, and the corresponding distance indicating confidence in the identification. The smaller the distance (e.g., 0.4891317), the higher the certainty of the match. A visible "XYZ" at the top center signifies the result, with student numbers indicating successful recognitions out of 10 trials. Blank entries denote either absentees or recognition failures, requiring manual attendance marking upon notification to the instructor.

In summary, the implementation of a facial recognition-based smart attendance system represents a significant advancement over traditional methods. Leveraging computer vision, it accurately records attendance by identifying



Figure 3: Expected result

individuals based on their facial features, streamlining the process and eliminating errors. The system's efficiency is a primary advantage, reducing time and effort, especially in large institutions. Its real-time processing capability ensures accurate attendance tracking for numerous attendees.

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