

Facial Recognition Attendance System Using OpenCV implemented in Python

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Abstract

The Facial Recognition Attendance System is a sophisticated software solution that employs OpenCV and Python to automate the process of attendance tracking in real-time. Designed to replace outdated manual methods, this system utilizes state-of-the-art facial recognition technology to accurately identify individuals as they enter a monitored space. Upon detection and verification, the system records the individual's attendance by logging their arrival time, thereby streamlining the attendance process. This method significantly enhances efficiency, reduces potential for error, and ensures a secure and contactless check-in experience. With its user-friendly interface and quick setup, the system is an ideal application for educational institutions, corporate offices, and public events that require reliable attendance management.

Keywords: Facial Recognition, Attendance management, Automated systems, Biometrics, Real Time Tracking

1. Introduction

The distinctiveness or unique features of a person's face embody their identity. This research, utilizes an individual's facial characteristics to automate the attendance system [1-

3]. The attendance of both employees and students holds significant importance for any organization. The traditional methods of attendance taking involve RFID card systems, fingerprint scanners, and voice recognition systems, but these can be susceptible to employee or student manipulation [4-7]. To mitigate such risks, this research employs an automated process based on image processing. Within this research, both face detection and face recognition techniques are utilized. Face detection locates the facial region, while face recognition marks the attendance of the individual. The system stores a database of all employees within the company. When an employee's face matches one in the database, their attendance is recorded along with the precise entry time [8-10].

2. Related Work

2.1 RFID based Attendance System

An RFID-based attendance monitoring system is proposed in this paper [7], which aims to provide a more efficient and secure solution compared to manual attendance recording. The system uses RFID tags attached to employee or student ID cards, which are scanned by an RFID card reader to record attendance. The system consists of both hardware and software components based on IoT technology, with a web-based GUI for viewing attendance records. The system eliminates the need for paper-based attendance and provides a more accurate recording of attendance. The RFID reader operates at a frequency of 125 kHz and has a maximum range of 5 cm. The system is suitable for various educational institutions, corporate offices, and government offices.

2.2 Voice based Attendance System

In this paper [8], the author proposed a system with a speech recognition biometric feature for attendance tracking. Speech is distinctive in its pitch, loudness, and tone variations. Thus, a person's speech can be used to individually identify him or her. The author presented a system that uses voice recognition to register attendance for users and students. Speaker verification is the process of verifying individuals using voice. The speech-based attendance system fails in busy and noisy places, as it requires a single speech input for successful

identification. Additionally, the speech can be mimicked. Many candidates replicate the sounds of others, making the system open to fraudulent attendance marking.

2.3 Fingerprint based Attendance System

In the paper [9], the author proposed utilizing fingerprints to mark attendance. This system handles fingerprint recognition using two microcontrollers. The fingerprint pattern will first be collected using a fingerprint sensor, and then transferred to microcontroller 1. Microcontroller 1 will then transfer the information to microcontroller 2 for verifying against the database. After identifying a student match, the information is delivered to the PC through serial communication and displayed. This design is beneficial since it speeds up development while maintaining design flexibility and simplifying testing. However, this system is not portable because it is tethered to a PC. Aside from that, the information in the database is difficult to obtain. This means that parents who are interested in understanding their child's attendance cannot readily or comfortably obtain the information. As a result, to make the student's information available to the legitimate interested party, it might be uploaded to a web server for convenient access. While authentication for acceptable access can be ensured with a login screen.

3. Proposed Work

Assembling and Design of Components: The prototype of the proposed device shall be assembled and designed.

Coding: Necessary coding is uploaded to the PyCharm.

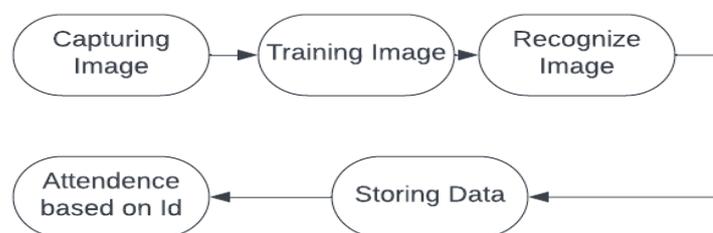


Figure 1. Shows the Proposed Device Block Diagram

3.1 Methodology

Image Collection

- The system collects images stored in a designated folder. Each image is expected to be named in a way that includes an ID number corresponding to the individual in the image.

Image Processing and Label Extraction

- Each image is converted into a grayscale image using the PIL library to reduce computational complexity.
- The images are then converted into NumPy arrays, which are suitable for processing with OpenCV.
- The ID is extracted from the filename of each image.

Recognition and Attendance Logging

- Develop Recognition Module: Create a script to recognize faces in real-time using the camera feed and the trained model.
- Log Attendance: Upon recognition, log the individual's attendance with a timestamp in a database or a file.

4. Instructions

Here are step-by-step instructions for a research on a Facial Recognition Attendance System using OpenCV and Python:

- a. Install Python: Ensure Python 3.x is installed on your system.
- b. Install Dependencies: Install OpenCV, NumPy, and Pillow with pip:

1. pip install opencv-python numpy Pillow

- c. Prepare Dataset: Create a directory for training images. Each individual's images should be in a sub-folder named with their ID or name.
- d. Capture Images: Develop or use an existing script to capture multiple images of each individual using a webcam or camera connected to your system.
- e. Preprocess Images: Implement a preprocessing step to convert images to grayscale as it simplifies the algorithm and reduces computational requirements.
- f. Detect Faces: Use Haar Cascades provided by OpenCV to detect faces in the images.
- g. Save Detected Faces: Crop and save the detected faces with a unique ID for each individual in a database folder.
- h. Implement Training Script: Use the TrainImages function to train the face recognizer on the preprocessed and labeled images.
- i. Save Training Model: Store the trained model in a file (e.g., Trainer.yml) for later use in recognition.

5. Results and Discussion

Once facial recognition successfully identifies an individual, their corresponding user ID and name are prominently displayed above the recognized face rectangle within the video frame. This integrated display ensures clear association between the recognized face and the individual's identity, enhancing the user experience for attendance tracking purposes. The efficiency of the system is underscored by its swift operation, taking a mere 3 seconds to recognize and record the attendance of each employee. This rapid processing minimizes delays and optimizes time management within the organization's attendance tracking workflow. Furthermore, the system ensures comprehensive documentation of attendance records by emailing an attendance sheet containing employee details such as ID and name, along with the exact entry time for each employee. This automated email feature guarantees

the accuracy and reliability of attendance data capture, facilitating streamlined record-keeping and administrative management. The Figures 2-7 shows the results observed for the proposed.

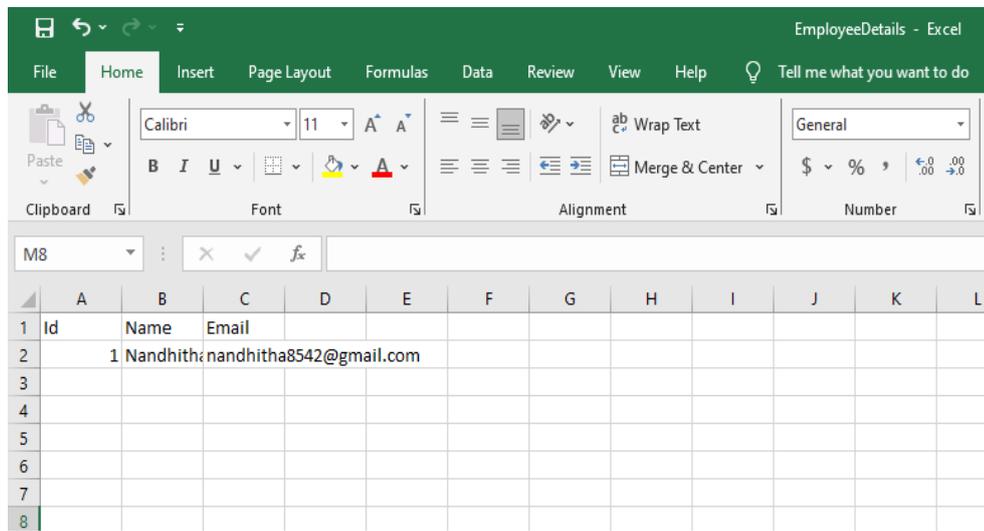


Figure 2. Student Details

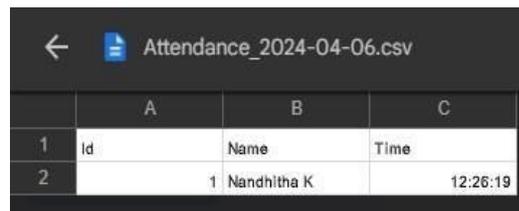


Figure 3. Sample Attendance Sheet

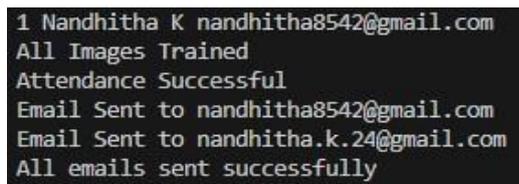


Figure 4. Output Displayed in Terminal

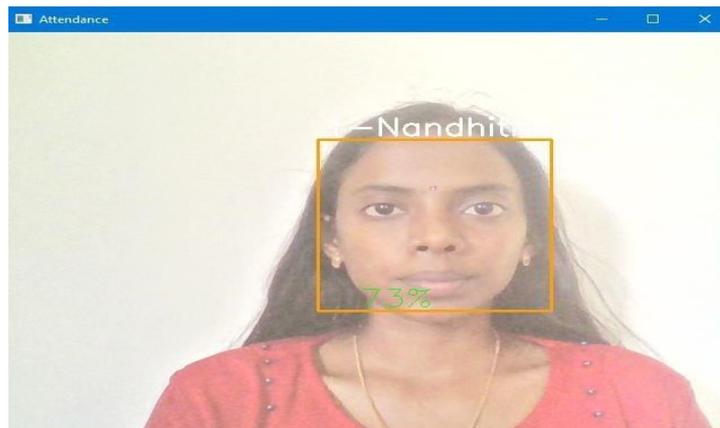


Figure 5. Recognized Face

Attendance Report for April 06, 2024

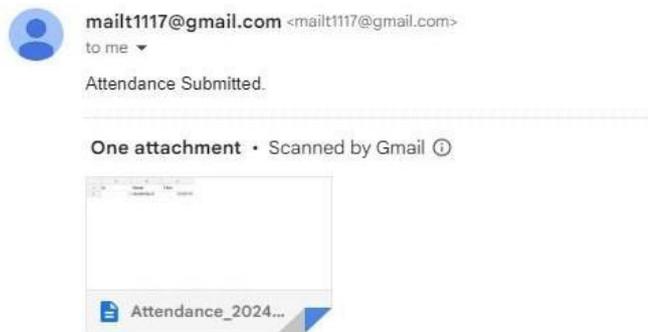


Figure 6. Mail to Employees

Attendance report for - April 06, 2024 Inbox x

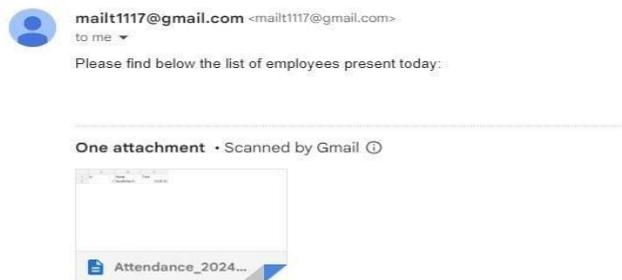


Figure 7. Mail to Administration Department

6. Conclusion

In conclusion, the outlined research involves the development of a Facial Recognition Attendance System solely through software implementation. The process encompasses various stages, including image collection, preprocessing, label extraction, face recognition, and attendance logging. The step-by-step instructions provided offer a detailed guide for implementing the system using OpenCV and Python within development environments such as PyCharm. The methodology described covers essential aspects such as dependency installation, image capture, preprocessing, face detection, saving detected faces, model training, and the preservation of trained models for future use. By employing this comprehensive approach, the objective to create an efficient and reliable system for automating attendance tracking through facial recognition technology is achieved. The Facial Recognition Attendance System operates precisely as intended: it quickly marks attendance, taking an average of just 3 seconds per person. Moreover, it's user-friendly, as it automatically emails the daily attendance sheet to both employees and the administration department. This feature enhances convenience for all parties involved, making the system efficient and accessible for seamless attendance management.

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Author's biography



Nandhitha K is a final year student pursuing her Bachelor's degree in Electronics and Communication Engineering (ECE) at Jeppiaar Institute of Technology. With a keen interest in programming, she specializes in Python coding. Despite being in the early stages of her academic journey, Nandhitha has demonstrated a deep interest in coding and a passion for exploring its applications in the field of ECE. She actively engages in researches and initiatives involving Python programming and IoT, aiming to leverage their capabilities in various technological domains. Nandhitha aspires to continue her exploration of programming languages and contribute to innovative solutions in the realm of technology.



Benisha M is research scholar of Anna University, department of information and communication engineering, and working as Assistant Professor, Department of ECE, Jeppiaar Institute of Technology. She received her Master of Engineering in Communication System with Anna University third rank. She has attended 30 conferences and published 28 papers in international journal among which 9 are indexed in WOS and 16 are indexed in Scopus. Currently she is an Assistant Professor in Jeppiaar Institute of Technology, Chennai, India with 8 years of experience. Her area of research includes 5G Antennas, mm – wave, Microstrip Patch Antennas. She is being the Nano satellite Project Director at Jeppiaar Institute of Technology and working in Launching CANSATs and UNITYSat-JITSat during Feb 28, 2021 in PSLV C51 mission. Currently she is working in the Satellite Project for 75 Student satellite mission 2022 for the 75th independence of India.