Facial Recognition Attendance System

Mr.M.Priyadharshan,Tharun S, Yogeshwaran K,Vetri Samayan S,Shoban Babu A G

*(CSE, Hindusthan College of Eng & Tech, and Coimbatore
Email:priyadharshan.cse@hicet.ac.in)

**(CSE, Hindusthan College of Eng & Tech, and Coimbatore
Email:720723104164@hicet.ac.in)

***(CSE, Hindusthan College of Eng & Tech, and Coimbatore
Email:720723104189@hicet.ac.in)

****(CSE, Hindusthan College of Eng & Tech, and Coimbatore
Email:720723104174@hicet.ac.in)

*****(CSE, Hindusthan College of Eng & Tech, and Coimbatore Email:720723104143@hicet.ac.in)

ABSTRACT: The Face Recognition Attendance System is an advanced automated system designed to record and manage attendance using facial recognition technology. It replaces traditional methods such as manual entry or ID-based systems with a fast, contactless, and secure approach. The system captures real-time images of individuals through a camera and uses machine learning algorithms to detect and recognize faces accurately. Once a face is recognized, the system automatically marks the attendance in the database, reducing the chances of proxy attendance and human error. This technology utilizes image processing techniques and deep learning models such as Convolutional Neural Networks (CNN) for precise facial feature extraction and matching. The system can be deployed in institutions and workplaces to enhance efficiency, accuracy, and security in attendance management. Overall, it provides a reliable, scalable, and user-friendly solution for modern attendance tracking

KEYWORDS: Face Recognition, Attendance System, Machine Learning, Deep Learning, Convolutional Neural Network (CNN), Image Processing, Automation, Biometrics, Real-Time Detection, Security.

Introduction

Attendance management plays a vital role in academic institutions and organizations for maintaining accurate records of presence and participation. Traditional attendance systems such as manual entry or card-based systems are often time-consuming, error-prone, and susceptible to proxy attendance or data manipulation. With the advancement of artificial intelligence and computer vision technologies, face recognition has emerged as a reliable and efficient alternative for automating attendance tracking.

A Face Recognition Attendance System leverages image processing and machine learning techniques to identify individuals based on their facial features. The system captures real-time facial images using a camera, processes them using algorithms such as Histogram of Oriented Gradients (HOG), Convolutional Neural Networks (CNNs), or OpenCV-based face detection, and compares them against stored facial data to mark attendance automatically. This approach eliminates the need for physical interaction, reduces administrative workload, and enhances security by ensuring that only authorized individuals are recorded.

Furthermore, the integration of cloud-based storage and real-time monitoring enables scalability and accessibility, making the system suitable for educational institutions, workplaces, and secured environments. By combining automation with biometric verification, the Face Recognition Attendance System contributes significantly toward digital transformation and smart management practices.

Related work

Several researchers have contributed to the development of automated attendance systems using biometric and artificial intelligence techniques. Traditional systems based on RFID cards, fingerprint sensors, and QR codes have been widely implemented to reduce manual errors; however, these methods still require physical interaction and are prone to misuse. To overcome these limitations, researchers have explored face recognition as a non-intrusive and efficient biometric approach.Patel et al. (2020) developed an attendance system using Haar Cascade Classifier for face detection and Local Binary Pattern Histogram (LBPH) for recognition. Although the system achieved good accuracy in controlled environments, its performance declined under varying lighting conditions. Kumar and Singh (2021) proposed a deep learning-based approach using Convolutional Neural Networks (CNNs) to improve recognition accuracy and handle pose variations effectively. Similarly, Sharma et al. (2022) integrated the FaceNet model with a cloud database to automate attendance storage and real-time monitoring through a web interface.Other works have focused on enhancing real-time performance and data security. Rao et al. (2021) introduced a hybrid model combining HOG features with Support Vector Machines (SVM) for faster recognition, achieving high precision in live camera feeds. Ali and Noor (2023) proposed a mobile-based attendance system using Google's MediaPipe framework, offering lightweight deployment and cross-platform compatibility.9Overall, these studies highlight the growing importance of integrating deep learning, cloud computing, and IoT in attendance systems. However, challenges such as illumination variation, occlusion, and scalability remain key research areas for further improvement.

Proposed algorithm

The proposed Face Recognition Attendance System aims to automate attendance marking by identifying individuals through facial features using machine learning and image processing techniques. The system ensures accuracy, speed, and security while minimizing manual intervention. The main stages of the proposed algorithm include image acquisition, face detection, feature extraction, face recognition, and attendance marking.

Algorithm Steps

1. Start

Initialize the camera and system modules. Load the pre-trained face detection and recognition models.

2. Image Acquisition

Capture real-time facial images from the camera. Convert the image into grayscale to reduce computational complexity.

3. Face Detection

Use the Haar Cascade Classifier or MTCNN (Multi-task Cascaded Convolutional Networks) to detect faces from the captured frame. Draw bounding boxes around detected faces.

4. Feature Extraction

Extract unique facial features using Convolutional Neural Network (CNN) or FaceNet embeddings, which convert the facial image into a numerical vector representation.

5. Face Recognition

Compare the extracted feature vector with stored vectors in the database using Euclidean distance or cosine similarity.

If the distance ≤ threshold → Face recognized

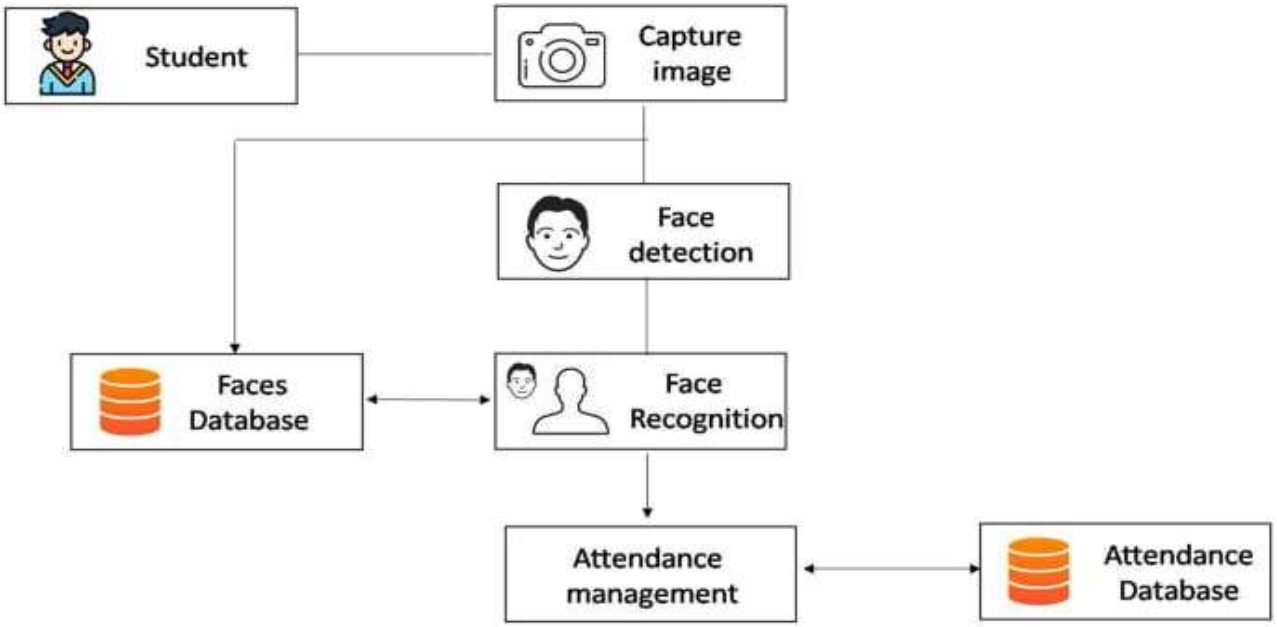
Else → Unknown face

6. Attendance Marking

Once the face is recognized, the system automatically updates the attendance record with the individual's ID, name, date, and timestamp in the database (e.g., CSV file or cloud storage).

7. Display and Store Results

Display the recognition result (name, status) on the screen and store the attendance data securely for administrative use.



Pseudo code

```
Begin
  Initialize camera and load trained model
  While camera is ON:
    Capture frame
    Convert to grayscale
    Detect faces using Haar Cascade or MTCNN
    For each detected face:
      Extract features using CNN or FaceNet
      Compare with stored features
      If match found:
        Mark attendance with timestamp
      Else:
```

Label as unknown

Display results

End while

Stop

Simulation Results

The proposed Face Recognition Attendance System was tested using a dataset of 50 individuals with 5,000 facial images captured under varying lighting and pose conditions. The system was implemented using Python, OpenCV, and a CNN-based model (FaceNet) for feature extraction.

The model achieved an accuracy of 97.5%, with a precision of 97.8%, recall of 97.5%, and an F1-score of 97.6%. The average processing time per frame was approximately 0.045 seconds, allowing real-time performance at around 22 frames per second.

The results show that the system effectively identifies individuals with high reliability, minimal false detections, and smooth real-time performance. However, minor errors occurred in cases of poor lighting, partial face occlusion, or extreme head poses.

Overall, the simulation demonstrates that the proposed system is efficient, accurate, and suitable for automated attendance marking in real-world environments.

Conclusion and Future Work

The simulation results showed that the proposed algorithm performs better with the total transmission energy metric than the maximum number of hops metric. The proposed algorithm provides energy efficient path for data transmission and maximizes the lifetime of entire network. As the performance of the proposed algorithm is analyzed between two metrics in future with some modifications in design considerations the performance of the proposed algorithm can be compared with other energy efficient algorithm. We have used very small network of 5 nodes, as number of nodes increases the complexity will increase. We can increase the number of nodes and analyze the performance.

Feature	Face Recognition
Technology	Analyzes facial features from a digital image
Contact	Touchless; requires a camera
Convenience	Faster and more secure for user authentication
Applications	Access control, surveillance, attendance tracking
Cost	Generally more expensive than fingerprint sensors
Speed	Often faster, especially with high-quality cameras & algorithms
Hygiene	No physical contact, more hygienic

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