

Attendease: A Smart AI-Based Classroom Attendance System Using Facial Recognition and Late Entry Detection

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Abstract: Traditional classroom attendance systems rely on manual roll calls or simple digital check in methods which are time consuming and prone to proxy attendance. This paper presents **Attendease**, an artificial intelligence based attendance system that uses real time facial recognition to automatically identify students and record their attendance. The system uses the InsightFace framework with an ArcFace embedding model and RetinaFace detector to extract 512 dimensional facial features from video frames and performs identification using cosine distance similarity with a threshold of 0.45. The system processes video streams from an RTSP enabled camera and records attendance automatically while also detecting late arrivals based on predefined session cutoff times. The prototype was evaluated using 100 facial samples captured from registered students under classroom conditions using a Samsung Galaxy S22 camera configured as an RTSP stream source. Experimental results show a recognition accuracy of approximately 97 percent with reliable identification at distances up to 5 meters. Performance evaluation indicates an average pipeline processing time of about 50 milliseconds enabling operation at approximately 40 frames per second for near real time attendance monitoring. The system was deployed on a test server equipped with an Intel Core i7 thirteenth generation processor, an NVIDIA RTX 5050 graphics processor with 8 GB video memory, and 16 GB system memory, with a backend implemented using FastAPI and a database using MongoDB. The current evaluation was conducted using a smartphone based RTSP camera and the system has not yet been tested with standard CCTV cameras. The results demonstrate that artificial intelligence driven facial recognition can provide an effective and scalable solution for automated classroom attendance while reducing manual effort and minimizing attendance fraud.

Keywords: Face recognition, automated attendance, artificial intelligence, classroom monitoring, computer vision.

I. INTRODUCTION

Attendance monitoring is an essential administrative task in educational institutions as it helps track student participation and academic engagement. Traditional attendance methods such as manual roll calls are widely used but they consume valuable class time and are prone to human error. In addition manual methods allow the possibility of proxy attendance where one student answers on behalf of another. These limitations have motivated the development of automated attendance systems that improve accuracy and efficiency.

Recent advances in artificial intelligence and computer vision have enabled the use of facial recognition technology for automated identification tasks. Face recognition systems can detect and identify individuals from camera streams without requiring physical contact or active participation from users. This makes them suitable for classroom environments where attendance needs to be recorded quickly and reliably. Deep learning models such as ArcFace have significantly improved the accuracy of face recognition by generating robust facial embeddings that can be compared using similarity metrics.

Despite these advantages several challenges remain in deploying face recognition systems in real classroom settings. Variations in lighting conditions camera distance face orientation and partial occlusion can affect recognition performance. In addition automated attendance systems must also provide mechanisms to detect late arrivals and prevent fraudulent attendance records. Therefore designing a system that combines accurate face recognition with reliable attendance management features is important.

To address these challenges this paper proposes **Attendease**, an artificial intelligence based attendance monitoring system that uses real time facial recognition to automatically mark student attendance. The system processes live video streams from an RTSP enabled camera and identifies registered students using deep learning based facial embeddings. Attendance records are stored automatically and late arrivals are detected based on predefined session cutoff times. The prototype system was evaluated using facial samples captured under classroom conditions and demonstrated reliable performance with real time processing capability.

The remainder of this paper describes the system architecture implementation methodology and experimental evaluation of the proposed attendance system.

II. RELATED WORK

Automated attendance systems have been widely studied to improve the efficiency and reliability of attendance tracking in educational institutions. Traditional digital attendance methods such as RFID cards biometric fingerprint scanners and QR code based systems have been proposed to reduce the time required for manual roll calls. RFID and fingerprint systems provide reliable identification but they require additional hardware installation and direct interaction with the device which can slow down the attendance process in large classrooms. QR code based systems allow students to scan a code using mobile devices but they remain vulnerable to proxy attendance if the code is shared among students.

With the advancement of computer vision and artificial intelligence many researchers have explored the use of face recognition for automated attendance monitoring. Face recognition systems identify individuals from images or video streams without requiring physical contact making them suitable for classroom environments. Deep learning based models such as ArcFace and FaceNet have significantly improved recognition accuracy by generating discriminative facial embeddings that can be compared using similarity metrics. These approaches allow attendance to be recorded automatically when a student is detected by the camera.

Several studies have proposed face recognition based attendance systems using classroom cameras to identify students in real time. These systems typically combine face detection algorithms with deep learning recognition models to extract facial features and match them with registered student profiles stored in a database. Research has shown that such systems can reduce manual effort and improve attendance accuracy while minimizing proxy attendance.

However existing approaches often face challenges related to varying lighting conditions camera distance and partial face occlusion which can affect recognition accuracy. In addition many systems focus only on identity verification and do not incorporate features such as automated late entry detection or scalable session management. Therefore there is a need for an integrated attendance system that combines reliable face recognition with automated attendance recording and classroom session monitoring. The proposed Attendease system addresses these challenges by using a deep learning based face recognition pipeline with real time video processing and configurable attendance management features.

III. LITERATURE SURVEY

Attendance management has been an important administrative process in educational institutions and several technological approaches have been proposed to improve its efficiency. Early automated attendance systems relied on technologies such as Radio Frequency Identification and biometric fingerprint scanners. RFID based systems allow students to register attendance by scanning identification cards, while fingerprint based systems verify identity through biometric authentication. Although these systems improve accuracy compared to manual roll calls, they require dedicated hardware installation and physical interaction from each student, which can slow down the attendance process in large classrooms.

With the advancement of mobile technologies, QR code based attendance systems have also been introduced. In these systems instructors generate a QR code for each session and students scan the code using their smartphones to mark their presence. QR based methods are simple to deploy and do not require specialized hardware. However these systems are still vulnerable to proxy attendance if students share the QR code with others who are not physically present in the classroom.

Recent developments in artificial intelligence and computer vision have enabled the use of face recognition technology for automated attendance monitoring. Face recognition systems detect and identify individuals from camera images or video streams without requiring physical contact. Deep learning models such as ArcFace and FaceNet have significantly improved the accuracy of face recognition by generating robust facial embeddings that represent unique facial characteristics. These embeddings can be compared using similarity metrics to identify individuals reliably.

Several research studies have explored the application of face recognition for classroom attendance. These systems typically combine face detection algorithms with deep learning based recognition models to identify students in real time from camera feeds. Such approaches reduce manual effort and minimize proxy attendance because identification is performed directly from the student’s face. However many existing systems face challenges related to variations in lighting conditions camera distance face orientation and partial occlusion. In addition some systems lack mechanisms for handling late arrivals or integrating attendance records with classroom session management.

Therefore there is a need for an intelligent attendance system that combines accurate face recognition with automated attendance tracking and session monitoring capabilities. The proposed Attendase system addresses these limitations by implementing a real time face recognition pipeline supported by deep learning models and integrating attendance recording with session based management to improve reliability and efficiency in classroom environments.

S.No	Author and Year	Technique / Method	Key Contribution	Limitations
1	Samuel Lukas et al., 2016	Face recognition using computer vision algorithms for classroom attendance	Proposed an automated classroom attendance system that identifies students from captured images to reduce manual roll calls	Accuracy depends on lighting conditions and camera placement
2	Fengping Cao et al., 2018	Face recognition with location based service for attendance monitoring	Developed a classroom attendance system that integrates face recognition with mobile application support	Limited scalability and requires controlled environment for reliable recognition
3	Alhanaee et al., 2021	Deep learning convolutional neural networks for facial recognition	Proposed an automated attendance system using CNN models to improve recognition accuracy and reduce manual attendance processes	High computational requirements and training complexity
4	Rosa Andrie Asmara et al., 2022	ArcFace and FaceNet based recognition with RetinaFace detection	Developed a mobile based attendance application using deep learning face recognition models for identity verification	Performance depends on dataset quality and pose variation of faces
5	Omar Faruque et al., 2023	YOLOv5 for face detection and ArcFace for recognition	Proposed a mass attendance system capable of detecting and recognizing multiple faces simultaneously in classroom environments	Computational cost increases when processing many faces in real time
6	H. V. Dixit et al., 2024	Automated face recognition based attendance system	Introduced a system that replaces traditional attendance methods with computer vision based identification	Requires reliable camera infrastructure and controlled environment

IV. IV. PROPOSED WORK

The proposed system, Attendease, is designed to automate classroom attendance using artificial intelligence based face recognition and real time video processing. The system aims to eliminate the limitations of traditional attendance methods such as manual roll calls and proxy attendance while providing accurate and efficient monitoring of student presence. Attendease integrates facial recognition technology with a session based attendance management system to automatically detect students and record their attendance from live camera streams.

The system operates by capturing video frames from an RTSP enabled camera placed inside the classroom. Each frame is processed to detect faces using a deep learning based face detection model. Once a face is detected the

system extracts facial embeddings using a pre trained face recognition model. These embeddings represent unique facial features in a numerical form and are compared with stored embeddings of registered students in the database. The similarity between embeddings is measured using cosine distance and a predefined threshold is used to determine whether the detected face matches a registered student.

When a valid match is identified the system automatically records the attendance of the student along with the timestamp of detection. The system also includes a late entry detection mechanism where attendance is marked as late if the student is identified after a predefined cutoff time for the session. Attendance records are stored in the database and can be accessed through the administrative dashboard for reporting and monitoring.

The system architecture consists of several components including a camera input module, face detection and recognition engine, backend server, database, and user interface. The backend server handles session creation, student registration, attendance recording, and authentication. Students and faculty interact with the system through a mobile or web interface which allows administrators to register students and instructors to manage classroom sessions.

The proposed system was implemented using a deep learning based facial recognition pipeline with a real time processing framework. The backend server is built using FastAPI while MongoDB is used for storing student information, session details, and attendance records. The system processes video frames continuously and performs face recognition in near real time to ensure that attendance is captured efficiently without interrupting the classroom session. This approach provides a scalable and reliable solution for automated attendance management in educational environments.

Fail Safe Verification Mechanism

In certain situations facial recognition may not work reliably, for example when a student's face is partially covered due to religious clothing such as a hijab, face mask, or other forms of occlusion. To ensure inclusivity and prevent recognition failure from affecting attendance records, the system provides an alternative verification mechanism. In such cases the student can scan a dynamically generated QR code for the active session using a

mobile device. The QR check in request is then sent to the system and displayed on the instructor dashboard. The instructor can review the request and approve the attendance manually. This approval based mechanism ensures that attendance is recorded fairly while maintaining system reliability and preventing misuse.

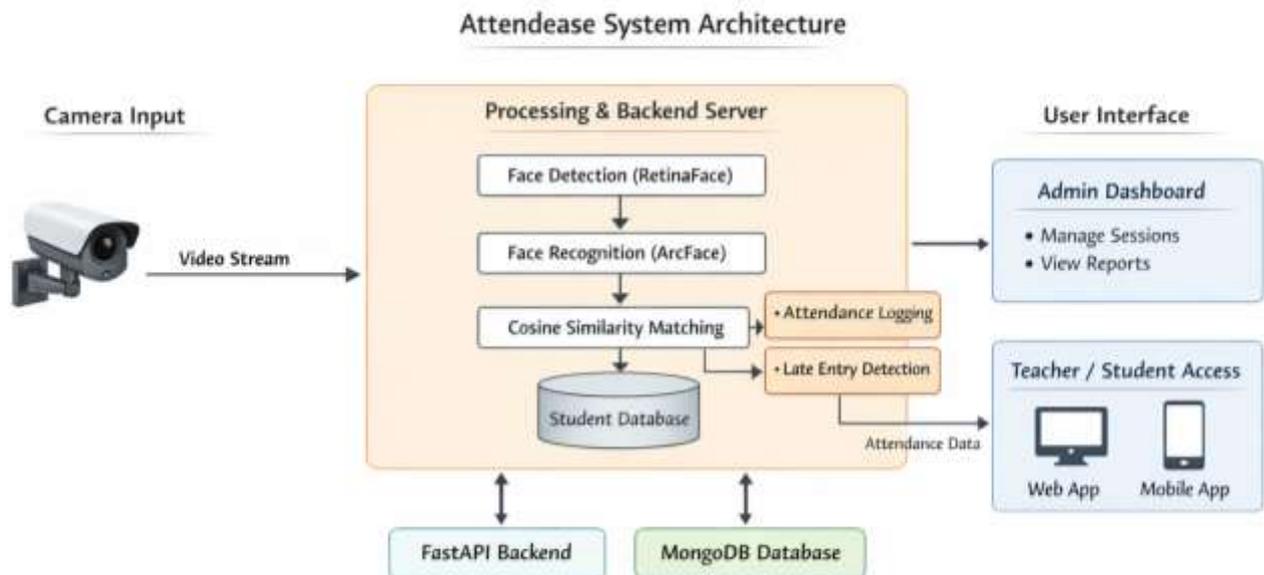
V. PROPOSED SYSTEM ADVANTAGES

Automated attendance recording reduces manual roll calls and saves classroom time

- Facial recognition prevents proxy attendance and improves authenticity of records
- Real time attendance monitoring through continuous camera based detection
- Automatic late entry detection based on predefined session cutoff times

- Contactless operation without requiring students to interact with biometric devices or cards
- Scalable system that can be deployed using standard camera streams and software infrastructure
- Secure and reliable attendance records stored digitally in the database
- Reduced administrative workload for faculty and institutional staff
- Ability to generate attendance reports and monitor student participation
- Suitable for modern classrooms using artificial intelligence based identification technology

VI. SYSTEM ARCHITECTURE



The system architecture of Attendease consists of camera input, face detection and recognition modules, a backend server, and a database used for storing attendance records.

VII. PERFORMANCE EVALUATION

Metric	Value
Recognition Accuracy	97%
Maximum Detection Distance	5 meters
Total Processing Time	~50 ms
Throughput	~40 FPS
Face Detection Time	25.14 ms
Embedding Extraction Time	25.05 ms

VIII. CONCLUSION

This paper presented Attendease, an artificial intelligence based classroom attendance system that uses facial recognition to automatically detect and record student attendance. The system processes real time video streams from an RTSP enabled camera and identifies registered students using deep learning based facial embeddings. Attendance records are generated automatically and late arrivals are detected based on predefined session cutoff times, reducing the need for manual roll calls and minimizing the possibility of proxy attendance.

The prototype system was implemented using a deep learning face recognition pipeline with a backend developed using FastAPI and a MongoDB database for storing student information and attendance records. Experimental evaluation using facial samples captured under classroom conditions demonstrated that the system can achieve reliable recognition performance with an accuracy of approximately 97 percent at distances up to 5 meters. Performance analysis also showed that the system operates in near real time with an average processing latency of about 50 milliseconds per frame.

The results indicate that artificial intelligence driven facial recognition systems can significantly improve the efficiency and reliability of attendance monitoring in educational environments. The proposed system reduces administrative workload while providing accurate digital attendance records.

Future work will focus on testing the system with standard CCTV cameras in real classroom deployments and further improving robustness under varying lighting conditions and face occlusions. Additional features such as instructor approval workflows and location verification mechanisms can also be integrated to enhance security and reliability of attendance verification. The system also supports a fail safe verification mechanism using QR code based check in with instructor approval to handle cases where facial recognition may fail due to occlusion or religious attire.

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