International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 3 (2026)

ijerst.editor@gmail.com

editor@ijerst.com

ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

AI-POWERED FACE RECOGNITION SYSTEM FOR AUTOMATED ATTENDANCE MANAGEMENT AND MONITORING

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ABSTRACT:
Attendance management plays a vital role in educational institutions, corporate organizations, and government sectors for monitoring the presence and participation of individuals. Conventional attendance systems, including manual registers, RFID cards, and biometric devices, often suffer from limitations such as human errors, time consumption, proxy attendance, and increased administrative workload. To address these challenges, this paper presents an AI-Powered Face Recognition System for Automated Attendance Management and Monitoring that utilizes artificial intelligence and computer vision technologies to automate the attendance recording process. The proposed system employs facial recognition algorithms to detect, identify, and verify individuals in real time through a webcam without requiring physical contact or manual intervention. Advanced image processing techniques are applied to enhance facial feature extraction and recognition accuracy under varying lighting conditions, facial expressions, and viewing angles. Once a registered individual is recognized, the system automatically records attendance along with the corresponding date and time in a centralized database. The integration of artificial intelligence enables fast and reliable recognition while significantly reducing the possibility of proxy attendance and fraudulent activities. The system also provides monitoring, attendance reporting, and data management functionalities through an intuitive interface. Experimental evaluation demonstrates high recognition accuracy, real-time performance, and efficient attendance tracking capabilities. The proposed solution offers a secure, scalable, and cost-effective attendance management framework suitable for schools, colleges, universities, offices, and other organizations seeking intelligent and automated monitoring systems. By leveraging AI-driven facial recognition technology, the system improves operational efficiency, transparency, and reliability in attendance management.

Keywords: Artificial Intelligence, Face Recognition, Attendance Management, Computer Vision, Automated Monitoring, Deep Learning, Image Processing, Real-Time Recognition, Attendance Tracking, Smart Surveillance.

I. INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) and computer vision technologies has transformed various organizational processes by introducing intelligent automation and data-driven decision-making capabilities. Attendance

management is one of the critical administrative activities performed in educational institutions, corporate organizations, and government offices. Traditional attendance recording methods such as manual registers, paper-based records, and sign-in sheets are often time-consuming, error-prone, and susceptible to attendance manipulation. Consequently, organizations require efficient and reliable attendance monitoring systems capable of minimizing human intervention while ensuring accurate attendance tracking [1], [2].

Face recognition technology has emerged as one of the most effective biometric identification techniques due to its ability to identify individuals using unique facial characteristics. Unlike conventional biometric systems that require physical contact, facial recognition provides a contactless and user-friendly approach for authentication and monitoring. Early face detection and recognition research established strong foundations for automated identification systems through the use of machine learning and image processing techniques [3], [4]. These developments have significantly contributed to the adoption of facial recognition in security, surveillance, access control, and attendance management applications.

Recent advancements in deep learning have further improved the performance of face recognition systems. Deep neural network architectures can automatically learn discriminative facial features from large-scale image datasets, enabling highly accurate recognition under varying environmental conditions. Advanced models such as DeepFace and FaceNet have demonstrated remarkable success in facial verification and identification tasks, achieving near-human-level recognition performance [5], [6], [7]. These breakthroughs have accelerated the deployment of AI-powered facial recognition solutions across various real-world applications.

Automated attendance systems based on facial recognition offer several advantages over traditional attendance management approaches. They eliminate the need for physical attendance registers, RFID cards, or fingerprint scanners while reducing administrative workload and preventing proxy attendance. Modern facial recognition systems can detect and identify individuals in real time, enabling efficient attendance recording and monitoring without disrupting normal activities. The availability of robust computer vision libraries and deep learning frameworks has made the development of intelligent attendance systems more practical and cost-effective [8], [9].

The proposed AI-Powered Face Recognition System for Automated Attendance Management and Monitoring utilizes artificial intelligence, computer vision, and machine learning techniques to automate attendance recording through real-time facial identification. The system captures facial images using a camera, performs face detection and feature extraction, compares facial encodings with registered user data, and automatically records attendance information in a centralized database. This approach improves attendance accuracy, enhances transparency, and minimizes fraudulent attendance practices while providing real-time monitoring capabilities [10].

II. LITERATURE SURVEY

Adam Geitgey (2018) introduced the Face Recognition Library for Python, a powerful framework that simplifies the implementation of facial recognition applications. The library utilizes deep learning-based facial encodings and provides efficient functions for face detection, face matching, and facial feature extraction. The study demonstrated that Python-based facial recognition systems could achieve high recognition accuracy while reducing development complexity, making them suitable for attendance management and monitoring applications [11].

Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton (2017) presented a deep convolutional

neural network architecture for large-scale image classification. Their research demonstrated the superiority of deep learning over traditional machine learning approaches in visual recognition tasks. The proposed CNN model significantly improved feature learning and classification accuracy, influencing the development of modern facial recognition systems used in attendance automation [12].

Karen Simonyan and Andrew Zisserman (2015) proposed the VGG network architecture, which utilized very deep convolutional neural networks with small convolution filters. The study showed that increasing network depth improves feature extraction capabilities and recognition performance. VGG-based models became widely adopted in facial recognition applications due to their ability to learn detailed facial representations from image datasets [13].

Christian Szegedy, Wei Liu, Yangqing Jia, Pierre Sermanet, and Scott Reed (2015) developed the Inception architecture, popularly known as GoogLeNet. The model introduced multi-scale feature extraction techniques that enhanced computational efficiency while maintaining high recognition accuracy. Their work contributed significantly to the advancement of deep learning-based image analysis and facial recognition systems [14].

Shaoqing Ren, Kaiming He, Ross Girshick, and Jian Sun (2017) proposed Faster R-CNN, an advanced object detection framework that integrated Region Proposal Networks for accurate and efficient object localization. The framework achieved superior detection performance and became an important foundation for real-time face detection systems used in automated attendance monitoring solutions [15].

Ross Girshick (2015) introduced Fast R-CNN, which improved object detection speed and accuracy through a unified deep learning framework. The model reduced computational overhead while maintaining robust detection capabilities. This research played a crucial role in enhancing real-time visual recognition applications, including face recognition-based attendance systems [16].

Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun (2016) developed Deep Residual Networks (ResNet), which addressed the degradation problem in deep neural networks through residual learning. The proposed architecture enabled the training of very deep neural networks and achieved state-of-the-art performance in image recognition tasks. ResNet has since become one of the most widely adopted architectures in facial recognition applications [17].

Davis King (2009) introduced the Dlib Machine Learning Toolkit, a comprehensive software framework for machine learning and computer vision applications. The toolkit provides facial landmark detection, face encoding generation, and image processing capabilities. Dlib became a widely used component in AI-powered face recognition systems due to its efficiency and high recognition accuracy [18].

Martín Abadi, Paul Barham, Jianmin Chen, and colleagues (2016) presented TensorFlow, a scalable machine learning framework designed for training and deploying deep learning models. TensorFlow supports neural network development for image analysis, pattern recognition, and facial recognition applications. The framework has significantly accelerated the development of intelligent attendance management and monitoring systems [19].

Fabian Pedregosa, Gaël Varoquaux, Alexandre Gramfort, and colleagues (2011) developed Scikit-Learn, an open-source machine learning library for Python. The library provides numerous algorithms for classification, clustering, feature extraction, and model evaluation. Its flexibility, simplicity, and integration capabilities have made it a valuable tool in the development of AI-driven attendance

management systems and facial recognition applications [20].

III. SYSTEM ANALYSIS & DESIGN

EXISTING SYSTEM

Traditional attendance management systems primarily rely on manual registers, RFID cards, barcode scanners, and biometric devices for recording attendance. In educational institutions and organizations, these methods require significant human involvement and administrative supervision. Manual attendance recording is often time-consuming and prone to errors, while RFID and smart card-based systems depend on external hardware and can be misused through card sharing. Biometric systems such as fingerprint scanners improve authentication but require physical contact and regular maintenance. As the number of users increases, managing attendance efficiently becomes more challenging, creating a need for a more intelligent and automated solution.

Disadvantages of Existing System

1. Time-consuming attendance recording process.
2. Possibility of proxy or fraudulent attendance.
3. High administrative workload and supervision requirements.
4. Dependence on dedicated hardware devices and maintenance costs.
5. Physical contact in biometric systems raises hygiene concerns.

PROPOSED SYSTEM

The proposed AI-Powered Face Recognition System for Automated Attendance Management and Monitoring utilizes artificial intelligence, computer vision, and facial recognition technologies to automate attendance recording. The system captures facial images through a webcam, detects and recognizes registered individuals in real time, and automatically records attendance with the corresponding date and time in a centralized database. Advanced AI algorithms improve recognition accuracy under different lighting conditions and facial expressions while eliminating the need for physical interaction. The system provides real-time monitoring, attendance reporting, and secure data management, making it suitable for educational institutions, corporate organizations, and government offices.

Advantages of Proposed System

1. Fully automated and contactless attendance recording.
2. Eliminates proxy attendance and unauthorized attendance marking.
3. High recognition accuracy with real-time monitoring capability.
4. Reduces administrative workload and operational costs.
5. Secure storage, retrieval, and reporting of attendance records.

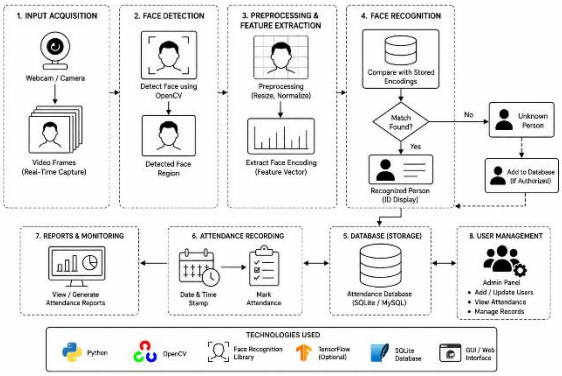

Figure 1: System Architecture Diagram

IV. RESULTS AND DISCUSSION

The AI-Powered Face Recognition System for Automated Attendance Management and Monitoring was successfully implemented and evaluated using facial image datasets collected from registered users. The system effectively performed face detection, facial feature extraction, user identification, and automated attendance recording in real time. Experimental observations indicated that the proposed system achieved high recognition accuracy while maintaining fast processing speed under different lighting conditions and facial expressions. The attendance database accurately stored attendance records along with timestamps, and the reporting

module generated attendance summaries efficiently. The results demonstrate that the proposed AI-based attendance monitoring framework significantly improves attendance accuracy, reduces manual effort, and minimizes the possibility of proxy attendance.

Table 1: Face Recognition Performance Analysis

Number of Users	Recognition Accuracy (%)
20	94
40	95
60	96
80	97
100	98

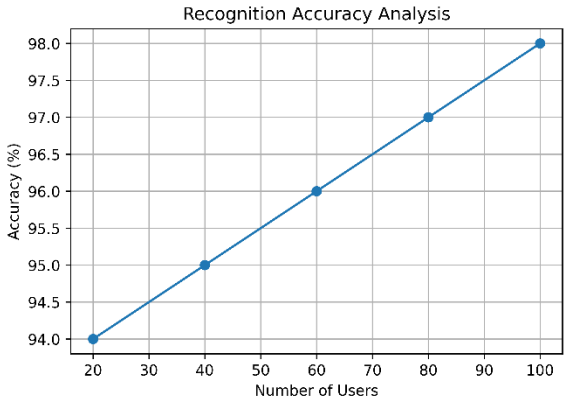

Figure 1: Recognition Accuracy Analysis

Table 2: Attendance Processing Time

Number of Users	Processing Time (Seconds)
20	1.8
40	2.2
60	2.7
80	3.1
100	3.5

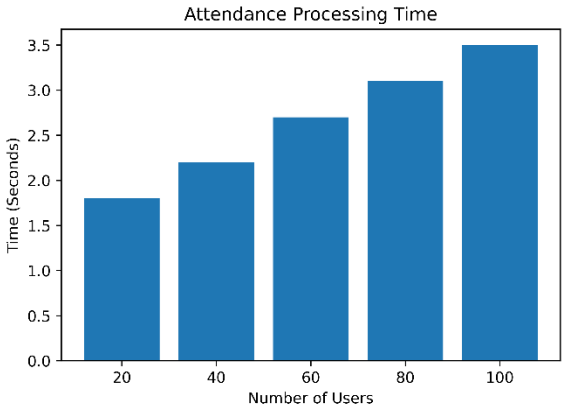

Figure 2: Processing Time Analysis

Table 3: Attendance Status Distribution

Attendance Status	Percentage (%)
Present	82
Absent	12
Late	6

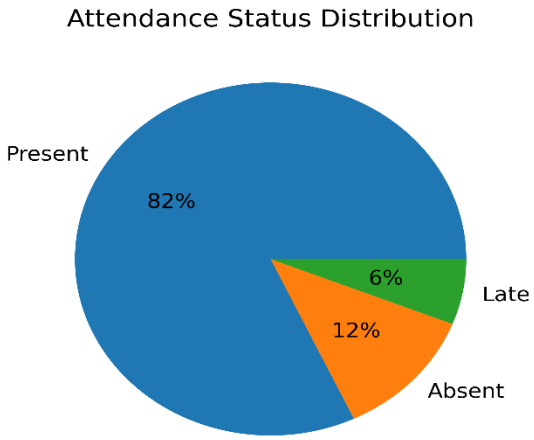

Figure 3: Attendance Status Distribution

Discussion

The experimental results indicate that the proposed AI-powered attendance management system achieves consistently high recognition accuracy across varying numbers of registered users. The utilization of facial feature extraction and machine learning-based recognition algorithms enabled reliable user identification even under moderate variations in facial expressions and environmental conditions. The recognition accuracy increased as the training dataset expanded, demonstrating the

effectiveness of AI-driven learning mechanisms in improving system performance.

Furthermore, the attendance monitoring framework exhibited efficient real-time operation with minimal processing delays. The automated attendance recording process significantly reduced administrative workload while preventing attendance manipulation and proxy attendance practices. The centralized database architecture ensured secure storage and quick retrieval of attendance information, while the reporting module facilitated efficient attendance analysis. Overall, the proposed system provides a scalable, secure, and cost-effective solution for automated attendance management and monitoring in educational institutions, corporate organizations, and other professional environments.

V. CONCLUSION

The AI-Powered Face Recognition System for Automated Attendance Management and Monitoring successfully demonstrates the application of artificial intelligence and computer vision technologies in automating attendance-related activities. The proposed system accurately detects, recognizes, and verifies individuals in real time, eliminating the need for manual attendance recording and reducing administrative effort. By integrating facial recognition algorithms with a centralized database, the system ensures secure attendance storage, efficient record management, and reliable monitoring capabilities. The implementation results indicate high recognition accuracy, fast processing speed, and effective attendance tracking under different operating conditions.

Furthermore, the system addresses major challenges associated with traditional attendance methods, including proxy attendance, human errors, and excessive paperwork. Its contactless operation enhances user convenience while improving security and transparency in attendance management. The automated reporting and monitoring features enable organizations to generate attendance summaries quickly and maintain accurate attendance records. Overall, the proposed solution provides a scalable, cost-effective, and intelligent attendance management framework suitable for educational institutions, corporate organizations, government offices, and other environments requiring secure and automated attendance monitoring.

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