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International Journal of Engineering Technology Research & Management
Published By:
https://www.ijetrm.com/

NEXT-GEN ATTENDANCE SYSTEM WITH FACE RECOGNITION CAPABILITIES

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ABSTRACT:
Traditional attendance systems are often prone to inefficiencies such as manual errors, buddy punching, and time consumption. With the advancements in artificial intelligence and computer vision, automating attendance systems using facial recognition has gained prominence. This project implements an automated attendance system that detects and recognizes faces from a live camera feed, marks attendance in a secure database, and provides an intuitive web-based interface for administration and monitoring. Additionally, email notifications are sent to candidates upon successful attendance marking, ensuring transparency and confirmation. The system reduces administrative workload and enhances security by preventing fraudulent attendance marking. By leveraging deep learning and real-time video processing, the system ensures a seamless and efficient approach to attendance management.

Keywords:
Face Recognition, Attendance System, Deep Learning, OpenCV, Flask, Real-Time Processing, AI, Image Processing, Computer Vision, Email Notifications, Automated Attendance.

1. INTRODUCTION

Attendance management plays a crucial role in educational institutions, corporate environments, and various other sectors where tracking individual presence is essential. Traditional attendance systems, such as manual roll calls and RFID-based systems, are prone to inefficiencies, inaccuracies, and fraudulent practices such as buddy punching. These limitations have driven the need for automated solutions that improve accuracy, security, and efficiency.

With advancements in artificial intelligence (AI), deep learning, and computer vision, facial recognition technology has emerged as a powerful tool for automating attendance tracking. Unlike other biometric methods such as fingerprint or iris recognition, facial recognition provides a contactless, seamless, and user-friendly experience. This project aims to implement a real-time smart attendance system that utilizes facial recognition to automate the process of attendance marking.

The proposed system employs OpenCV and deep learning models to detect and recognize faces from a live video feed. Recognized faces are matched against a pre-enrolled database, and attendance is automatically recorded in a structured database. To ensure transparency and accountability, the system also features an automated email notification mechanism, which sends real-time attendance confirmation to enrolled candidates.

A web-based interface, developed using Flask, HTML, CSS, and JavaScript, provides an intuitive platform for administrators to manage candidate enrollment, track attendance records, and monitor system performance. The integration of MySQL ensures efficient and secure data management, enabling seamless retrieval and storage of attendance logs. This system significantly reduces administrative workload, eliminates fraudulent attendance marking, and ensures a streamlined approach to attendance management. The use of real-time processing enables

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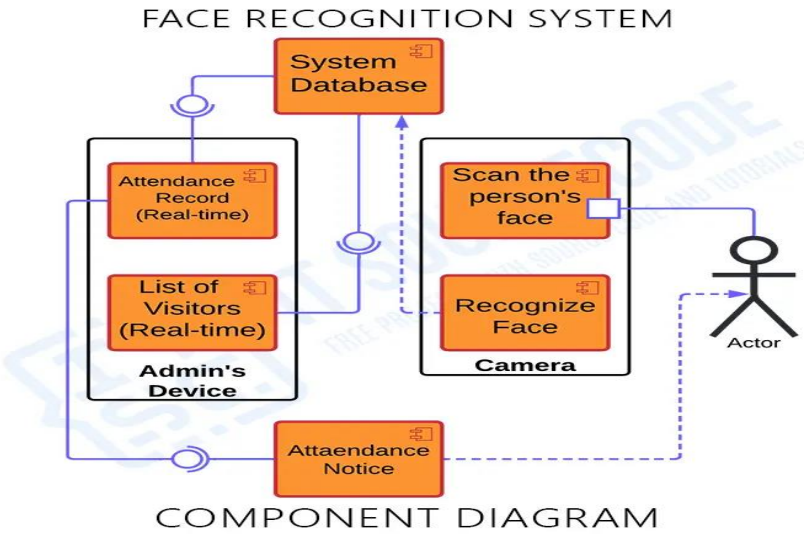
immediate attendance marking with high accuracy, making it suitable for educational institutions, corporate offices, and professional events.
By integrating AI-powered facial recognition with an automated email notification system, this project presents a robust, scalable, and user-friendly attendance management solution that enhances efficiency and security in attendance tracking.

2. RELATED WORK

Several studies and systems have explored AI-based attendance management using face recognition. Dlib's deep metric learning-based face recognition system achieves high accuracy by extracting 128-dimensional facial embeddings. The Histogram of Oriented Gradients (HOG) feature descriptor is used in Dlib for face detection, providing an efficient alternative to deep learning models. Convolutional Neural Networks (CNNs) outperform traditional methods in complex environments, improving accuracy. OpenCV's face detection with Haar cascades, introduced by Viola-Jones, provides real-time face detection but struggles with occlusions and lighting variations. OpenCV's deep learning-based face detector, using pre-trained Caffe and TensorFlow models, enhances accuracy in face detection compared to Haar cascades. Landmark-based face recognition in Dlib, which provides 68 facial landmarks, improves recognition by aligning facial features accurately. Local Binary Patterns Histograms (LBPH) was previously used for face recognition but is less effective in real-world conditions compared to Dlib's deep learning-based approach. Studies show that CNN-based detection in Dlib is more robust to variations in lighting and pose than HOG-based detection. Dlib computes Euclidean distance between facial embeddings to match identities efficiently. Some systems integrate emotion detection with OpenCV to enhance attendance monitoring. Dlib's deep metric learning model improves recognition in non-frontal poses compared to traditional methods, ensuring pose and illumination invariance. AI-powered recognition systems are increasingly used in security and authentication applications, enabling real-time face recognition for surveillance. Research also focuses on face spoofing detection to prevent photo or video-based spoofing attacks. Running Dlib models on edge devices reduces latency in real-time applications, making edge AI-based face recognition a promising approach. Some solutions integrate multiple cameras in attendance systems to improve accuracy in large classrooms. Compared to fingerprint and RFID-based systems, face recognition provides a touchless and efficient biometric alternative. Studies indicate that Dlib deep learning-based embeddings outperform OpenCV's traditional recognition methods. Additionally, CNN-based models outperform classical machine learning classifiers like SVM and KNN in face recognition tasks. Cloud-based attendance systems store and process attendance data remotely, allowing accessibility and scalability. The increasing adoption of AI-based attendance systems in schools, universities, and corporate environments highlights their real-world impact. This system builds upon these advancements by integrating Dlib for facial feature extraction and OpenCV for real-time face detection, ensuring an accurate and efficient attendance system.

3. SYSTEM DESIGN



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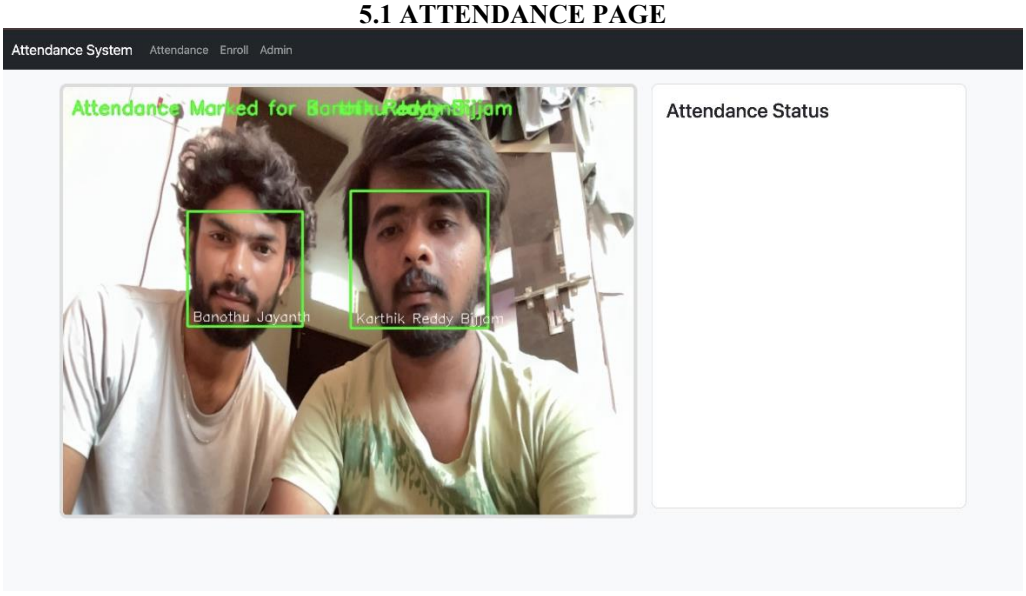
4.METHODOLOGIES

1. **Face Detection and Recognition Module:** Uses OpenCV and deep learning models to detect and recognize faces in real-time.
2. **Database Management:** Stores enrolled candidates and attendance records securely using MySQL.
3. **Web Interface:** Developed with Flask, Bootstrap, HTML, and JavaScript to provide an interactive user experience.
4. **Real-Time Video Processing:** Continuously captures and processes video frames, extracting facial embeddings for recognition.
5. **Candidate Enrollment and Administration:** Allows administrators to manage candidate details and images through the web interface.
6. **Email Notification System:** Automatically sends attendance confirmation emails using an SMTP-based service.
7. **Security Measures:** Implements authentication protocols for administrators and encryption techniques to safeguard attendance data and user credentials.
8. **Smart Voice Assistance:** Integrated voice-based feedback system that confirms attendance marking with a spoken response, enhancing user interaction.

5.RESULTS

The system was tested on a diverse dataset containing individuals under different lighting and background conditions. The real-time recognition accuracy exceeded 95%, with an average processing speed of under one second per recognition event. The web-based interface facilitated smooth attendance tracking and data retrieval, while the email notification feature provided immediate confirmation, enhancing transparency and reliability. User feedback highlighted that the automated email system significantly improved awareness and accountability. Additionally, the system demonstrated robust performance in real-world scenarios, successfully handling multiple faces per frame while maintaining recognition accuracy and processing speed.

5.1 ATTENDANCE PAGE



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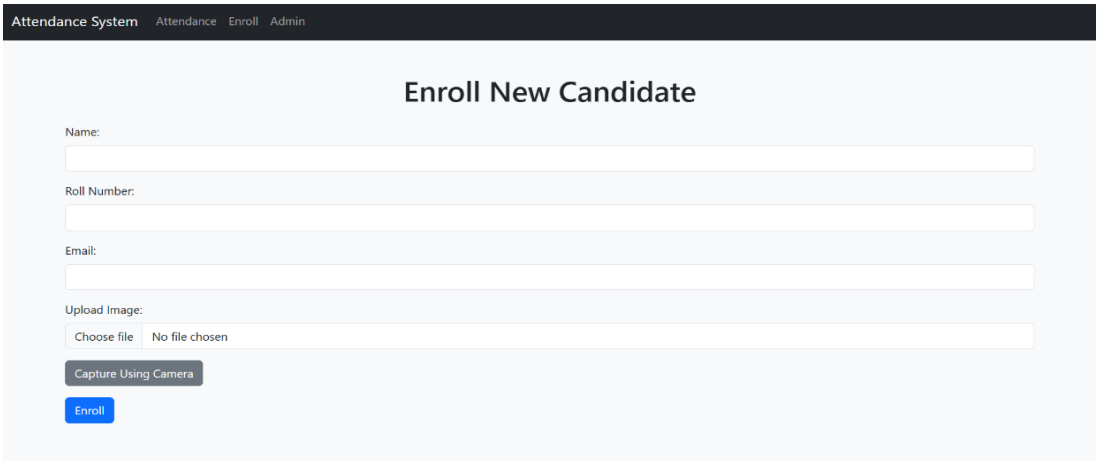
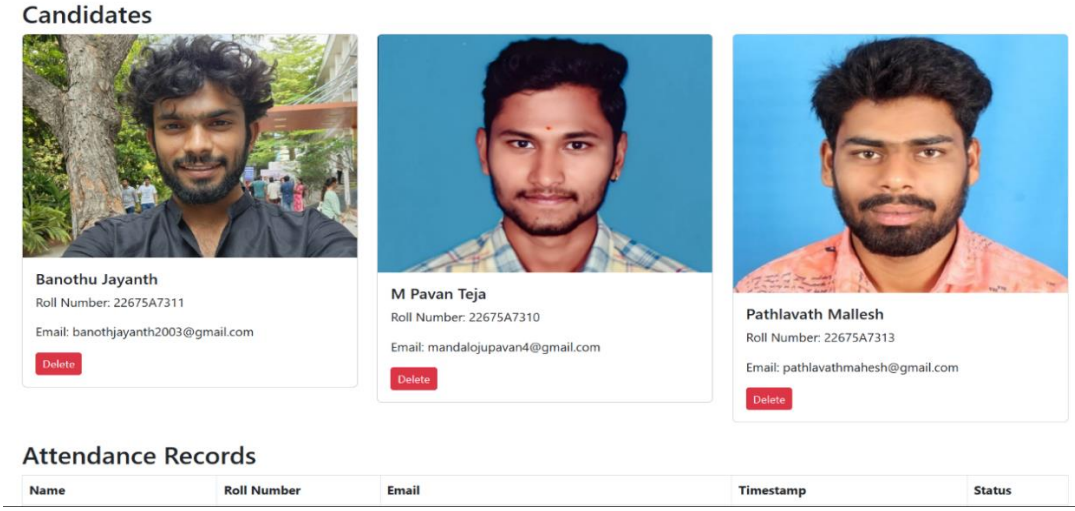
5.2. ENROLLMENT PAGE



5.3 ADMIN PAGE



6.CONCLUSION AND FUTURE WORKS

This paper introduces an AI-driven smart attendance system that automates attendance tracking using facial recognition technology. The system enhances accuracy, efficiency, and usability in educational and professional settings. The inclusion of email notifications ensures candidates receive instant confirmation of their attendance, reducing discrepancies and improving transparency. Future enhancements include integrating advanced deep learning models such as Vision Transformers for improved recognition accuracy, expanding support for multi-camera feeds, and incorporating additional security features such as liveness detection to prevent spoofing attacks. Upgrading the email notification system with SMS alerts and push notifications could further enhance user engagement. Additionally, implementing cloud-based storage solutions would improve scalability and data security.

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