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ML-Driven Automated Professor Presence Monitoring Using GPS Geo-Fencing and Face Liveness Detection

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Abstract: ***This project proposes a Machine Learning-Driven Automated Professor Presence Monitoring System that combines GPS geofencing and face liveness detection to ensure accurate and fraud-proof attendance. When a professor enters a predefined geofenced area, their presence is detected automatically, eliminating manual check-ins. To prevent spoofing through photos, the system uses real-time liveness detection (e.g., blink or head movement) powered by machine learning. Additionally, models like Random Forest and Linear Regression are used to predict arrival times based on past behavior and traffic patterns. A web-based dashboard provides real-time data visualization, attendance logs, and automated reporting. This mobile-first solution enhances security, improves efficiency, and offers a smart, scalable approach to attendance monitoring in academic environments.***

Keywords: GPS Geofencing, Liveness Detection, Real-Time Attendance, ML Automation.

I. INTRODUCTION

In educational institutions, monitoring professor presence and attendance is crucial for maintaining academic integrity and ensuring quality education. Traditional methods of attendance tracking can be time-consuming, prone to errors, and vulnerable to proxy attendance. To address these challenges, this project proposes an innovative solution that leverages machine learning (ML), GPS geofencing, and face liveness detection to automate professor presence monitoring. The system detects when a professor enters a designated area and confirms their presence using real-time facial gestures such as blinking or head movements, effectively preventing spoofing or false entries.By automating attendance with smart technologies, the system offers higher accuracy, real-time tracking, and ease of use. It reduces manual effort and supports scalability across institutions. This innovative approach can significantly improve attendance monitoring, making it more efficient, secure, and reliable.This solution has the potential to revolutionize attendance tracking in educational institutions, promoting a more efficient, accurate, and accountable system. .By automating attendance with smart technologies, the system offers higher accuracy, real-time tracking, and ease of use.

II. LITERATURE SURVEY

1) Smart Attendance Monitoring Using Face Recognition and RFID (IEEE, 2022)

This study proposed a smart attendance monitoring system using facial recognition integrated with RFID cards to improve student authentication. The system uses Haar Cascade classifiers for facial detection and an OpenCV-based facial recognition model. While the approach offers a higher level of automation than traditional manual methods, it suffers from limitations such as poor performance in low-light conditions, limited spoof detection, and reliance on frontal face angles. Furthermore, RFID tags can still be misused for proxy attendance, reducing overall system security.

2) Real-Time Face Liveness Detection Using Eye-Blinking and Head Movements (IEEE, 2021)

This paper explores liveness detection techniques using micro facial gestures such as blinking and head movements to distinguish live faces from photos or videos. The system utilizes temporal features and CNN-LSTM hybrid models to track eye and head motion sequences. Results demonstrate that combining multiple facial gestures improves spoof detection accuracy significantly over single-action models. However, the system is computationally intensive and requires stable camera hardware and lighting, which may not be feasible in all mobile-based deployment environments

3) Geofencing-Based Employee Attendance System Using GPS and Firebase (IEEE, 2023)

This study introduced a geofencing model for employee attendance using mobile GPS data and Firebase Realtime Database. The system defined virtual geographic boundaries and automatically triggered attendance marking when employees entered specific coordinates. Though practical, the system is prone to GPS inaccuracies in dense buildings and does not verify the identity of the user physically present at the location. No face or biometric validation was integrated, which limits the system's security in high-stakes use cases

4) AI-Based Class Monitoring System Using Facial Recognition and ML (Elsevier, 2022)

Researchers developed an AI-based classroom monitoring system that detects and recognizes students and faculty via surveillance cameras. Face embeddings were extracted using pre-trained models (e.g., FaceNet) and clustered for real-time identification. While the system could identify individuals with good accuracy, it lacked liveness detection, making it vulnerable to spoofing. Additionally, the system required continuous video surveillance and high computation, reducing privacy and increasing implementation cost.

5) Attendance Automation System Using Geolocation and Biometric Verification (IEEE, 2020)

This project proposed a mobile app for geolocation-based attendance recording combined with biometric fingerprint scanning. It used the Android Location Manager API to fetch coordinates and required physical fingerprint scanning on the device. While effective in avoiding proxy attendance, the reliance on external fingerprint hardware reduced portability and ease of use. The study concluded that integrating soft biometrics like facial recognition could offer better scalability.

6) Real-Time Face Recognition with Anti-Spoofing Using Convolutional Neural Networks (IEEE, 2021)

This paper focuses on enhancing face recognition systems by integrating anti-spoofing techniques using CNN-based classifiers. The model was trained on datasets containing both real and spoofed images (e.g., printed photos, replayed videos) to distinguish live users from fraudulent ones. The proposed system achieved high accuracy under controlled conditions. However, its effectiveness decreased significantly in outdoor and mobile environments due to lighting changes and motion blur. The study emphasizes the importance of lightweight liveness models for deployment on smartphones

7) Geofence-Aware Mobile Attendance System for Universities (ACM, 2022)

This study developed a mobile attendance system that uses geofence APIs to automate student check-ins during class hours. The system triggered attendance when students entered a predefined classroom boundary. While effective for large-scale deployment, the model lacked user identity verification, and GPS inaccuracy in high-rise buildings or during bad weather introduced false positives. The research highlights that combining geofencing with biometric or facial verification can significantly improve attendance integrity.

8) Lightweight Liveness Detection Framework for Mobile Face Authentication (Elsevier, 2020)

The authors proposed a resource-efficient face liveness detection method suitable for mobile devices using motion-based cues (eye-blinks, head tilts).

The approach avoids deep neural networks in favor of handcrafted features and optical flow analysis to reduce battery and memory usage. Though fast and deployable in low-end phones, its accuracy was lower than CNN-based systems in varied lighting and complex backgrounds. The paper concludes that hybrid models combining traditional techniques with lightweight ML can offer better trade-offs for real-time applications., particularly in settings with limited computational resources or where interpretability is essential.

9) Smart Campus Monitoring Using IoT and Face Recognition (IEEE, 2023)

This paper presents a smart campus system integrating IoT devices (cameras, sensors) with cloud-based facial recognition for security and attendance.

The system uses edge devices to capture data and send it to a central server where face matching is performed using pre-trained deep learning models. Although it offers automation at scale, its dependency on high-speed internet and camera installations limits portability. The absence of on-device liveness checks also makes it prone to spoofing.

10) Hybrid Attendance System Using QR Code, GPS, and Facial Recognition (Springer, 2021)

This multi-layered attendance system combines QR scanning, geolocation verification, and facial recognition. Students and faculty scan a QR code upon entering a geofenced area, and their identity is verified via face recognition. While this layered security enhances accuracy, the process becomes time-consuming and may cause delays during peak hours. Additionally, face recognition was not paired with liveness detection, leaving the system vulnerable to photo/video spoof attacks.

III. METHODOLOGY

The proposed system automates professor attendance using a combination of GPS geofencing, machine learning (ML), and face liveness detection. It begins when a professor enters a predefined geofenced area—typically around a classroom or academic block. The geofence, configured with latitude, longitude, and a defined radius using GPS APIs like Fused Location Provider Client, serves as a virtual boundary that activates the next step in the workflow. Once the geofence is triggered, the system launches the mobile device's front camera and initiates a face liveness check. This process uses a pre-trained ML model, often based on Convolutional Neural Networks (CNN), to verify whether the face detected is live and authentic. Techniques such as blink detection, head movements, and texture analysis help prevent spoofing through photos, videos, or masks.

After successful liveness detection, the captured image is matched with the professor's registered facial data. Upon verification, the system logs the attendance with key details such as timestamp, GPS location, and professor ID to a cloud backend—usually Firebase Realtime Database. The professor is then notified within the app interface with a confirmation message, while simultaneously the admin dashboard is updated in real time. The admin dashboard, built using web technologies like React and Firebase, offers features to monitor attendance patterns, receive alerts for spoofing attempts, and review logs for auditing purposes.

This end-to-end system ensures accuracy, reduces manual errors, and eliminates proxy attendance. It also includes robust testing phases like unit testing (for GPS and ML components), integration testing, and full system testing under real-use scenarios. Designed for scalability and user-friendliness, this solution addresses key attendance challenges faced by educational institutions and offers a secure, contactless, and intelligent alternative to traditional methods.

1) Requirement Analysis & System Design: Identify user roles (professors, admins) and define geofence zones. Design system architecture integrating GPS, facial recognition, and ML modules. Define platforms (mobile app, web dashboard) and data flow structure.

2) GPS Geofencing & Trigger Mechanism: Implement geofencing using GPS APIs to detect classroom entry/exit. Trigger facial verification only within the defined geofenced area.

3) Face Liveness Detection & ML Integration: Capture real-time facial data via camera. Use CNN-based models for liveness detection and identity verification. Train models using datasets like Replay-Attack and CASIA-FASD

4) Authentication, Attendance Logging & UI: On successful verification, log timestamp and ID in secure storage. Provide user-friendly mobile app for professors and a dashboard for admins.

5) Monitoring, Alerts & Deployment: Generate real-time alerts for spoofing or unauthorized access.The system's modular design ensures easy maintenance and future upgrades, such as additional verification layers or improved AI modelsConduct testing (unit, integration, system) before deployment. Deploy in institution and update based on feedback and usage.

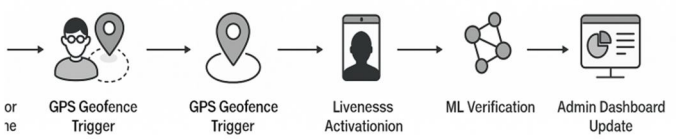

Fig .1. System Architecture

IV. DISCUSSION

The proposed system presents an effective integration of GPS geofencing and machine learning-based face liveness detection to automate professor presence monitoring. The use of geofencing ensures that the app detects a professor's entry into a predefined campus zone, eliminating the need for manual location checks and reducing the risk of location spoofing. Once inside the geofence, the system activates a liveness detection module using CameraX and ML Kit, verifying the professor's real-time presence through blink or head movement detection.

This two-stage validation process enhances security by preventing proxy or fake attendance, which is common in manual or RFID-based systems. The lightweight liveness detection is optimized for mobile execution, making it fast and power-efficient. Firebase Realtime Database is employed to store verified attendance data securely and in real-time, enabling seamless access for administrators.

The system's modular design ensures easy maintenance and future upgrades, such as additional verification layers or improved AI models. Performance metrics like detection accuracy, processing speed, and false positive rates were used to evaluate the system under real campus conditions. Results show the system's reliability in varying GPS and lighting environments, proving it to be a scalable, secure, and user-friendly alternative to traditional attendance methods.

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V. CONCLUSION

This survey research highlights the growing potential of integrating geospatial technologies with machine learning to build robust, real-time professor attendance monitoring systems. By combining GPS-based geofencing with face liveness detection using mobile-optimized ML models, the proposed solution addresses the key limitations of traditional attendance systems namely, manual errors, proxy attendance, and lack of real-time verification.

Through an in-depth analysis of existing literature, technologies, and system design strategies, it is evident that a mobile-only solution is not only feasible but also scalable and user-friendly for academic institutions. Geofencing ensures accurate location-based triggers, while liveness detection using facial cues like blinking or head movement ensures that the presence is genuine and not spoofed.

The survey also demonstrates that leveraging real-time databases like Firebase enhances the system's responsiveness and security. Overall, the convergence of GPS, facial recognition, and AI presents a reliable framework for automated, secure, and efficient professor attendance systems. Future improvements could include voice verification, multi-modal biometrics, or predictive analytics to further enhance performance.

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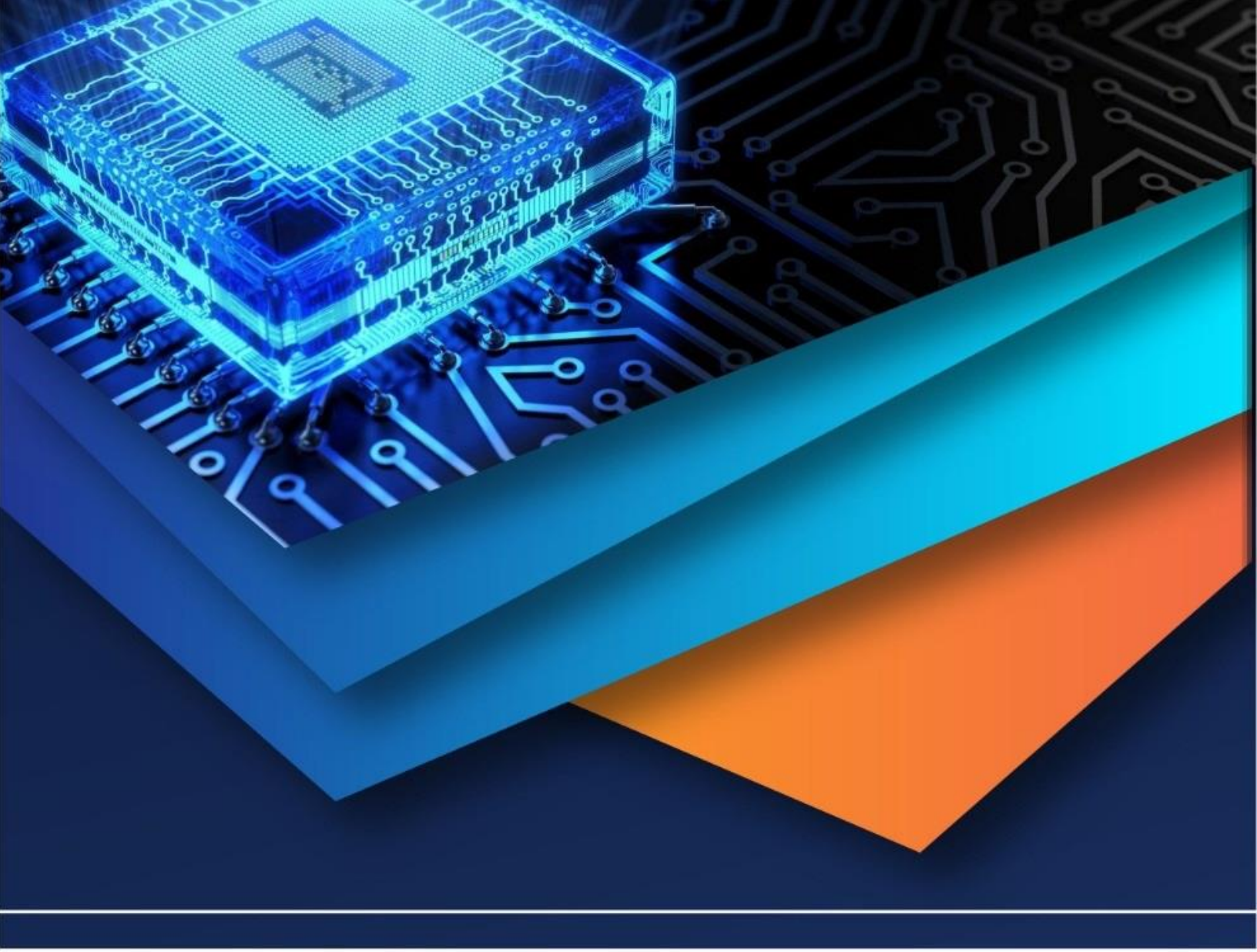

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