iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.68524

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Tick Mark: Geofencing Attendance System

Prof. Hemangi Patil[1], Omkar Darekar[2], Bhanudas Thorbole[3] Prajwal Kindre[4], Vaishnavi Dekate[5]
Department of Artificial Intelligence and Data Science, Ajeenkya DY Patil School of Engineering, Pune, Maharashtra, India

Abstract: ***The development of a geofencing-based attendance system aims to simplify attendance management in educational institutions. Traditional methods like manual registers and biometric systems require significant administrative effort, which can disrupt instructional time and lower overall efficiency. The proposed system uses smartphone GPS technology to establish a virtual boundary, or geofence, around the institution. When a registered user enters or exits this geofence, their attendance is automatically recorded in real-time. This approach eliminates the need for manual attendance tracking, saving time for both educators and administrators. Battery optimization techniques ensure the system runs efficiently on smartphones, while secure data handling protects user information. The geofencing-based system is scalable, making it suitable for institutions of various sizes. Results indicate that this technology not only reduces administrative burdens but also enhances the accuracy and reliability of attendance records. By automating the process, educational institutions can focus more on teaching and less on routine administrative tasks. This innovative solution provides a modern, hassle-free approach to attendance management, ensuring convenience for both staff and students.***

Keywords: geofencing, attendance tracking, GPS-based system, automated attendance, location-based services, virtual boundaries, mobile application.

I. INTRODUCTION

Attendance management in educational institutions is often a time-consuming and error-prone process. Traditional methods, such as manual roll calls or paper-based records, are inefficient, labour- intensive, and susceptible to inaccuracies, including proxy attendance and data loss [1]. As educational institutions expand and classrooms become larger, teachers need automated solutions that allow them to focus on their primary responsibilities rather than spending valuable time on attendance tracking. [2] A potential solution to this challenge lies in geofencing technology, a location-based approach that creates virtual boundaries, or "fences," around a defined geographical area [3]. When a registered user's smartphone enters or exits this geofenced region, the system automatically records their attendance, eliminating the need for manual intervention. This method ensures accuracy, prevents attendance fraud, and streamlines administrative workflows [4]. Unlike biometric or RFID-based systems, which require physical interaction, geofencing operates seamlessly in the background, making it a non-intrusive and scalable alternative [5].

The purpose of this research is to develop and evaluate a geofencing-based attendance tracking system that leverages smartphone GPS capabilities to detect user entry and exit within a predefined boundary around the institution. This automated approach reduces administrative workload, enhances security, and provides real-time attendance monitoring [6]. Additionally, the system incorporates selfie-based proof of presence, ensuring authenticity without requiring complex facial recognition algorithms [7].

Future improvements may include integrating Wi-Fi triangulation or Bluetooth Low Energy (BLE) to improve location accuracy in indoor environments where GPS signals are weak [8]. The potential of geofencing-based attendance systems extends beyond educational institutions, offering valuable applications in corporate environments, healthcare facilities, and remote workforce management [9]. By combining automation, security, and efficiency, this research highlights how geofencing can modernize attendance tracking and optimize operational processes in institutional settings [10].

II. SYSTEM ARCHITECTURE

The proposed geofencing-based attendance management system automates attendance tracking by verifying students' real-time location within a geofenced boundary and capturing a live selfie as proof. It comprises a mobile application, a cloud-based server, and an administrator dashboard. Students log in, enable location tracking, capture a selfie, and mark attendance when inside the geofence. The cloud server securely stores attendance records, while the dashboard allows teachers to monitor and generate reports [3],[4]. The system ensures accuracy through GPS-based geofencing, Wi-Fi triangulation, and IP tracking to prevent location spoofing [5],[6]. Live selfie capture prevents proxy attendance, with all data securely stored. Encryption and access control protect user privacy, and real-time analytics provide attendance insights [1],[7]. Additionally, the system optimizes battery efficiency by adjusting location check frequency based on user movement [5]. Teachers can post notices and assign marks, streamlining administrative tasks. Future improvements may integrate Bluetooth-based location tracking for enhanced indoor accuracy[8].

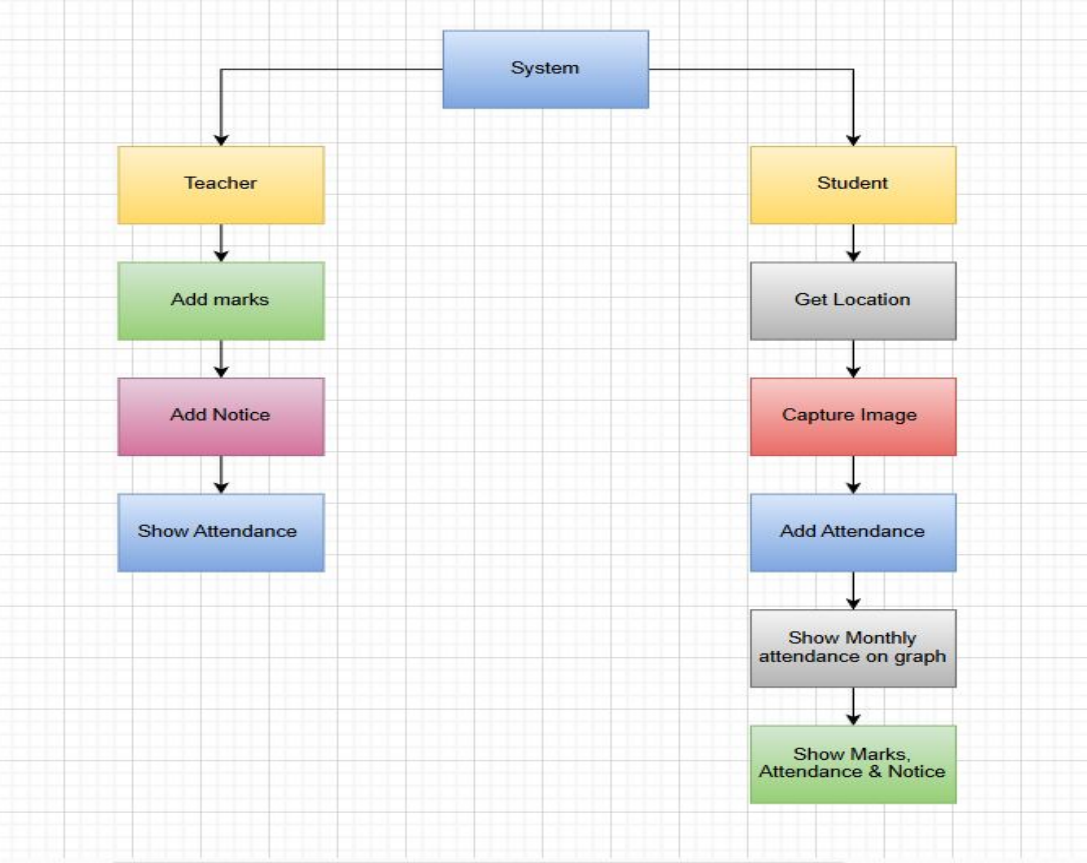


Fig.1 System Architecture

A. System Workflow

System Workflow The system consists of three main components working together:

1) Mobile Application: Installed on students' smartphones to track location, capture selfies, and submit attendance [3].
2) Cloud Server: Stores attendance records, including location data, timestamps, and images [4].
3) Administrator Dashboard: Enables teachers and administrators to review attendance records, manage notices, and generate reports.

User Roles and Attendance Process

1) Teachers: Manage attendance records, add marks, and post notices.
2) Students: Enable location tracking, capture a live selfie, and submit attendance.

Attendance marking process:

1) The student logs into the mobile application.
2) The app detects the user's GPS location and verifies whether they are within the predefined geofenced boundary (100-meter radius) [5].
3) If the student is inside the geofence, the system automatically records a check-in and similarly records a check-out upon exit.
4) The system prompts the student to capture a live selfie as proof of presence.
5) The captured selfie, along with timestamp and location data, is securely transmitted to the cloud server.
6) Teachers and administrators can review attendance records and analyse reports through a graphical dashboard [9],[10].

B. Geofencing Implementation and Optimized Location Tracking

Geofencing is the core technology used in the system to establish a virtual boundary around the institution. It utilizes a combination of GPS, Wi-Fi, and mobile network signals to accurately detect when a student enters or exits the designated area.

To ensure precise location verification, the Haversine formula is employed to calculate the distance between the user's current location and the geofence center. The geofence radius is set to 100 meters, offering a balance between location accuracy and battery efficiency. To further optimize battery usage, the app does not continuously monitor the user's location. Instead, it intelligently increases the frequency of location checks only when the user is near the geofence boundary. This approach minimizes power consumption while still ensuring accurate attendance tracking. Additionally, anti-fraud measures are integrated into the system, such as requiring a live selfie for verification and preventing fake location spoofing, ensuring the integrity of the attendance process.

C. Live Selfie Capture for Attendance Proof

To ensure the authenticity of attendance, the system requires students to capture a live selfie as proof of presence [1]. This approach, unlike facial recognition systems, prioritizes user privacy while still implementing strong anti-fraud measures. When a student enters the geofenced area, the mobile application prompts them to take a selfie using the device's camera. To maintain integrity, the option to upload images from the gallery is disabled, ensuring that only real-time images are accepted. Each captured selfie is automatically timestamped and geo-tagged, making it difficult to manipulate the data. If needed, teachers or administrators can manually review the submitted images through the dashboard for further verification, adding an extra layer of reliability to the attendance process [7].

D. Backend Processing and Secure Data Storage

All attendance records, including location metadata, timestamps, and selfies, are securely stored in a cloud-based server. The backend system includes data encryption, access control, and optional blockchain integration for enhanced security.

1) Cloud Storage (Firebase): Stores attendance records, images, and timestamps securely [3].
2) Data Encryption: Ensures that all location and selfie data are encrypted before transmission to the cloud.
3) Anonymization Techniques: Protects user privacy by removing identifiable personal information from attendance records [8].
4) Access Control Mechanisms: Only authorized personnel (teachers and administrators) can access attendance data.

E. Attendance Reports and Analytics

1) Students can view their attendance history, trends, and check their attendance percentage.
2) Teachers can generate attendance reports, review timestamps.
3) Administrators can analyse institution-wide attendance trends.
4) Graphical Analytics provide insights into attendance patterns over time, helping institutions identify trends such as frequent absences or irregularities.

III.BENEFITS

A. Accurate Attendance Tracking

Location-based systems use technologies like GPS, Wi-Fi, and mobile networks to precisely determine a student's physical presence within the predefined campus boundaries. This eliminates the possibility of proxy attendance or manual entry errors [5]. By automatically logging check-ins and check-outs, the system ensures that records are accurate, improving trust and accountability [6].

B. Real-time Data

The system offers real-time updates on student attendance, accessible through a centralized administrator dashboard [4]. This capability enables teachers and administrators to promptly detect irregularities, address absenteeism, and monitor student presence in emergency situations, enhancing safety and responsiveness [6].

C. Reduced Administrative Burden

Traditionally, teachers spend a significant amount of time taking attendance and maintaining records [2]. With an automated system, this process becomes seamless, freeing up valuable time for instructional activities. It also reduces the need for paper-based registers, minimizes human error in data entry, and eliminates repetitive tasks like report generation [4].

D. Enhanced Security

Geofencing ensures that attendance is recorded only within the institution's boundaries, preventing location spoofing or off-site attendance submissions [8]. Additional verification mechanisms, such as live selfie capture, further reinforce system integrity by requiring real-time, location-validated submissions [1].

E. Parental Engagement

Providing parents access to their child's attendance records increases transparency and strengthens communication between school and home [2]. Parents can receive notifications of absences, track attendance trends, and take timely actions if issues arise.

IV. LIMITATIONS

1) Privacy Concerns: Location tracking can raise privacy concerns, as it involves collecting and storing data about the whereabouts of students. This may infringe on students' privacy rights and lead to ethical concerns [6].
2) Data Security Risks: Storing and transmitting location data can pose data security risks. If the system is not adequately secured, there is a potential for data breaches and unauthorized access to sensitive information [3],[5].
3) Battery Drain: To use location services, students and staff may need to keep their devices' GPS or other location services turned on, which can lead to increased battery drain. This can be particularly problematic if students are in class for extended periods without the ability to charge their devices [5].
4) Inaccuracies: Location-based systems may not always provide accurate data. Factors such as GPS signal interference, network connectivity issues, or technical glitches can lead to incorrect attendance records [6],[8].
5) Parental Engagement: Parents can be given access to the attendance data, allowing them to monitor their child's attendance and be more actively involved in their education [2].

V. IMPLEMENTATIONS

A. User Authentication Module

Purpose: Ensures secure access to the system for both students and staff.
Features:
- Login/Registration for students and teachers.
- User roles (Admin, Teacher, Student) to access specific features.
- Session management and token-based authentication for mobile/web clients.

B. Geofence Creation & Management Module

Purpose: Enables administrators/teachers to define the virtual attendance area (geofence) for a specific location (e.g., campus, classroom).
Features:
- Define geofence boundaries using GPS coordinates (latitude, longitude).
- Set geofence radius (distance around the defined location). - Manage multiple geofences for different locations.

C. GPS Location Tracking Module

Purpose: Tracks the GPS location of students in real-time to verify whether they are within the geofenced area.
Features:
- Fetch and monitor the student's real-time GPS coordinates. - Periodic GPS updates to ensure accuracy.
- Background tracking functionality (for mobile devices).

D. Attendance Management Module

Purpose: Manage and view attendance records for students. Features:
- View real-time attendance status (Present/Absent).
- Generate reports based on attendance data (monthly, weekly).
- Export attendance data for analysis or administrative purposes.
- Track student attendance trends and patterns.

E. Mobile/Web Application Module

Purpose: Interface for students and teachers to interact with the system (attendance marking, status tracking).
Features:
- For students: View attendance status, receive notifications, check-in via GPS.
- For teachers: View students' attendance, manage geofences, receive alerts.
- For administrators: Monitor system usage, user activities, and reports.

F. Reporting and Analytics Module

Purpose: Provides insights into student attendance patterns and geofence effectiveness.

Features:

- Generate detailed attendance reports (e.g., absenteeism rate, tardiness).
- Analyze student location-based attendance trends.
- Monitor geofence effectiveness based on real-time attendance logs.

VI. FUTURE SCOPE

1) Enhanced Indoor Accuracy – Integrating Bluetooth beacons and Wi-Fi-based tracking to improve location accuracy in indoor environments where GPS signals are weak.
2) AI-Based Identity Verification – Implementing AI-powered facial recognition (with privacy safeguards) to automate identity verification and prevent proxy attendance.
3) Blockchain Integration – Using blockchain technology to securely store attendance records, ensuring tamper-proof and immutable data storage.
4) Multi-Institution Support – Expanding the system to allow different organizations to customize geofencing rules, attendance policies, and reporting formats.
5) Predictive Analytics – Leveraging machine learning algorithms to analyse attendance trends, predict absenteeism, and provide insights for better academic or workforce management.
6) Cross-Industry Applications – Scaling the system for corporate offices, remote work tracking, event management, and other industries requiring automated attendance monitoring.

VII. RESULTS

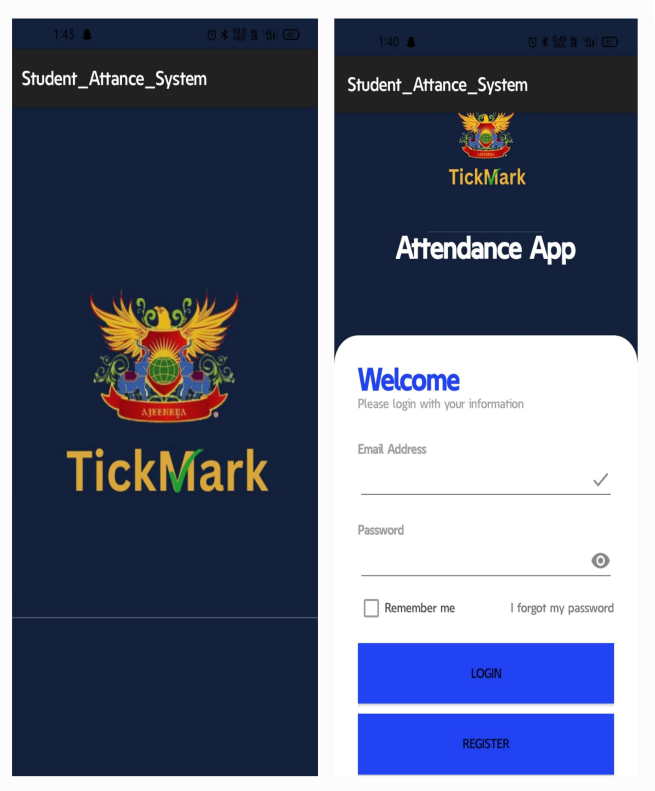


Fig. 2 Login/Registration for students and teachers

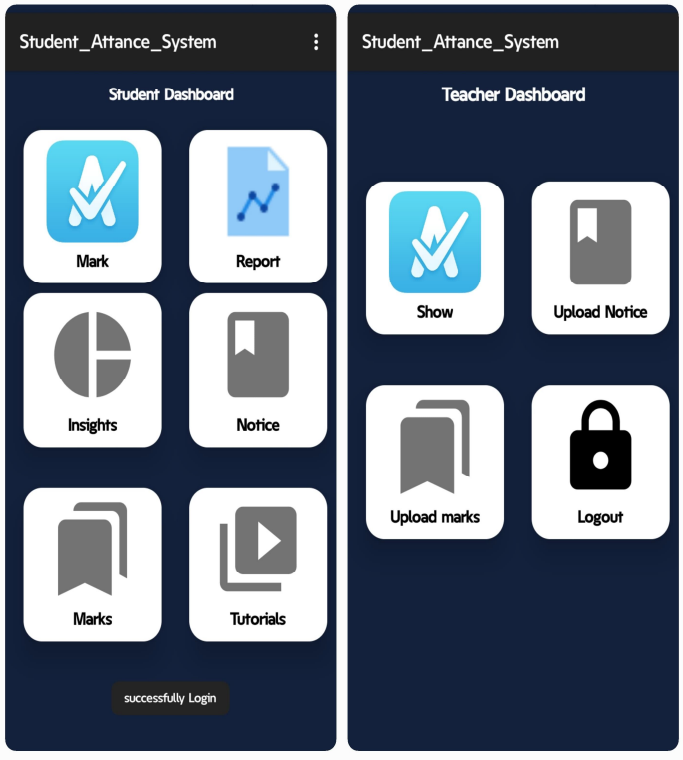


Fig.3 Student/Teacher Dashboards

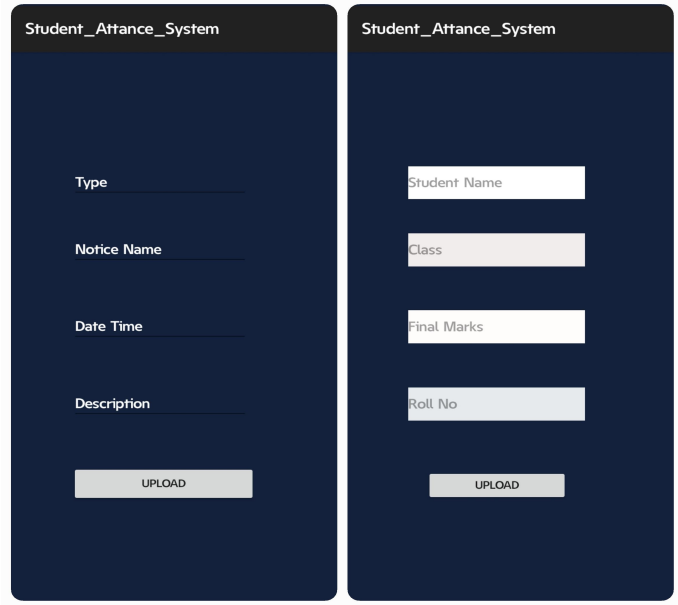


Fig.4 Manage attendance and records of students

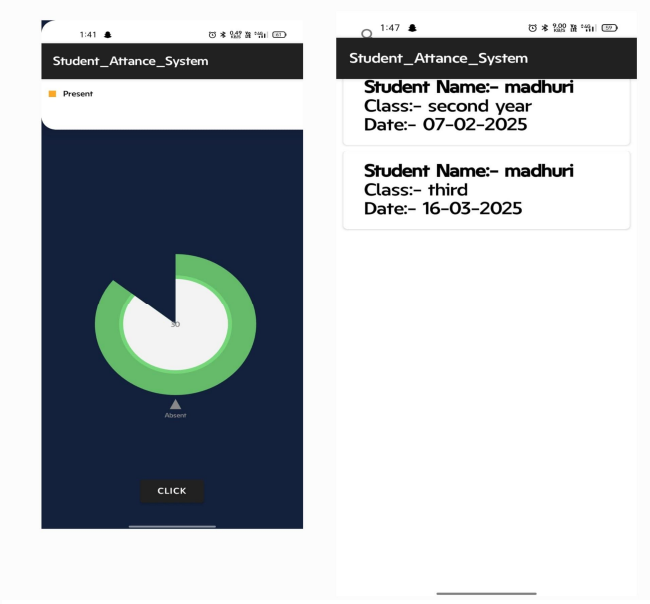


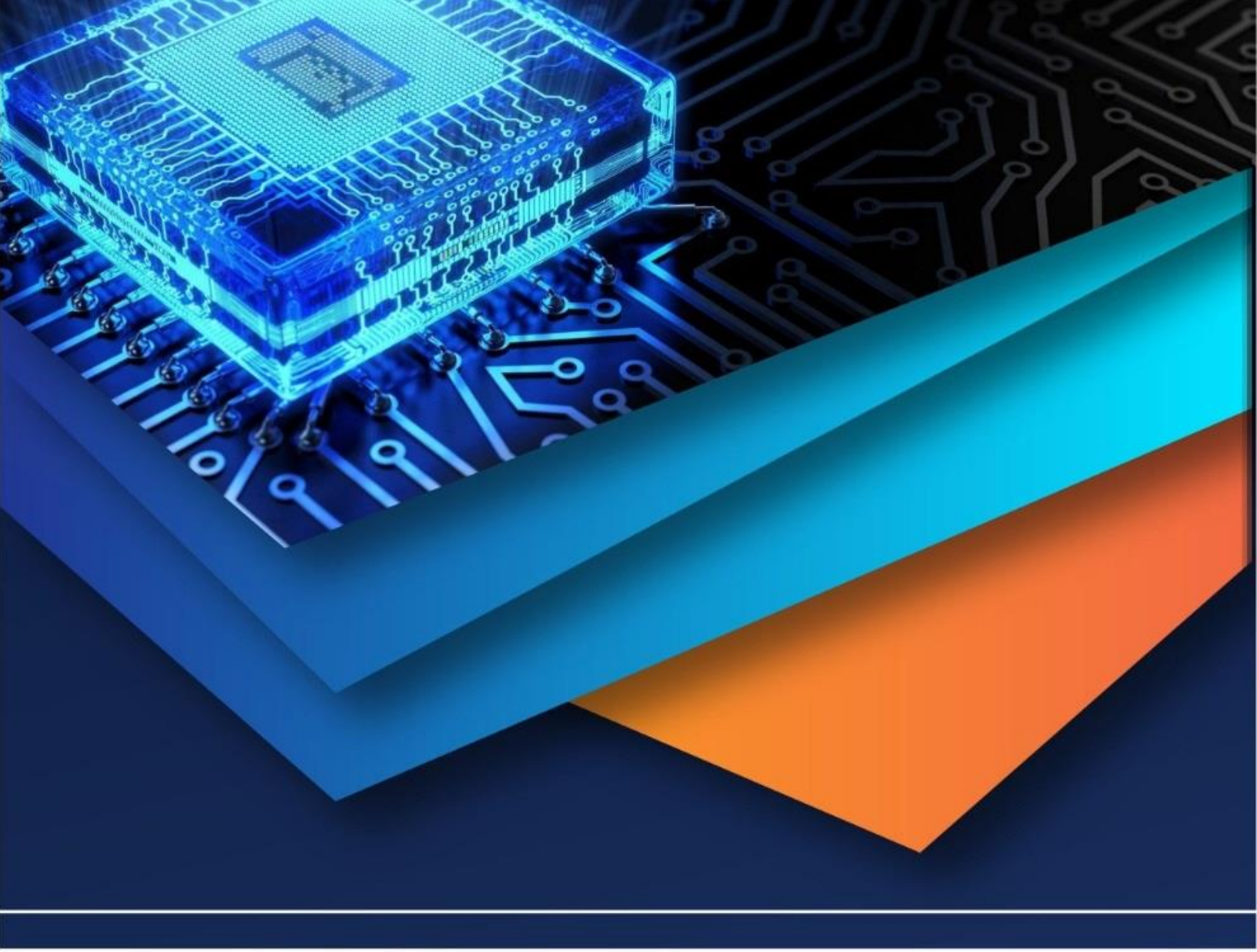
Fig.5 View Student's record and Progress

VIII. CONCLUSIONS

The geofencing-based attendance tracking system are efficient and accurate solution for managing attendance in educational institutions. We implemented an experimental system by using geofencing and evaluated the system in a campus area. By utilizing GPS technology, the system effectively automates the attendance process, reduce administrative burdens. Our system has shown promising results, with high levels of user satisfaction and minimal impact on smartphone battery life. However, challenges remain, particularly in environments with weak or unreliable GPS signals. Future advancements, such as integrating Wi-Fi or Bluetooth to enhance indoor accuracy, could address these limitations and further improve the system's reliability. Overall, this geofencing-based solution offers a scalable, user-friendly alternative to traditional attendance methods, with promising applications. Ongoing research and development will be crucial to refining the technology, ensuring its robustness, and expanding its applicability across diverse institutional environments.

REFERENCES

[1] HeCWangYZhuM, "A class participation enrollment system based on face recognition," 2nd International Conference on Image, Vision and Computing (ICIVC), pp. 254-258, 2017.
[2] Li Zhong-shi, Cai Min-guan, "The Internet Plus and the application of fast sign-in for class attendance in university," in Journal of Yanbian University (Social Sciences), vol. 52, 2019, pp. 83-90.
[3] WuJunsheng, Mo Jing tong, "The design and application of cloud login system based on WeChat public platform," in Microcomputer Applications, vol.34, 2018, pp. 5-8.
[4] Yang Bing, Lu Guoqing, Wang Yinglong, "Based on the App Inventor classroom name system teaching application," in The Chinese Journal of ICT in Education, no. 10, 2016, pp. 91-94
[5] T. Nakagawa et al., "Variable interval positioning method for smartphone-based power-saving geofencing," Proceedings of 2013 IEEE 24th International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), September 2013, pp. 3482-3486.
[6] M. Alsager, B. Hilton, T. Horan, and O. Aboulola, "Performance assessment of geo-triggering in small geo-fences: accuracy, reliability, and battery drain in different tracking profiles and trigger directions," Procedia Engineering, Elsevier, vol. 107, 2015, pp. 337-348.
[7] SH. Shimada et al.," Implementation and Evaluation of Local Dynamic Map in Safety Driving Systems," J. Transp. Tech. vol. 5, no. 2, 2015, pp. 102–12.
[8] P. T. S. Rajan, R. L. D. Singh, and A. K. M. Rao, "Challenges in Geofence-Based Attendance Systems and Proposed Enhancements," *International Journal of Computer Applications*, vol. 182, no. 33, pp. 21-29, 2018. DOI: 10.5120/ijca2018917284



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY