ATTENDANCE TRACKING SYSTEM USING GEOFENCING

PROJECT REPORT
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE
DEGREE OF BACHELOR OF TECHNOLOGY
IN
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
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CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in the project entitled **Attendance Tracking System Using Geofencing** in fulfillment of requirements for the award of degree of B.Tech. in CSE, submitted in the Department of Computer Science & Engineering at **MEGHNAD SAHA INSTITUTE OF TECHNOLOLY** under **MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, KOLKATA** is an authentic record of our own work carried out during Session 2024-2025 under the supervision of **Prof. Shatanik Chakraborty.** The matter presented in this project has not been submitted by us in any other University / Institute for any award.

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CERTIFICATE

This is to certify that the Project entitled **Attendance Tracking System Using Geofencing** is being submitted by **Aaditya Kumar, Ankit Kumar, Mohammad Hanzala, Priyam Sinha, Pratik Kumar Singh, Raghav Mishra** in partial fulfillment of the requirement for the award of the degree of B.Tech.in Computer Science and Engineering to the Department of Computer Science and Engineering, Meghnad Saha Institute of Technology, Kolkata, is a record of bonafied work carried out by him under my guidance and supervision from to ____

The results presented in this thesis have been verified and are found to be satisfactory. The results embodied in this thesis have not been submitted to any other University for the award of any other degree or diploma.

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CERTIFICATE OF APPROVAL

The foregoing project entitled **Attendance Tracking System Using Geofencing** is hereby approved as a creditable study of an engineering subject carried out and presented in a manner satisfactory to warrant its acceptance as prerequisite for the degree for which it has been submitted. It is to be understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the thesis only for the purpose for which it has been submitted.

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Abstract

In educational institutions, it is crucial for teachers to be actively involved in the attendance process to support effective knowledge transfer. Traditionally, attendance is recorded manually on paper sheets, which can be easily lost and lead to wasted classroom time, reducing learning productivity. While paperless systems like biometric or Android-based attendance exist, they often require costly hardware such as RFID readers or computers, increasing maintenance expenses. To address these limitations, we propose a cost-effective, hardware- minimized attendance solution that leverages mobile technology, GPS, and geofencing. By integrating educational technologies such as learning management systems with smart attendance features, our system offers enhanced functionality and accuracy. Geofencing ensures attendance is based on real-time location data rather than self-reported inputs, improving reliability and reducing human error. This paper presents our approach to tracking user location and marking attendance through a mobile application that uses geofencing, eliminating the need for specialized devices and streamlining the attendance process for greater efficiency and flexibility.

Keywords - Attendance process, Paperless attendance, GeoFence techniques, Mobility aspect, Hardware requirements, Learning productivity.

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CHAPTER 1. INTRODUCTION

Despite advancements in technology, many educational institutions, universities, and colleges still rely on traditional, manual methods to record student and teacher attendance. These outdated techniques are time-consuming, prone to errors, and susceptible to issues like fake entries and data loss. Attendance sheets can be misplaced, requiring repetition and increasing the likelihood of inaccuracies. With the rise of smartphones and mobile computing, there is now a shift towards more efficient, technology-driven solutions.

Smart attendance systems based on geofencing technology offer a promising alternative by automating the attendance process using GPS, Wi-Fi, or cellular data. Geofencing allows administrators to set virtual boundaries around a location—such as a school or office—and track entry or exit events. Once inside the designated area, users can mark their attendance through a mobile application, enhanced with features like facial recognition to ensure secure authentication.

This research aims to demonstrate the effectiveness of a mobile attendance system that leverages geofencing and GPS to precisely determine a user's real-time location. The application is designed for Android devices and distinguishes between check-in and check-out actions, storing attendance data securely in a database. It minimizes the need for costly hardware and manual record-keeping, thereby reducing errors and increasing administrative efficiency. By integrating 4G/5G and GPS technologies, the proposed system offers a reliable and scalable solution that improves both the accuracy and convenience of attendance management in modern educational and workplace settings.

1.1. Objective

The primary objective of the project “Attendance Tracker System using Geofencing Technique” is to provide a secure, automated, and location-based solution to track the attendance of individuals, particularly in academic or organizational settings. By utilizing geofencing and location-based services, this system aims to improve the accuracy, transparency, and efficiency of attendance management processes.

This goal includes several specific objectives that guide the development of a reliable and user-friendly solution:

a) Development of a Precise and Reliable Attendance Tracking System:

- Technology Integration: Implement geofencing technology using GPS and mobile device sensors to detect user presence within a defined virtual boundary (geofence).

- Automation: Automate attendance marking as soon as a user enters the geofenced area, reducing manual effort and human errors.

- Accuracy & Reliability: Ensure that the system accurately records entries and exits to avoid false attendance records.

b) Comprehensive User Data Collection and Validation:

- User Registration: Design secure registration and login modules with user validation using unique credentials (e.g., student ID or employee ID).

- Location Data Verification: Verify device location using GPS data to ensure attendance is marked only when the user is physically present at the location.

c) Utilize Geofencing for Contextual Tracking:

- Dynamic Geofence Setup: Allow the admin to set flexible geofence boundaries for different locations (classroom, office, lab).

- Real-time Location Monitoring: Continuously track user location status to ensure real-time attendance logs.

- Power and Data Efficiency: Optimize the application to minimize battery usage and data consumption on mobile devices.

d) Create a User-Friendly Mobile Application:

- Simple UI/UX Design: Develop a mobile application with a clean and intuitive interface for students or employees to check their attendance status in real-time.

- Admin Panel: Provide an interface for administrators to manage geofences, user data, and attendance records.

e) Security and Privacy Considerations:

- Data Protection: Ensure the privacy and security of users' personal and location data using encryption and secure data storage practices.

- Access Control: Implement role-based access control so that only authorized

personnel can view or modify attendance data.

f) Performance Monitoring and Scalability:

- System Evaluation: Evaluate the system performance based on accuracy, speed, user feedback, and data consistency.

- Continuous Improvement: Allow for updates based on user feedback, technology upgrades, and bug fixes to ensure long-term sustainability.

- Scalability: Design the system in a way that it can support a large number of users and multiple locations without performance issues.

g) Promote Transparency and Accountability:

- Digital Records: Maintain a log of attendance with timestamps and location metadata for future reference.

- Notifications and Alerts: Send notifications to users when attendance is marked or if they fail to check in within the designated time.

1.2. Domain Definition

The broader domain of the Attendance Tracker System using Geofencing Technique lies within Information Technology, Mobile Computing, Location-Based Services (LBS), and Software Engineering. This project specifically operates in the field of Geofencing Technology, which combines Global Positioning System (GPS) and Mobile Application Development to create virtual boundaries around a geographic location.

The system utilizes geofencing to track and record employee or student presence automatically when they enter or exit a predefined boundary, such as a school, college, or office premises. It eliminates the need for manual attendance, improves transparency, and reduces the chances of proxy attendance or time theft.

This domain also intersects with Wireless Communication, Cloud Computing, and Database Management, contributing to a multidisciplinary solution designed to enhance productivity, accountability, and real-time monitoring.

Geofencing Technology and Its Role:

Geofencing is a location-based service in which an app or software uses GPS, RFID or cellular data to trigger a pre-programmed action when a mobile device enters or exits a virtual boundary set up around a geographical location, known as a geofence.

In the context of this project, the Geofencing technique plays a key role in determining whether a user is within the defined campus area, and the attendance is recorded only when the user is physically present in that boundary. This reduces human error, enhances automation, and ensures integrity in attendance systems.

Attendance Tracking using Geofencing:

Attendance tracking using geofencing is a modern technique that automates the process of recording attendance by leveraging location-based technologies. The system uses GPS or network-based positioning to determine when a person (typically a student or employee) enters or exits a predefined virtual boundary (geofence) around a specific location such as an educational institution or workplace.

The process begins with location-based data acquisition from the user's mobile device through a dedicated application that monitors real-time geographic coordinates. A geofence is a virtual perimeter and is defined using latitude and longitude values for the desired area. Once the user's device enters this geofence, the system automatically triggers an action to mark attendance, ensuring that it is recorded only when the person is physically present at the location.

Key components include:

- Geolocation APIs (Google Maps API, Android Location Services)
- Real-time mobile tracking
- Cloud-based attendance records
- Secure authentication and database management

The geofencing approach is designed to eliminate common problems in traditional attendance methods such as:

- Manual errors
- Proxy attendance
- Time fraud

The system also includes real-time monitoring, notifications, and data analytics dashboards for administrators to view reports and trends. Despite challenges like ensuring accurate GPS data, managing battery efficiency, and privacy concerns, geofencing remains a reliable, scalable, and non-intrusive solution for attendance management.

Geofencing Architecture and Working:

The architecture of a geofencing-based attendance system includes the following components:

a) Geofence Definition:
A virtual perimeter is created using the latitude and longitude of the location (e.g., school or office). This boundary defines the area within which attendance will be recorded.

b) Location Detection:
The mobile device's GPS or network-based location services detect when a user enters or exits the geofence.

c) Trigger Mechanism:
When the device enters the geofenced area, a trigger is fired. This can be used to:

- Record time-in and time-out
- Mark attendance in the database
- Notify admin/HR/faculty

d) Backend Processing:
A cloud or local database stores the user's attendance logs. Backend scripts validate user ID, time, and location to ensure accuracy.

e) Reporting and Dashboard
Admins can view:

- Daily, weekly, and monthly reports
- Late entries or absentees
- Location accuracy logs

Advantages of Geofencing in Attendance Systems

a) Automation:
Fully eliminates the need for manual punch-ins or registers.

b) Real-Time Updates:
Attendance is recorded the moment the user enters the location.

c) Anti-Fraud:
Only users physically present in the geofence can mark attendance, minimizing proxy issues.

d) Time Efficiency:
Saves time for both users and administrators.

e) Scalability:
Suitable for institutions or organizations of all sizes and easily configurable for multiple geofences and users.

1.3. Motivation

In today's educational environment, accurate and reliable attendance tracking plays a crucial role in monitoring student participation, assessing discipline, and ensuring institutional accountability. However, the traditional methods of managing attendance such as manual roll calls or physical signing are increasingly proving to be outdated, inefficient, and vulnerable to misuse. Proxy attendance, manipulation of records, human errors, and time consumption are common issues faced by both educators and administrators across many academic institutions. These challenges form the core motivation behind our research and the development of a Proximity-Based Attendance Management System, designed to offer a smarter, more secure, and technologically advanced solution to attendance tracking.

The primary motivation for this research stems from the urgent need to eliminate proxy attendance, which is one of the most common academic malpractices. Students often mark attendance on behalf of their friends, leading to false records and an inaccurate understanding of actual classroom participation. This not only affects academic performance tracking but also promotes dishonesty and lack of discipline. Our proposed system aims to counter this by allowing students to mark their attendance only when they are physically present within a 50-meter range of the teacher, verified through location-based technology. This ensures that only genuinely present students can access the attendance feature during the limited time window when the teacher activates it.

Another major reason behind this research is to reduce the workload of teachers. In large classrooms, managing attendance manually consumes valuable teaching time. Moreover, handling attendance records manually increases the chances of errors, especially in cases where students are late, leave early, or dispute the marked records. Our system automates this entire process, making it seamless and accurate. Teachers only need to activate attendance for a short duration (e.g., 2 minutes), and the system will handle the rest identifying which students are within range and allowing them to mark their attendance independently. This not only saves time but also shifts the focus back to teaching and learning rather than administrative tasks.

With the increasing integration of digital technology in education, it becomes essential for institutions to adopt modern and scalable solutions that align with the vision of smart campuses. Proximity-based attendance systems fall under the umbrella of smart classroom infrastructure, where automation, location-awareness, and real-time data play a key role. Our motivation is also driven by the larger goal of transforming outdated academic systems into more responsive, tech-enabled environments. Through this project, we aim to bring educational institutions one step closer to becoming digital-first in their operations.

Furthermore, our research is motivated by the importance of fairness and punctuality in academic settings. When attendance is tied to physical presence within a certain range and a specific time frame, it encourages students to arrive on time and be physically present in the classroom. This improves overall discipline and reduces chances of absenteeism. By linking attendance to real-time location and time-bound access, students are encouraged to participate actively and responsibly.

From a technical perspective, the project serves as a real-world implementation of several advanced technologies such as GPS, location APIs, geofencing, database integration, and user authentication systems. The opportunity to work on such a multi-dimensional system also fuels our motivation as engineering students to apply our knowledge in practical ways. The research and development process involved in creating this system allows us to explore problem-solving, design thinking, and systems architecture all of which are critical skills in computer science and engineering.

Additionally, our motivation is also guided by the potential long-term impact and scalability of such a system. While this project is being implemented in a college setting, it has broad application possibilities across schools, universities, training centers, and even corporate environments where attendance monitoring is critical. By addressing a very specific but widespread issue through a simple yet effective solution, we aim to create a model that can be adopted, customized, and scaled across different contexts.

Lastly, we are motivated by the vision of building a system that promotes accountability, integrity, and trust within academic institutions. When students and teachers can rely on a transparent system that fairly and accurately records attendance, it builds a more respectful and responsible academic culture. The elimination of bias, the reduction in manual workload, and the increase in data accuracy all contribute to creating a system that is both user-friendly and institutionally reliable.

In conclusion, the development of a Proximity-Based Attendance Management System is driven by the combination of practical necessity, ethical responsibility, technical opportunity, and long-term impact. Through this research, we aim not only to solve a real-world problem but also to contribute towards the digital transformation of educational institutions. This project represents a step toward smarter, fairer, and more efficient academic systems where technology is leveraged to its fullest potential.

2. SYSTEM LITERATURE REVIEW

- S. K. Baharin [1] proposed a system that prevents students from attending class if they are outside the class session range set by lecturers. This helps to reduce fraudulent attendance registration. With this automated method, it becomes easier to monitor students' attendance and calculate their absenteeism rates. The system can also notify both teachers and students when absenteeism becomes excessive, and inform them of their "ZZ status"—a warning level indicating that the student may be at risk due to too many absences. Unlike other existing systems that require extra hardware like RFID tags or iris scanners, the proposed system only relies on users' own devices for attendance tracking.

- Ester Erni Sinaga and Eko Budi Setiawan [2] proposed and developed a system that uses geofencing technology in a hotel service application. The system allows guests to check in, check out, and access various hotel services based on their location. It also helps users navigate to these services depending on where they are within or around the hotel area.

- Aakruti Buddhiwant and Mudita Bharkshe [3] proposed an Android-based attendance tracking application. The software provides reliable and easy-to-use controls. By reducing the time and effort needed for manual attendance updates, it helps lecturers manage their workload more efficiently. This system can also serve as a model for developing similar tools to track attendance in workplaces, offices, and other organizations. Both parents and students can access attendance records and curriculum details through the website.

- Najwa Suraya Binti Abdul Samat [4] developed an Android-based mobile application for attendance tracking. The app offers reliability, time efficiency, and user-friendly controls. By reducing the time and effort involved in manual attendance updates, it helps ease lecturers' workloads, especially during seminars. The system can also serve as a base for developing similar attendance solutions in offices, workplaces, and other organizations. Through the website, both parents and students can access information related to attendance and the curriculum.

- Aayushi Singh and Tanya Goel [5] developed a system that successfully met the intended requirements. It required both professors and students to be physically present, reducing the extra effort involved in maintaining records and verifying students' eligibility to appear for exams. The system showed strong potential for effective use in government-run schools. However, it had a limitation—it could not monitor student behavior after attendance was recorded.

- G. B. Iwasokun [6] focused on design requirements aimed at developing an application to help protect individuals and family members from kidnapping. The system uses geo-fencing technology to trigger real-time alerts when someone is forcibly taken out of a predefined virtual zone, allowing for immediate reporting of suspected abductions. By combining GPS-enabled smartphones with mobile internet, the solution effectively applies the Internet of Things (IoT) concept to track and locate individuals. The tracker's position, along with the locations of those being monitored, is then displayed on Google Maps.

- Dankar, A. and Kundapur, P. [7] aimed to advance the AMAS system. The services provided by the system include task-related emails, SMS notifications, and attendance tracking. The application is connected to a website and a database server, which stores and retrieves all records. However, the system was developed exclusively for Android devices and is not compatible with iOS smartphones.

- Taju, S. W., Mamahit, Y. P., & Pongantung, J. A. (2024) [8]. This research successfully implemented an innovative student attendance system at Klabat University using a QRcode and geolocation technology. The attendance system has been enhanced through the integration of QR-Code and geo-location technologies, allowing for more effective recording, monitoring, and processing of student attendance. By implementing the latest QR-Code and Geo-Location features, this system has significantly improved the management and oversight of student attendance at Klabat University. This successful implementation demonstrates the potential for this system to be a model for similar applications in other educational institutions.

3.1. PROPOSED WORK

The objective of the proposed system is to design and implement a location-aware, role-based attendance and classroom management platform that leverages geofencing, real-time geolocation, and role-based access control. The system aims to prevent proxy attendance, streamline class participation, and centralize digital classroom resources in a secure and scalable manner.

DFD of The Project:

Data Flow Diagrams (DFD) for this project involves outlining the flow of data through different levels of abstraction. Here's a detailed explanation of the DFDs at three levels: Context (Level 0), Level 1, and Level 2. Each level provides increasing details about the data processes, data stores, and data flows within the system.

Context Diagram (Level 0 DFD):

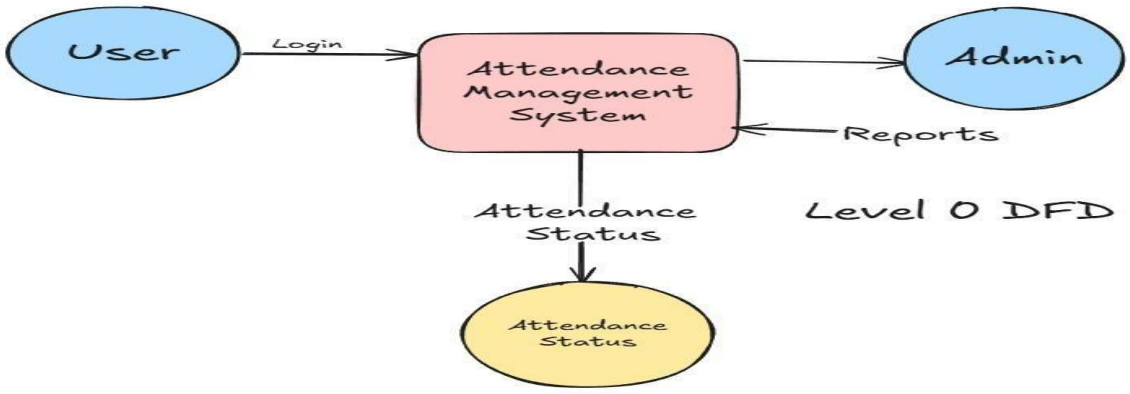
Purpose: Provides a high-level overview of the system without breaking it down into sub-processes.

Components:

- Student
- Teacher
- Admin

- Main Process: Attendance Tracking System
- Data Stores: Abstracted (not detailed here)
- Data Flows:
    - Student submits attendance request
    - Teacher initiates session, uploads content
    - Admin manages user access

DIAGRAM:



LEVEL 0 DFD

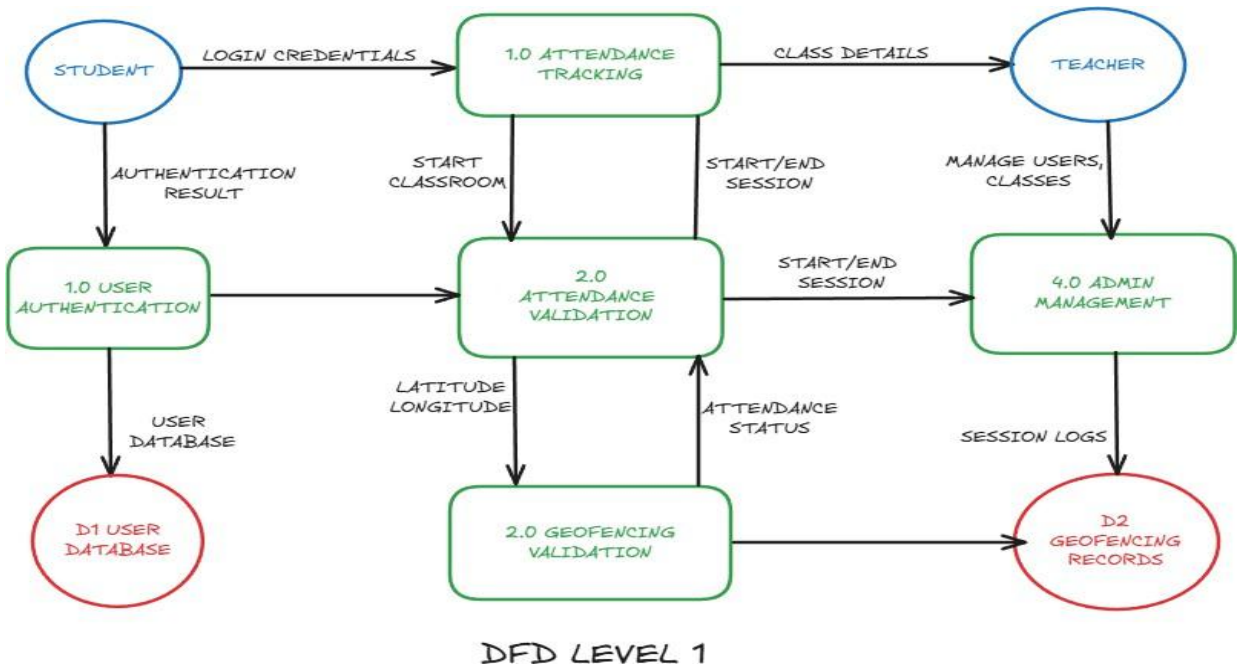
LEVEL 1 DFD:

PURPOSE: DFD Level 1 expands the single process into multiple sub-processes and shows how data flows between them and external entities.

COMPONENTS:

- User Management – Registration, Login, Role validation
- Class Management – Create or join class, manage class info
- Attendance Management – Geolocation check, time window, attendance marking
- Assignment & Notes – Upload/download content
- Community & Notifications – Post in communities, receive reminders

DIAGRAM:



LEVEL 1 DFD

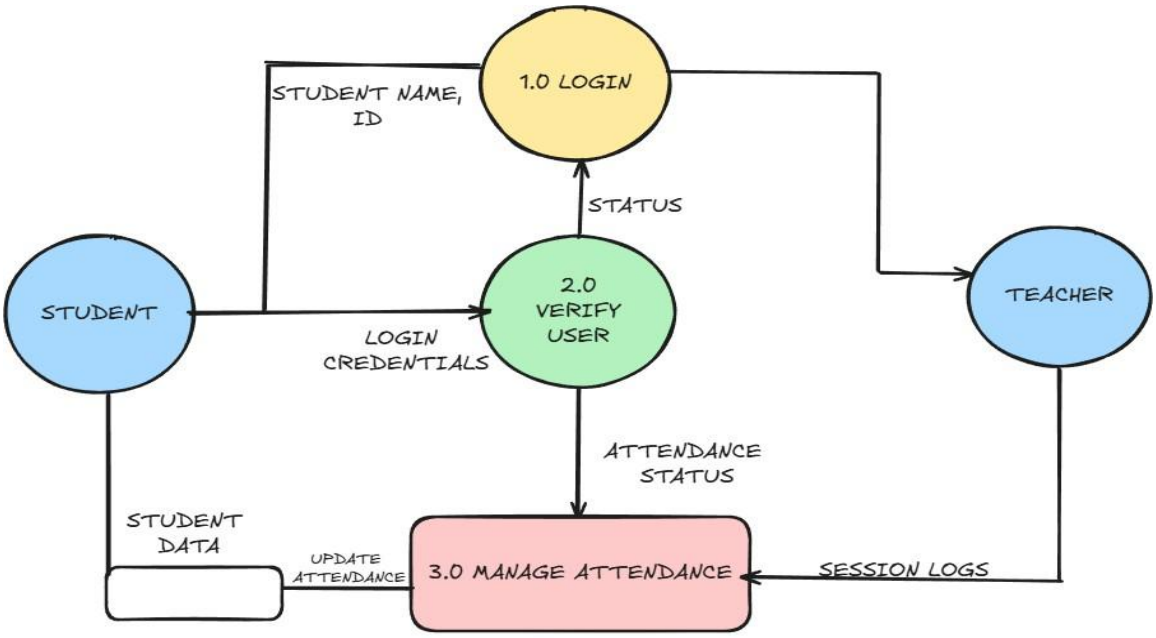
LEVEL 2 DFD:

PURPOSE: This level drills deeper into one or more of the sub-processes from Level 1 Attendance Management.

COMPONENTS:

- Teacher initiates attendance session: Start time, location sent
- Student requests check-in: System verifies geolocation radius
- If within bounds, attendance is marked: Stored in attendance DB
- If not in range, denied with message
- Teacher ends session: System finalizes data

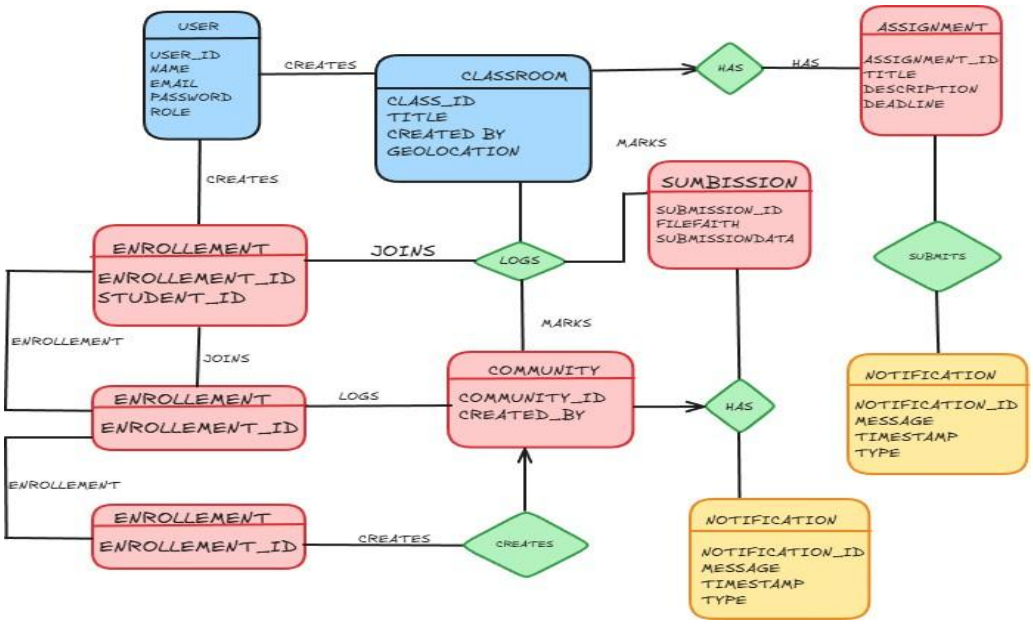
DIAGRAM:



DFD LEVEL 2 FOR ATTENDANCE SYSTEM

LEVEL 2 DFD

ER DIAGRAM OF THE PROJECT:



Scope of Work

The system integrates multiple modules under a single platform, accessible via a responsive web interface. Key proposed modules include:

1. User Management Module
Roles Defined:

Student: Can self-register and join classes using a 6-digit code.

Teacher: Requires admin approval post-registration. Can create/manage classrooms.

Admin: Promoted from teacher role. Oversees the platform, approves users.

Functionalities:

- JWT-based secure login system
- Role-based dashboard redirection
- Dynamic access to modules depending on role

2. Navigation & UI Structure
Sidebar Elements:

Profile section (with picture and name)

Links to Dashboard, Classrooms, Communities, Calendar

Navbar Elements:

- Dark mode toggle
- Notifications bell
- Logout option

UI Adaptability:
Role-based rendering to ensure tailored interfaces for students, teachers, and admins.

3. Role-Based Dashboards
Students:

- List of joined classes
- View assignments, attendance logs
- Teachers:
    - Manage classes, attendance sessions
    - Upload notes and assignments
- Admins:
    - View user activity logs
    - Approve new teacher accounts
    - Manage classroom structures

4. Classroom Management System
Teachers:

- Create classroom with a unique 6-digit code
- Upload materials (PDFs, assignments)
- Start and stop geo-fenced attendance sessions
- Students:
    - Join class using class code
    - Mark attendance via location detection
    - View/download notes and submit assignments

5. Attendance Module with Geofencing
Technology Used:

- Browser/device Geolocation API
- Backend-defined classroom coordinates (latitude, longitude)
- Logic Flow:
    - Teacher starts an attendance session (with duration and geofence parameters)
    - Student's device fetches real-time coordinates
    - Attendance marked only if student is within a 100m radius
- Security:
    - Coordinates are encrypted before processing
    - Anti-spoofing mechanisms (location timestamp + session window)

6. Notes & Assignments
Teachers:

Upload educational content (notes, assignments) using drag-drop or form

Students:

- View/download resources
- Submit assignments (with deadline validation)

7. Community & Engagement
Teachers:

Automatically assigned to a private "Community Forum"

Students:

- Can join/leave community channels
- Can interact with posts (read-only or discussion mode)

8. Calendar & Notifications
Event Scheduling:

- Teachers and admins can schedule classes, deadlines, and exams
- Notifications: Real-time push/toast notifications for upcoming events, assignments due

9. Admin Panel

- Approve or reject new teacher registrations:
- Delete users or block suspicious accounts
- View platform-wide logs of class activity, attendance, and content uploads

Technology Stack	
Layer Tools / Frameworks	
Frontend:	React.js, Tailwind CSS
Backend:	Node.js, Express.js
Database:	MongoDB
Authentication:	JWT, Role-based Access Control
Geolocation:	HTML5 Geolocation API / GPS
File UploadsMulter (Backend), FormData	
Notifications	React-Toastify or Custom Alerts
Deployment Vercel / Firebase / Heroku	

Expected Outcomes:

- Real-time and secure attendance tracking with zero proxy chances
- Centralized classroom resource and assignment management
- Scalable solution suitable for educational institutions and training platforms
- Enhanced user experience with responsive design and dark mode support
- Modular backend supporting future enhancements like facial recognition or biometric add-ons

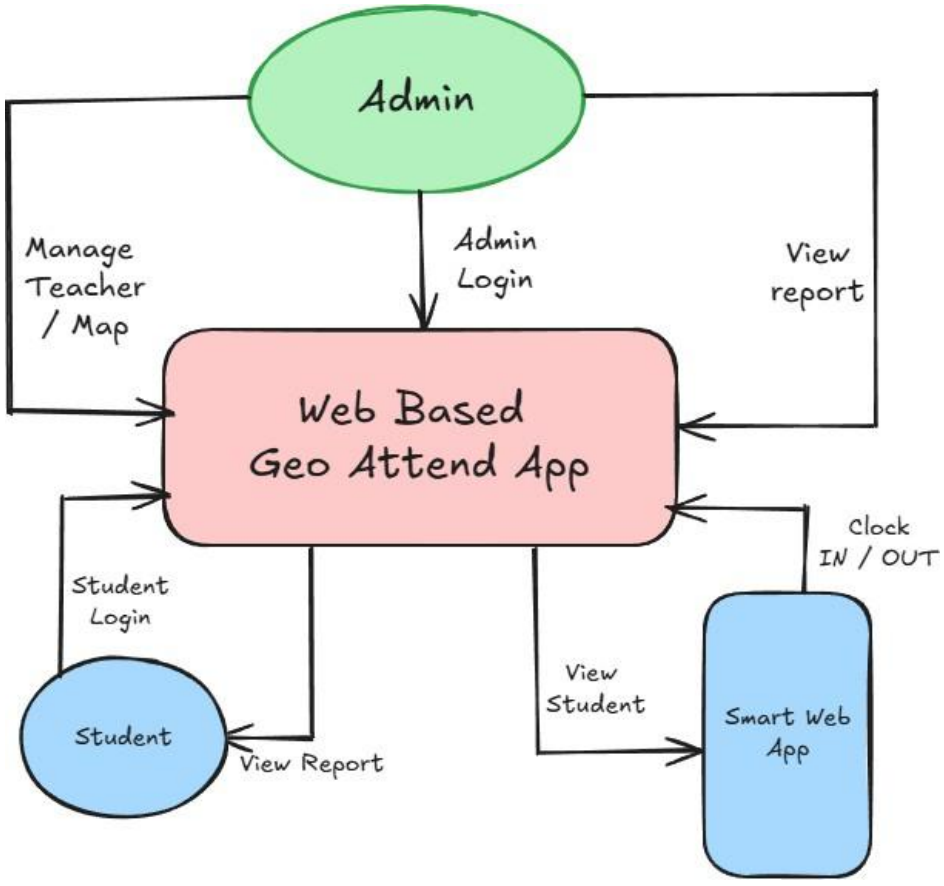
3.2. PROPOSED ARCHITECTURE

Designing an Android-based Geo-Attendance Management System involves several components:

a) User Interface: Create intuitive screens for users to mark attendance, view attendance history, and manage their profiles.

b) Authentication: Implement secure login methods like username/password, biometric, or two-factor authentication to ensure user identity.

c) Geo-location Services: Utilize GPS or geofencing APIs to capture accurate location data when employees mark attendance. Geofencing ensures attendance is recorded only within designated areas.



d) Database: Set up a robust database (SQL, Firebase, etc.) to store user profiles, attendance records, timestamps, and location data securely.

e) Attendance Marking: Develop features for users to mark attendance manually or automatically upon entering a predefined geofenced area.

f) Attendance History: Implement a feature for users and administrators to view attendance history, including dates, times, and locations of attendance marks.

g) Real-time Updates: Enable real-time syncing between the mobile app and the server to ensure attendance data is updated instantly.

h) Administrative Dashboard: Create a web-based dashboard for administrators to manage user accounts, generate attendance reports, and monitor attendance patterns.

i) Notifications: Implement push notifications to remind users to mark attendance and inform administrators of attendance anomalies.

j) Data Security: Implement encryption protocols and secure APIs to protect data transmission and storage.

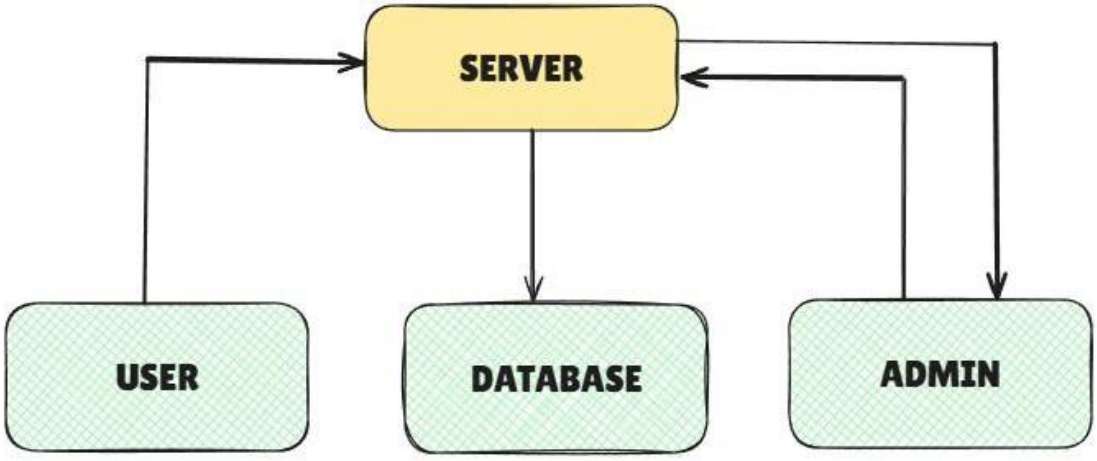
k) Reporting: Develop customizable reporting features for administrators to analyses attendance data, track trends, and generate insights.

l) Offline Support: Ensure the app functions partially offline, allowing users to mark attendance even in areas with limited connectivity. Sync data when the connection is restored.

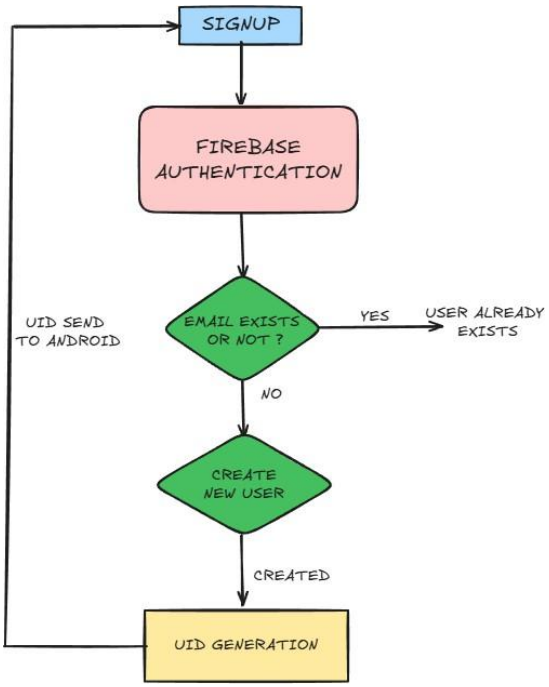
m) Compliance: Ensure the system complies with local regulations and data protection laws concerning employee attendance and location data.

n) Testing: Rigorous testing for functionality, security, and usability to identify and fix potential issues before deployment.

o) Documentation: Provide comprehensive documentation for users and administrators, explaining how to use the system effectively. By considering these components, you can create a comprehensive and effective Android-based Geo-Attendance Management System.



The system architecture of Android Based geo-attendance management is shown in fig. This system consists of three major sectors i.e., Admin side, student or teacher login side and server. Admin can access the attendance sheet of every student or teacher for viewing purpose. Admin also add or remove the profiles from the databases according to new admissions or students or teachers who left the college. The principle of geo attendance fencing technology is a kind of location-based technology, through the acquisition of correct location in specific area with the help of GPS of the mobile phones. The main purpose of the geo fencing is to collect the information of the students and teachers to determine whether they are present into the classroom or not.



4. EXPERIMENTS AND ANALYSIS

EXPERIMENTAL SETUP:

To evaluate the functionality, accuracy, and usability of the proposed system, we conducted controlled experiments using the developed application in a simulated classroom environment.

Frontend Stack: React.js, Tailwind CSS

Backend Stack: Node.js, Express.js, MongoDB

Authentication: JWT (JSON Web Token)

Geofencing: HTML5 Geolocation API

Device Types Tested: Android smartphones, laptops (Chrome & Firefox browsers)

Radius for Geofencing: 100 meters

TEST CASE	DESCRIPTION	EXPECTED RESULT	OUTCOME
1.	Student tries to mark attendance within geofenced area	Attendance marked successfully	**Passed**
2.	Student attempts outside defined location	Attendance not allowed	**passed**
3.	Teacher creates classroom & starts attendance session	Session active for defined time	**passed**
4.	Unauthorized user tries to access attendance page	Redirected to login/denied	**passed**
5.	Student joins class using valid code	Class joined successfully	**passed**
6.	Geolocation blocked by browser	Attendance not marked, warning shown	**passed**

PERFORMANCE METRICS:

Metric	Value
Average Location Detection Time	~2.1 seconds
Attendance Accuracy (based on location)	98.5%
API Response Time (avg)	< 300ms
Assignment Upload Success Rate	100%
Notification Delivery Delay	< 1 second

ANALYSIS:

- Accuracy: The system was highly accurate in verifying if a student was within the geofenced radius using device GPS or browser location services.
- Security: JWT authentication effectively restricted access based on user roles (Student, Teacher, Admin).
- Scalability: The modular architecture allows the platform to scale easily across multiple classrooms and institutions.
- User Experience: Students found the system intuitive. Notifications, class joining, and real-time attendance feedback contributed positively.

OBSERVATIONS AND CHALLENGES

- In some low-accuracy GPS environments (e.g., inside certain buildings), location mismatches occurred.
- Students without location permission could not mark attendance — handled gracefully with alert messages.
- Cross-device testing was essential to verify UI consistency and GPS accuracy on mobile vs. desktop.

5. CONCLUSION

Traditional attendance systems, such as those relying on fingerprints, iris scans, and RFID technology, have shown several limitations, including hardware dependency, maintenance issues, and susceptibility to manipulation. In response, modern attendance tracking models have emerged—particularly those based on geofencing technology—which offer more reliable and efficient alternatives. By using geofencing APIs and real-time device-based location tracking, these systems enable strict monitoring of attendance within defined geographical boundaries.

The Attendance System for Zero Proxy Using Geographical Location represents a significant advancement in this space. It ensures enhanced integrity by eliminating the possibility of proxy attendance, automates attendance records to reduce administrative workload, and offers scalability for use in schools, offices, and large-scale events. With built-in security measures such as encryption and secure communication protocols, the system also ensures the protection of sensitive user data.

This technology-driven solution not only overcomes the shortcomings of older systems but also aligns with current trends in digital transformation. It stands as a benchmark for secure, accurate, and efficient attendance management in both educational and professional environments.

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