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SAAPT : Smart Attendance and Progress Tracker

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Abstract: *Attendance monitoring is a critical component of academic management in educational institutions. Conventional paper-based or spreadsheet-driven systems are slow, error-prone, and fail to provide students with timely awareness of their attendance standing, often resulting in students unknowingly becoming defaulters.*

This paper presents SAAPT (Smart Attendance and Progress Tracker), a cross-platform mobile application developed using React Native and Expo, with Firebase Firestore as the real-time cloud database and Firebase Authentication for secure access management. The system implements a role-based architecture supporting three user types — Administrator, Teacher, and Student — each with a dedicated interface and feature set. Administrators can manage users, create classes and subjects, assign teachers to subjects, and monitor institution-wide attendance analytics. Teachers can mark subject-wise attendance using an interactive three-state toggle mechanism and view class reports with a defaulter identification module. Attendance data is stored locally on the device using SQLite when internet connectivity is unavailable, allowing teachers to mark attendance without interruption even in low-connectivity environments. A one-tap sync mechanism detects network availability and uploads all pending offline attendance records to Firebase Firestore, ensuring no data is lost. Students can track their overall and subject-wise attendance percentages in real time, with an in-built algorithm that calculates the exact number of classes required to meet the 75% attendance threshold. The system delivers proactive defaulter alerts through visual indicators and status banners, enabling students to take corrective action before shortfall becomes irreversible. The proposed system reduces administrative overhead, improves attendance transparency, and empowers students with actionable progress information through an intuitive mobile-first interface..

Keywords: Smart Attendance System, React Native, Firebase Firestore, Role-Based Access Control, Offline-First Architecture, Defaulter Detection, Mobile Application, Education Management System, Progress Tracking

I. INTRODUCTION

Attendance is a key parameter used by educational institutions to evaluate student discipline, consistency, and participation. Many colleges and universities still rely on paper registers or basic
spreadsheet-based systems for attendance management [1][7]. These traditional methods are time-consuming, prone to human errors, and inefficient for long-term data analysis.

Another major drawback of conventional attendance systems is the absence of real-time monitoring. Students are usually informed about attendance shortages during internal assessments or at the end of the semester [2]. This delay often results in unintentional defaulter cases and academic stress. With the rapid advancement of mobile technologies and digital education platforms, there is a growing need for intelligent systems that provide continuous attendance tracking and academic progress monitoring [3]. SAAPT is proposed as a mobile-first solution to overcome these limitations by integrating attendance tracking, offline support, progress monitoring, and early warning notifications into a single cross-platform application [6].

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II. PROBLEM STATEMENT

Existing attendance management systems suffer from several critical limitations. Attendance data is generally recorded manually and processed after long intervals, which delays the identification of defaulter students [5]. There is no centralized system that allows students to continuously monitor their attendance in real time.

Additionally, most digital attendance systems require a constant internet connection, making them unusable in areas with unstable or no connectivity — a common challenge in rural and semi-urban college campuses across India [7]. Most systems do not provide automated alerts when attendance approaches the minimum required threshold, causing students to remain unaware of their status until it is too late [10].

III. MOTIVATION

The increasing number of defaulter students has become a major concern for educational institutions. One of the primary reasons is delayed attendance reporting and the lack of early warning mechanisms. Traditional attendance systems mainly focus on record-keeping rather than student awareness, which causes students to realize their low attendance only at the end of the term, when it becomes difficult to improve [1][6].

Another challenge is the absence of real-time attendance tracking and meaningful insights such as subject-wise attendance and required classes to maintain eligibility. This limits students' ability to take timely corrective actions. Faculty members also face difficulties such as manual attendance marking, increased workload, and difficulty identifying defaulters early.

Motivated by these challenges, SAAPT aims to develop a smart system that not only records attendance but also actively guides students through visual alerts, notifications, and progress insights. The system also supports teachers in low-connectivity environments by allowing attendance to be marked offline and synced to the cloud once connectivity is restored. This ensures uninterrupted attendance management and improves overall reliability of the system [10].

IV. LITERATURE SURVEY

Several attendance management systems have been proposed in recent years to digitize traditional attendance processes. Most existing systems focus on automating attendance entry and generating reports at the end of the academic term [2][5]. While these systems reduce manual workload, they do not support real-time analysis or offline operation.

Biometric and RFID-based systems [2][3] require dedicated hardware installations that are expensive and impractical for most institutions. QR code-based approaches [6] are susceptible to proxy attendance. Firebase-based mobile attendance applications [8][9] leverage real-time cloud synchronization but are entirely dependent on internet connectivity, with no mechanism for local data persistence and deferred synchronization. This research gap — fully integrated offline-first attendance with progress monitoring and defaulter prevention — motivates the development of SAAPT [7][10].

V. PROPOSED SYSTEM

The proposed system SAAPT is a role-based cross-platform mobile application developed using React Native and Expo, designed to manage student attendance and academic progress efficiently. SAAPT consists of three major modules: Student Module, Teacher Module, and Admin Module. The overall system architecture is shown in Fig. 1.

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Fig. 1: SAAPT System Architecture

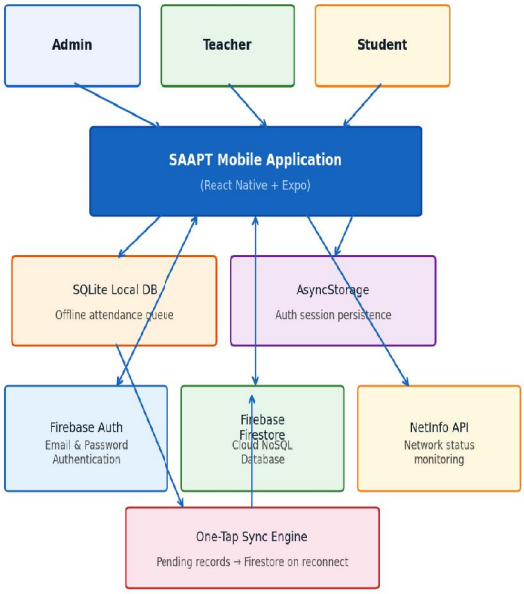

Fig. 1: SAAPT System Architecture Block Diagram

A. Student Module

Students access the system using secure Firebase Email and Password authentication. After successful login, students can view subject-wise attendance percentages and overall progress through animated progress bars with a 75% threshold marker. The system calculates attendance using: Attendance % = (Classes Present / Total Classes) × 100. When attendance falls below 75%, a warning banner is displayed showing the exact recovery value: Classes Needed = ⌈(75 × Total − 100 × Present) / 25⌉ [1][7]. Students can also view the class defaulters list showing classmates below the threshold.

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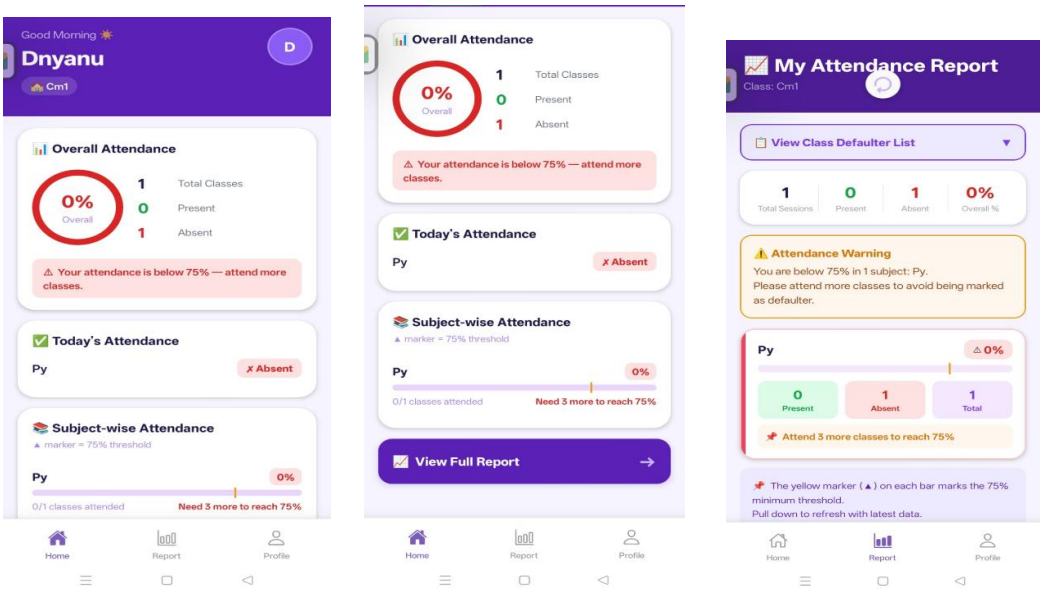
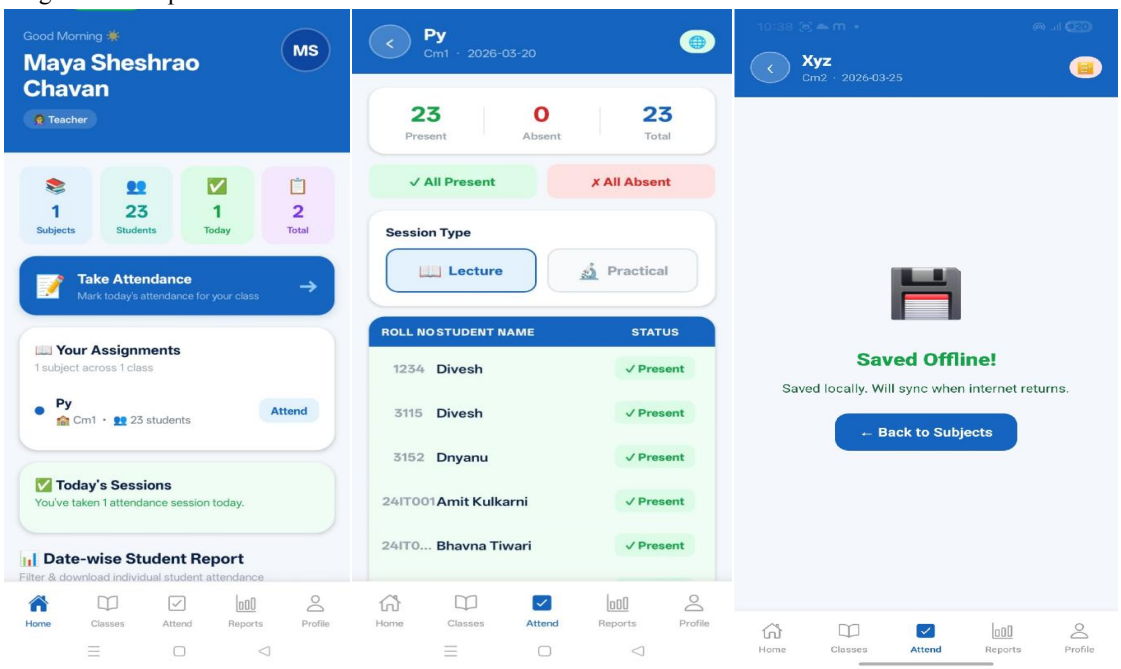


B. Teacher Module

Teachers mark subject-wise attendance using a three-state toggle — Unmarked, Present, and Absent — with a "Mark All Present" shortcut for efficiency [4][8]. A key feature is offline attendance support: when internet is unavailable, data is stored locally using SQLite and synced to Firestore with a one-tap sync button when connectivity is restored, ensuring no attendance data is ever lost. The flowchart in Fig. 2 illustrates the complete attendance marking process including the offline path.



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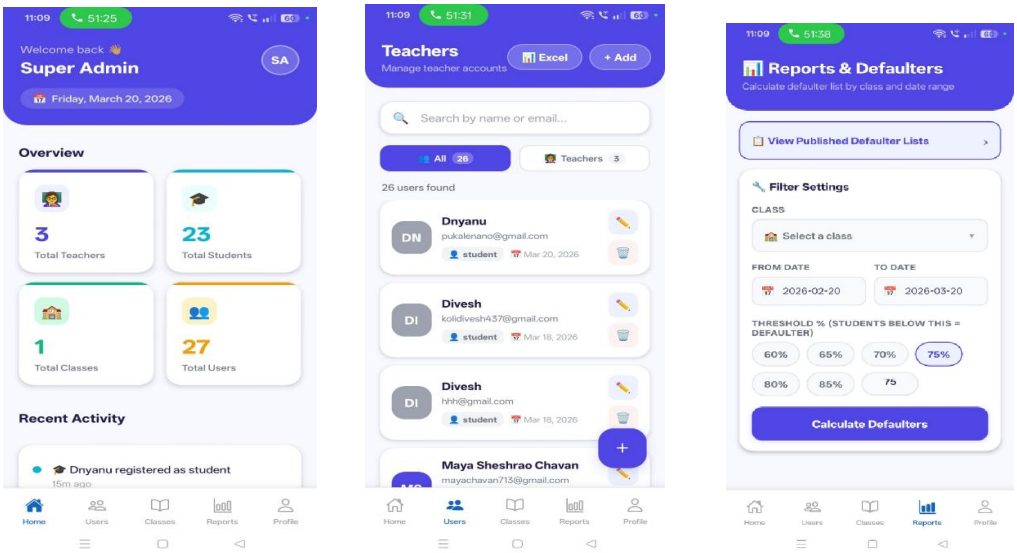
C. Admin Module

Administrators manage user accounts, create classes and subjects, assign subjects to teachers using a three-step guided wizard with atomic batch writes, and monitor institution-wide attendance through a reporting dashboard [5][6].



VI. PROPOSED FRAMEWORK

The framework follows a mobile-first client-cloud architecture. For online scenarios, attendance is saved directly to Firebase Firestore. For offline scenarios, a local SQLite database queues attendance records with timestamps. The NetInfo API continuously monitors device connectivity, and the sync engine automatically uploads pending records to Firestore when connectivity is restored — or upon a manual one-tap sync by the teacher. Fig. 3 illustrates the complete offline sync flow.

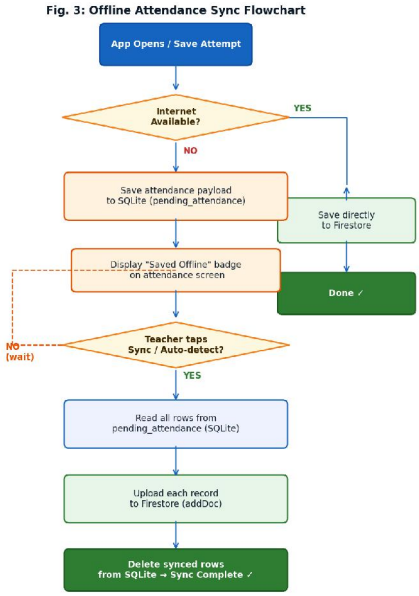


Fig. 3: Offline Attendance Sync Flowchart

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The Firestore data model consists of five collections as shown in Table I. The class_subjects collection acts as a junction table linking classes, subjects, and teachers. The attendance collection stores one document per session with an embedded records array containing each student's status [3][6].

TABLE I: FIRESTORE COLLECTION STRUCTURE

Collection	Document ID	Key Fields
users	{uid}	name, email, phone, role, classId, className, rollNumber, createdAt
classes	{autoId}	name, students: [uid, ...], createdAt
subjects	{autoId}	name, teacherId, teacherName, createdAt
class_subjects	{autoId}	classId, className, subjectId, subjectName, teacherId, teacherName
attendance	{autoId}	classId, subjectId, teacherId, date, savedAt, records:[{studentId, name, status}]

VII. DEFAULTER PREVENTION MECHANISM

The defaulter prevention mechanism is the core feature of SAAPT. For each subject, attendance is computed as: Attendance % = (Classes Present / Total Classes) × 100. When this value falls below 75%, the student is immediately flagged as a defaulter. SAAPT further provides an actionable recovery formula: Classes Needed = ⌈(75 × Total − 100 × Present) / 25⌉, telling the student exactly how many consecutive classes they must attend to restore their standing [3][6].

Table II presents a comparative analysis of SAAPT against existing attendance management approaches, demonstrating its advantage across all key feature dimensions.

TABLE II: COMPARATIVE ANALYSIS OF ATTENDANCE SYSTEMS

Feature	Manual System	Web-Based Systems	Existing Apps	SAAPT (Proposed)
Attendance Marking	Paper Register	Manual Entry	Basic Toggle	3-State Toggle + Mark All
Offline Support	N/A	Not Available	Rare	SQLite Queue + One-tap Sync
Defaulter Detection	Manual Calc.	Limited	Basic %	Auto-detect + Recovery Formula
Student Visibility	None	Delayed	Partial	Real-time Subject-wise
Role-Based Access	None	Limited	2 Roles	3 Roles (Admin/Teacher/ Student)
Platform	Physical	Web Browser	Single	Cross-platform (Android + iOS)
Report Generation	Manual	Basic	Limited	Subject-wise + Defaulter List

VIII. CONCLUSION

SAAPT provides a comprehensive and intelligent solution for attendance and academic progress monitoring on mobile devices. By integrating real-time tracking, animated progress visualization, offline-first attendance marking with one-

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tap synchronization, and proactive defaulter detection with a mathematical recovery formula, the system effectively addresses the limitations of both traditional and existing digital attendance systems.

The offline attendance feature is a significant practical contribution, ensuring that teachers in low-connectivity environments can continue marking attendance without interruption. The three-role architecture ensures that administrators, teachers, and students each receive precisely the tools relevant to their responsibilities. Future work will focus on push notifications, QR code-based attendance, PDF/Excel report export, and biometric login [1][6][10].

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