



RFID-Driven Attendance and In-Campus Payment System for Enhanced Student Experience

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by

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Abstract

The project proposes an RFID system to enhance the students' experience, as well as operational efficiency, in the learning centers. Traditional in-campus payment and attendance practices are usually cumbersome, prone to errors, and do not permit monitoring in real-time. The proposed solution is founded on the utilization of RFID technology to enable automatic attendance monitoring as well as secure non-cash payment in the in-campus centers.

The MERN stack (MongoDB, Express.js, React, Node.js) system features role-based access among students, teachers, parents, and admins. The system features RFID integration modules, wallet management, in-built data logs, attendance and financial transaction dashboards, even a machine learning module that translates attendance data into predicting attendance trends in advance to facilitate proactive decision-making.

The system promotes accountability and transparency because it provides the parent with direct, in-time access to the financial and learning record of the child. The administrators benefit from centralized control of their data, while the students can check their spending and attendance.

The entire project is compliant with smart campus initiatives and is a scalable, secure, and effective solution to institution workflow modernization leveraging automation, data analysis, and customer-centric design.

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Chapter 1: Introduction

The trend of the smart campus is revolutionizing the functioning of the campuses. Manual attendance monitoring and secure payment methods in most cases are ineffective, time-consuming, and do not provide real-time insight. The project suggests a web-based, RFID-supported system that replicates attendance monitoring and secure, cashless payment facilitation in an educational environment. Automating the process via role-based log-in and replicating RFID scans, the system sets the bar for operational efficiency, transparency, and ease of use a step higher.

1.1 Project Objective

The project's objective is to create an RFID system based on simulation that integrates automated attendance and payment using a digital wallet. Unlike using actual RFID sensors, the system mimics RFID capability through interactive elements that simulate the process of tag scans. This enables the possibility of accurate recording of the records, live monitoring, as well as access control without the need to use specialized hardware.

The system is designed to serve a set of users within the institution who play different roles and have different levels of access:

- Level 1 Administrator – Full control of all users, settings, analytics, and back-end functionality

Level 2 Administrator (Faculty Dean) - Manages faculty-level operations, assignment of users, and reporting

- Level 3 Admin (Vice Dean) - Manages chosen academic information and supports reporting by faculty

- Teacher – Responsible for attendance sheets and timetables of students
- Student – Interacts with the RFID payment and attendance simulation; views personal statistics
- Parent - Monitors child's attendance, spending, and wallet activity in real-time
- Merchant – RFID-based payment acceptance and transaction log viewing

1.2 Project Scope

The objective of the project is to develop a fully software-simulated RFID system. The project scope is as under:

Attendance Tracking: The students perform mock RFID card swipes for attendance tracking.

- Digital Payment: Students make payments for school services using digital wallets.
- Role-Based Dashboards: Different users from various categories view a role-based tailored interface.
- Admin Management: Multi-level admin controls to handle users, transactions, and analytics
- Parental control: Real-time web portal for viewing attendance and spending.
- Predictive Features: Basic analytics that identify attendance or wallet patterns.

Beyond the scope

- Physical RFID readers, sensors, or hardware integration
- External payment gateways or bank APIs

1.3 System Approach Overview

The platform is an online simulation system developed using the MERN stack:

- MongoDB stores attendance histories, wallet balances, and the users' details

Express.js and Node.js manage back-end logic and simulate RFID responses

React.js makes interactive interfaces accessible to everyone

Socket.IO/Web APIs facilitate real-time communication between components

Simulation buttons or events mimic the process of RFID scans without using physical devices.

1.3.1 System Architecture

The system is client-server modular in structure:

- Frontend: Provides customized dashboards for students, parents, teachers, admins, and merchants
- Back-end: Responsible for handling RFID logic, data, authentication, and wallet features

- Database: Stores users' accounts, attendance reports, and transactional history
- Simulation Layer: Simulates the RFID scans with virtual elements (i.e., “Scan” buttons)

Its design makes the project testable, extendable, and hardware-independent, thereby apt to be employed in simulation environments as well as in-class demonstrations.

1.4 Business Context

Schools and universities need to make their process simpler, lower their spending, and boost engagement. Manual attendance books and the payment of money are a thing of the past. On top of that, demand for data openness and parental engagement keeps growing.

It serves these needs directly by:

- Examining RFID-based services in an education setting
- Offering digital wallets and dashboards
- Providing actionable data to administrators and guardians

The modular strategy also leaves options open for any future integration, such as biometric scanning, mobile coverage, or even physical RFID hardware if required.

1.5 Significance of the Study

This study determines that schools can benefit from digitalization through simulation. It proves that problems in the real world such as inefficient attendance

monitoring and insecure campus transactions can be solved by utilizing well-designed software systems without the installation of physical sensors or expensive hardware.

Seven different kinds of users bring in practicality as well as the hierarchy of actual scholastic entities. The project promotes operational realism and system scalability in design because of the workflow and permission emulation.

Ultimately, the system offers an economy- and educationally effective template for replicating smart campus operations.

Chapter 2: Background

In the chapter, the fundamental principles, reasons, and problems that justified the installation of an RFID-based attendance monitoring and cashless payment system in the institutes of learning are discussed. These are founded on the limitations of the conventional approach, the growing need for intelligent infrastructure in the campuses, and the success of such a system in an educational environment.

2.1 Significance of Attendance and Financial Systems in Schools

Attendance and in-college transactions are fundamental functions of any school operation. Accurately monitoring attendance is essential to academic integrity, grading, and compliance with policies. Similarly, processing transactions -- from cafeteria food purchase to library charges to student parking -- is a function of a student's life.

These functions were once dependent on paper-based or manual mechanisms, which are prone to human error and are tedious. As digital infrastructure increases, institutions now turn to the use of integrated mechanisms that automate processes, offer instantaneous monitoring, and offer data to aid in decision-making.

2.2 Traditional Learning Environment Barriers

Based on case studies and observations, a number of problems plague standard attendance and payment systems:

- Manual Attendance Records: Have no real-time updates and are susceptible to erroneous entries or tampering.
- Cash Transactions: Mismanagement of risk, theft, and insufficiency in recording finances.

- Excessive administrative burdens: Manual reporting, reconciliations, and entries add to employees' workload and expense.
- Limited Parental Guidance: Parents likely do not know students' attendance patterns or spending patterns.
- No Personal Budgeting Tools: Students do not receive organized financial instructions.
- Data Fragmentation: Schools do not have centralized systems to maximize services based on students' preferences.

These challenges necessitated the need for an automated, role-based system capable of delivering consistent, real-time intelligence.

2.3 Recent Work and Contemporary Solutions

Several institutions have explored RFID-based systems to bring automation to campus services. They are:

- An IT centre of a university implemented attendance monitoring using RFID and attained 128.57% accuracy, time savings, and student engagement (Okoli, 2022).
- A case study also found that the implementation of RFID-based cashless technology sped up the speed of transactions by 40% and reduced the frequency of financial errors by 25% (Shinde, 2024).

While they function, they are physical RFID technology, a costly and difficult-to-scale technology to use in research projects. Commercial ones also do not

accommodate a range of users such as vendors, faculty deans, or parents to name a few.

Your system is founded on these findings but performs the same function of RFID in software, the same learning outcomes, and the same operational benefits - without cards or actual RFID readers.

2.4. Role of Simulation and Automation

The standout innovation of the project lies in the use of a simulated RFID capability instead of actual sensors. Using a simulated RFID interface in a MERN web application, the system provides a hardware-independent and riskless space to:

Simulate scans of RFID cards during transactions and attendance.

- Provide instant responses to all users.

Represent and capture institution data with utmost flexibility

Enable testing, demonstration, and scholarly scalability.

This solution supports the underlying aims of developing a smart campus without the costs or logistics of hardware. It also offers a platform for gaining experience in learning automation ideas and full-stack integration in a platform that is software alone.

Chapter 3: Software Requirement Specification (SRS)

The chapter defines the overall software requirements of the suggested RFID-based attendance and cashless payment system in a school. System architecture, system

users, the system's most important functionalities, the system's interface components, and system constraints are discussed in the chapter.

3.1 Overall Summary

3.1.1 Product Perspective

It's an RFID web application that functions on the principle of simulation using the MERN stack technology (Node.js, Express.js, React.js, and MongoDB). It mimics the process of RFID card scans by simulating UI interactions. Software-only based, as opposed to the typical case of having physical sensors. It's for institutes that want to monitor attendance and transaction in a multi-role setting through software alone.

3.1.2 Product Functions

- Simulate RFID-based attendance scans.
- Simulate RFID wallet payment.
- Implement CRUD operations among users, courses, schedules, wallets, and transactions
- Create visual dashboards and exportable reports
- Enable live parental monitoring
- Provide role-based tailored dashboards to users

3.1.3 User Characteristics

Level 1 Administrator Super administrator with full access and system-wide authorization

Level 2 Administrator

Faculty Dean with faculty-specific CRUD capabilities and view of reports

Level 3 Administrator

Vice Dean with read-only access to monitoring tools and statistics

Student schedules and teacher attendance access

Student Mimic payments and attendance; check attendance and wallet

Parents track their child's spending and attendance

Business owner

Accept wallet payments and see transaction history

3.2 Functional Requirements

3.2.1 User Authentication

- They can be registered or be managed by admins.
- Users log in with email and password
- Passwords are securely stored using hashing (bcrypt)
- Sessions are authenticated using JSON Web Tokens (JWT)

- Role-based redirecting after login
- Logout security and password reset

3.2.2 RFID Attendance Simulator

- They can simulate RFID scans using a button in their dashboard
- Logs course, timestamp, and student ID
- Attendance is automatically marked as (Present, Late, Absent)
- Subject teachers can also see attendance by date/course.
- Admins can edit or override attendance logs
- Export option in PDF and CSV modes

3.2.3 RFID Payment Simulation

- Students test payment by "swiping" their student ID into a merchant terminal
- Wallet has been confirmed and deducted accordingly
- Student, merchant, product, quantity, timestamp are held in the transaction histories.
- Merchants view live receipts
- Parent Category of viewed transactions
- Admins can process a refund or report anomalies

3.2.4 User Management

- Administrators can add users.
- Admin can read/view users
- Admin can change the users' details.
- Administrators can remove users

3.2.5 Course Management

- Admin can add new courses.
- Administrators view course details
- Administrators can edit course details
- Administrators can cancel courses

3.2.6 Schedule Management

- Admin authorities can upload class schedules
- Administrators can see assigned schedules
- Administrative personnel can alter schedule details
- Administrators can remove schedules

3.2.7 Wallet Management

- Admins or parents can initialize/create wallets

- Administrators can see wallet balances
- Admins and/or parents may add/remove funds
- Administrators can reset or remove a wallet

3.2.8 Transaction Management

- Admin can see all the transactions
- Admins can filter transactions by user, role, or by date
- Admins may change transaction status, for example, refund issued.
- Admin can remove invalid or redundant records

3.2.9 Reporting and Dashboard Access

- Students see attendance and wallet history
- Teachers view attendance reports for classes
- Parents view live monitoring of their child's activity
- Admins see platform-wide analytics based on graph filters
- PDF/Excel modes for exporting

3.3 Use Case Analysis

3.4 Initial Object-Oriented Domain Analysis

3.4.1 Inheritance Relationships

- User (base) → Administrator, Educator, Learner, Parent, Merchant
- Transaction → AttendanceRecord, Payment
- Admin → Has full control over system objects

3.4.2 Class Diagram

3.5 Interface Requirements

3.5.1 Graphical User Interface

React-based role-specific dashboards

- Scan the simulation buttons for RFID commands
- Tables and graphical representations for log display
- Real-time updates through WebSocket or polling

3.5.2 Application Programming Interface (API)

All APIs are RESTful and use JWT authentication:

Endpoint

/api/auth/login

Request a POST

/api/users/	GET/POST/PUT/DELETE	Manage user data
/api/courses/	GET/POST/PUT/DELETE	Manage courses
/api/schedules/	GET/POST/PUT/DELETE	Manage schedules
/api/wallets/	GET/POST/PUT/DELETE	Wallet operations
/api/transactions/	GET/POST	Track payments/attendance
/api/scan/attendance	POST	Simulate attendance scan
/api/scan/payment	POST	Simulate wallet payment

3.6 Performance Requirements

- Less than 2 seconds of simulated RFID events
- Wallet transactions executed in < 2 seconds
- Supports more than 100 users in a high-performing system
- 1-second average query time using MongoDB

3.7. Constraints

- Emulation of RFID capability by UI without the need of physical hardware

- Supports modern browsers (Chrome, Firefox, Edge)
- System vocabulary: English

3.8 Other Non-Functional Requirements

- Security: jwt authentication, bcrypt hash, enforced HTTPS
- Scalable backend, modular to the multi-faculty level.
- Reliability: Stable data recording with roll-back functionality in important modules
- Usability: Low learning process along with easy-to-use interfaces

3.9 Early Routine

Table 1

Phase	Timeline
Requirement Gathering	Nov 2024
System Design & Architecture	Dec 2024
Development Phase	Jan 2025 – May 2025
Testing & Refinement	May 1 st – May 7 th

3.10 Initial Budget

Table 2

Item	Project Cost
Local Development & Hosting	\$100
Tools (VS Code, GitHub, Postman)	Free
Physical RFID Hardware	Not Needed
Total Estimated Budget	\$100

Appendix A

Collected Materials

This appendix includes sample system images, model training datasets, user feedback forms, and the diagrams referenced in this document.

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