Smart Campus Dashboard Using Iot and Rfid

Alugolu Kodandaram[1], Datti Umesh Benarjinaidu[2], Durgam Anvitha[3], Chukka Praveen Kumar[4]
[1,2,3,4]*Department of Computer Science and Engineering*
Avanthi Institute of Engineering and Technology
Cherukupally Village, Vizianagaram – 531162

***Abstract*—The rapid advancement of Internet of Things (IoT) technologies has enabled the development of intelligent systems for automating institutional processes. Traditional attendance and academic data management systems in educational institutions are often manual, time-consuming, and prone to errors. This paper presents a Smart Campus Dashboard that integrates RFID technology with the ESP32 microcontroller to automate attendance tracking and academic data management. The system enables real-time data synchronization using a cloud-based database and provides an interactive web dashboard for monitoring and analysis. The proposed solution improves efficiency, ensures data accuracy, reduces proxy attendance, and enhances decision-making capabilities. The system demonstrates scalability, reliability, and suitability for modern smart campus environments.**

***Index Terms*—Smart Campus, IoT, RFID, ESP32, Firebase, Attendance System, Web Dashboard**

I. INTRODUCTION

The integration of digital technologies in educational institutions has led to the development of smart systems aimed at improving efficiency and transparency. Traditional attendance systems rely on manual methods, which are time-consuming and prone to errors. IoT-based solutions provide automation and real-time data processing capabilities. The Smart Campus Dashboard leverages RFID technology and ESP32 to automate attendance tracking while integrating cloud computing and web technologies for data management and visualization.

II. LITERATURE SURVEY

Existing systems include:

- Manual attendance systems (error-prone)
- RFID-based systems (limited real-time access)
- Biometric systems (costly and complex)
- IoT-based systems (lack integration)

Most systems lack:

- Real-time synchronization
- Centralized dashboards
- Scalability

This paper proposes a fully integrated system combining IoT, cloud, and web technologies

III. PROPOSED SYSTEM

A. System Overview

The system automates attendance using RFID cards and ESP32, storing data in the cloud and displaying it via a web dashboard.

B. Methodology

The system consists of:

- RFID scanning
- Data processing via ESP32
- Cloud storage (Firebase)
- Backend API (Spring Boot)
- Frontend dashboard (React)

C. Workflow

- Student scans RFID
- ESP32 captures UID
- Data sent to Firebase
- Backend processes data
- Dashboard displays results

D. Advantages

- Eliminates manual work
- Prevents proxy attendance
- Real-time updates
- Scalable system

IV. IMPLEMENTATION

A. Hardware

- ESP32 microcontroller
- RFID RC522 module
- RFID cards

B. Software

- Frontend: React, Tailwind CSS
- Backend: Spring Boot
- Database: Firebase

C. Modules

- Attendance Module
- Cloud Storage
- Dashboard Visualization
- Backend API

V. RESULTS AND DISCUSSION

A. Performance Analysis

The system demonstrates significant improvements in operational efficiency through the integration of IoT and cloud technologies. The use of the ESP32 microcontroller and RFID module enables fast and reliable data capture, while Firebase ensures real-time data synchronization.

Key observations include:

- Real-Time Synchronization: Attendance data is instantly updated in the cloud database and reflected on the dashboard.
- Fast Processing: RFID scanning and UID detection occur with minimal delay.
- Low Latency: The time between scanning and dashboard update is very low, ensuring smooth system performance.

B. Accuracy Analysis

The system ensures high accuracy in attendance tracking by using unique RFID identifiers assigned to each student. The automated process eliminates manual intervention and significantly reduces errors.

Key features include:

- Unique Identification: Each student is identified using a distinct RFID UID.
- Error Reduction: Eliminates human errors such as incorrect or missed entries.
- Proxy Prevention: Prevents unauthorized attendance marking by ensuring physical presence.

C. Comparison with Traditional Systems

Feature	Manual System	Smart Campus System
Attendance Method	Manual	Automated (RFID)
Accuracy	Low	High
Real-Time Access	No	Yes
Data Storage	Registers	Cloud (Firebase)
Scalability	Limited	High
User Interface	None	Interactive Dashboard

D. System Testing

The system was tested using various modules to evaluate its reliability and functionality:

- RFID-based attendance recording
- Cloud data synchronization
- Dashboard visualization
- Backend API communication

All modules performed successfully with:

- Accurate UID detection and attendance marking
- Real-time data updates in Firebase
- Proper visualization on the web dashboard
- Stable communication between hardware and software components

E. Discussion

The results clearly indicate that the Smart Campus Dashboard provides a more efficient and reliable alternative to traditional attendance systems. The integration of RFID, IoT, and cloud computing ensures real-time processing, improved accuracy, and enhanced scalability. The system not only reduces administrative workload but also provides meaningful insights through data visualization, making it suitable for modern educational institutions.

VI. SYSTEM ARCHITECTURE DIAGRAM

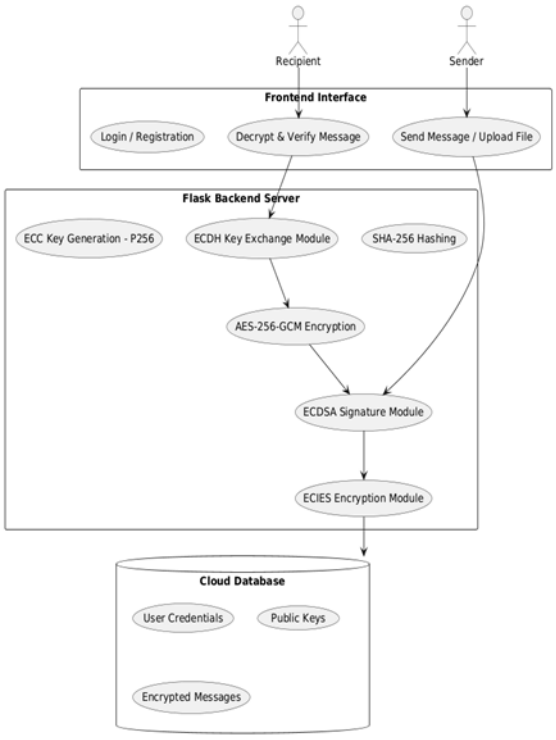

Fig 1: Proposed System Architecture

Diagram Explanation:

- The student scans the RFID card, and the RC522 module reads the unique UID.
- The ESP32 microcontroller processes the UID and transmits the attendance data to the Firebase cloud database using Wi-Fi.
- The cloud database stores attendance records in real time, ensuring centralized and secure data management.
- The backend (Spring Boot) handles data processing, validation, and communication between the database and frontend.
- The web dashboard (React) retrieves and displays attendance data through interactive charts and reports.
- Administrators and faculty can monitor attendance and academic data in real time through the dashboard interface.

VII. CONCLUSION

The proposed Smart Campus Dashboard system successfully demonstrates the effectiveness of integrating Internet of Things (IoT) technology with cloud computing for automated attendance and academic data management. By utilizing RFID technology in combination with the ESP32 microcontroller and Firebase cloud database, the system ensures accurate attendance tracking, real-time data synchronization, and efficient data handling.

Overall, the system provides a reliable, efficient, and scalable solution for modern educational environments. It not only simplifies administrative tasks but also enables better monitoring and decision-making through real-time data visualization, contributing to the development of smart and digitally empowered campuses.

VIII. FUTURE SCOPE

The proposed system can be further enhanced in the following ways:

- Integration with advanced cloud platforms such as AWS or Azure to improve scalability and performance.
- Development of a mobile application for real-time access to attendance and academic data.
- Incorporation of biometric authentication (fingerprint or facial recognition) to enhance security.
- Implementation of AI-based analytics to predict attendance trends and student performance.
- Addition of automated notifications (SMS/Email) for attendance alerts and academic updates.

REFERENCES

[1] K. Ashton, “That ‘Internet of Things’ Thing,” RFID Journal, 2009.

[2] S. Li, L. Da Xu, and S. Zhao, “The Internet of Things: A Survey,” IEEE Internet of Things Journal, 2015.

[3] M. Want, “An Introduction to RFID Technology,” IEEE Pervasive Computing, 2006.

[4] Firebase Documentation, “Firebase Realtime Database,” Google, 2023.

[5] Espressif Systems, “ESP32 Technical Reference Manual,” 2023.