

Implementation of RFID and IoT Technology in School Attendance System for Efficiency and Accuracy

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Abstract: This study discusses the application of RFID (Radio Frequency Identification) and IoT (Internet of Things) technology in a school attendance system designed to improve the efficiency and accuracy of student attendance recording. This system allows students to automatically record attendance by bringing their RFID cards close to the attendance device, which then stores attendance data in memory and sends it to the server via an IoT connection. Additional features, such as a timer for limiting attendance time, provide more control over student tardiness. The results of the study show that this system is able to record attendance quickly and accurately, with a fairly good operational endurance of 9 hours using batteries. Although there are limitations on data storage capacity, this system is still effective for use in schools with a moderate number of students. The implementation of this technology shows great potential in improving the efficiency of attendance management and data accuracy in educational environments.

INTRODUCTION

In the ever-evolving digital era, information technology has become an integral part of various aspects of life, including in the world of education. One of the main challenges faced by schools is how to manage student attendance data effectively and accurately. Conventional attendance systems that still rely on signatures or manual attendance cards are often inefficient and vulnerable to various forms of fraud, such as fake attendance or data manipulation.

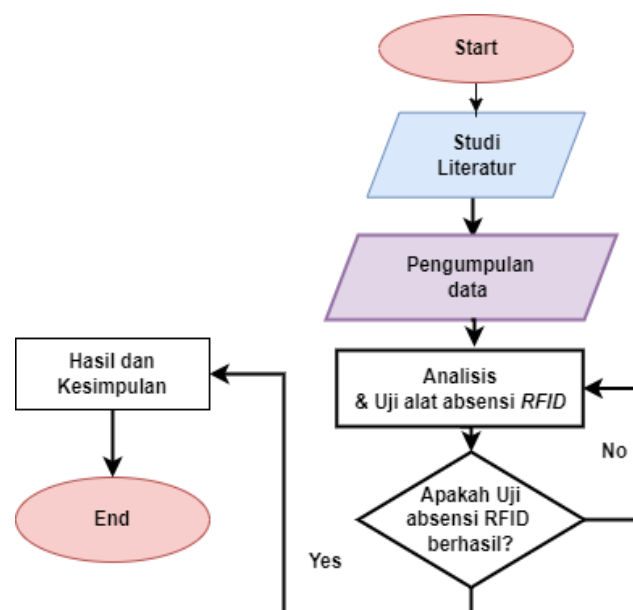
The limitations of this manual attendance system cause a number of problems, such as difficulty in identifying students who are often absent, a long time to recap attendance data, and the potential for human error in recording. This can have a negative impact on monitoring student attendance and making the right decisions by schools, which can ultimately affect the quality of education. [4]

Radio-Frequency Identification (RFID) and Internet of Things (IoT) technology offer

innovative solutions to overcome this problem. By utilizing RFID, the attendance system can be automated, enabling a faster, more accurate, and more efficient attendance recording process. In addition, integration with IoT allows attendance data to be sent in real-time to a central server, which can be accessed by schools for further analysis.[1]

The application of this technology not only improves operational efficiency, but also provides better data transparency and security. Therefore, this study aims to design and implement an RFID and IoT-based school attendance system that can improve the efficiency and accuracy of student attendance recording, as well as provide a positive impact on attendance data management in the school environment.

RESEARCH METHODS



Here is the sequence of steps for the RFID Attendance Device Testing project:

- 1) Start: Start the RFID attendance device testing project.
- 2) Literature Study: Conduct a literature review on RFID technology and its implementation in the attendance system.
- 3) Data Collection: Collect the necessary data, including RFID hardware, software, and system requirements.
- 4) Analyze & Test RFID Attendance Device: Conduct a system analysis and start testing the RFID attendance device.

- 5) Was the RFID Attendance Test Successful?
- 6) If Yes: Continue to the Results and Conclusions step.
- 7) If No: Return to the Analyze & Test RFID Attendance Device step to fix any errors or problems found.
- 8) Results and Conclusions: Document the test results, findings, and conclusions from the RFID attendance device test.

These steps can help ensure that the RFID attendance device testing process is carried out systematically and effectively.

RESULTS AND DISCUSSION

Implementation of RFID-Based Attendance System

An RFID-based attendance system designed for use in classrooms includes several features and components that aim to facilitate the process of recording student attendance. This discussion will explore the implementation of this system from various aspects, including its advantages, potential development, and challenges that need to be addressed.

1. System Implementation

- a) **Use in Classrooms:** The implementation of this attendance system is designed to help lecturers manage student attendance efficiently. By bringing the attendance device into the classroom, lecturers can immediately start the attendance process by allowing students to bring their RFID tags close to the device. This process is simplified by the presence of an "OK" display on the LCD screen and a buzzer sound, signaling that the attendance data has been successfully saved. Once all students have completed the attendance process, the lecturer can easily turn off the device.
- b) **Time Limitation (Timer):** The timer feature allows lecturers to set a time limit for attendance, which is crucial in managing student tardiness. By activating the timer, lecturers can ensure that students arriving more than 30 minutes late will not be able to record their attendance. This feature serves as an incentive for students to arrive on time and adhere to the rules set.
- c) **Data Retrieval Process:** After the class session ends, attendance data is retrieved by the academic service department. The attendance device is connected to a computer in the academic service, where the data is organized based on department, semester, class, course, and lecturer. This process ensures that attendance data is well-organized and easily accessible for academic administration purposes.

Table 1. Data Retrieval and Attendance Testing Using RFID

Number ID	Input Data	Time	Date
591815	succeed	14:16:32	5/7/2024
591816	succeed	14:16:30	5/7/2024
591817	succeed	14:16:24	5/7/2024
591818	succeed	14:16:25	5/7/2024
591823	succeed	14:16:27	5/7/2024
1745217770	succeed	14:16:48	5/7/2024
1745214755	succeed	14:16:42	5/7/2024
1745217306	succeed	14:16:40	5/7/2024
1745205368	succeed	14:16:45	5/7/2024
1745206088	succeed	14:16:50	5/7/2024
1745207294	succeed	14:16:51	5/7/2024
1745208532	succeed	14:16:44	5/7/2024
1745217613	succeed	14:16:34	5/7/2024
1745209949	succeed	14:16:36	5/7/2024
1745212679	succeed	14:16:38	5/7/2024
591815	succeed	13:53:31	5/7/2024
591816	succeed	13:53:30	5/7/2024
591817	succeed	13:53:28	5/7/2024
591818	succeed	13:53:26	5/7/2024
591823	succeed	13:53:25	5/7/2024
1745217770	succeed	13:53:41	5/7/2024
1745214755	succeed	13:53:39	5/7/2024
1745217306	succeed	13:53:37	5/7/2024
1745205368	succeed	13:53:43	5/7/2024
1745206088	succeed	13:53:46	5/7/2024
1745207294	succeed	13:53:40	5/7/2024
1745208532	succeed	13:53:47	5/7/2024
1745217613	succeed	13:53:33	5/7/2024
1745209949	succeed	13:53:34	5/7/2024
1745212679	succeed	13:53:35	5/7/2024

2. Evaluation System

a) Power and Battery Performance:

This attendance system is designed to operate for 9 hours using 6 AA batteries (1.2V, 2400mAh). However, battery life can become a challenge if the class runs longer or if the device is used continuously without replacing the batteries. Additionally, system performance begins to deteriorate if the battery voltage drops below 4.5V, which is the minimum threshold for the AVR microcontroller. Therefore, alternatives like using a DC adapter with a 7.5V output can be considered to improve system reliability.

b) Storage Capacity:

With a 1KB EEPROM memory capacity, this attendance device can store up to 45 RFID cards. This capacity may be sufficient for smaller classes, but for larger classes, there is a need for development by using larger memory. This is crucial to ensure that all attendance data can be securely stored and no data is lost.

c) Communication with the Computer:

The attendance device uses a serial port converted via USB to Serial for communication with the computer at the academic service. Stable data communication between the attendance device and the computer is essential to prevent data loss and ensure that all attendance records can be accessed and managed properly.

d) Physical Design:

The physical design of the attendance device, made of acrylic material in a block shape with dimensions of 14.5cm x 11.5cm x 5.5cm and weighing 560 grams, makes it easy to carry and use in various locations. However, the sustainability of the device also depends on easy maintenance, such as replacing batteries and repairing damaged components.

3. Advantages and Potential Development:

- a) Portability: The lightweight and compact design of this attendance device makes it easy for lecturers to carry it to various classrooms. This provides flexibility in its use and allows the system to be applied in different teaching situations.
- b) Timer Function: The attendance time limitation feature is a key advantage that provides additional control for lecturers in managing student tardiness. This feature can serve as a reminder for students to arrive on time.
- c) Potential Development: The use of larger memory would allow for the storage of more RFID cards, which is important for larger classes. Additionally, developments in power aspects, such as using batteries with larger capacity or stronger power adapters, will enhance the system's reliability and durability.

4. Challenges and Considerations:

- a) Battery Power: One of the main challenges is battery life, especially if the device is used for longer periods than expected. The system's performance, which depends on battery voltage, must be monitored, and alternative solutions such as the use of power adapters should be prepared as a backup.
- b) Storage Capacity: If the number of students exceeds the capacity of 45 cards, there will be a need to expand memory capacity or periodically delete old data. This challenge can be addressed by using more advanced storage technology or more efficient data management.

- c) Data Communication: Ensuring smooth connectivity between the attendance device and the computer at the academic service is essential to prevent the loss of attendance data. Stable and reliable connections are crucial to ensure that all attendance data is properly synced and no data is lost.

An RFID-based attendance system offers an effective and efficient solution for attendance management in educational environments. With its portable design and features that support time management and tardiness control, this system is well-suited for implementation in classroom settings. However, for broader and more sustainable applications, attention needs to be given to battery life, storage capacity, and data communication stability. With further development in these aspects, this system has the potential to become a reliable and easy-to-use attendance tool in various educational scenarios.

CONCLUSION

This research shows that the RFID-based attendance system that has been implemented is effective in recording student attendance quickly and accurately. The time-limiting feature provides good control over student tardiness. Although the data storage capacity is limited, the system is adequate for small classes. The use of batteries supports operation for up to 9 hours, but more attention is needed to power management to maintain performance. Overall, this system has great potential to enhance attendance management in educational settings with some technical improvements.

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