NETAJI SUBHAS UNIVERSITY OF TECHNOLOGY

INTERNET OF THINGS

(COCSC20)

Project Synopsis & Report:

Arduino RFID Based Attendance System

Submitted By:

Ritik: 2021UCS1653

Ankit: 2021UCS1654

Vivek:2021UCS1679

Anil Kumar: 2021UCS1698

Submitted To:

Monu Kumar

SYNOPSIS

ARDUINO RFID BASED ATTENDANCE SYSTEM

1. Introduction

Traditional paper-based attendance systems are a common sight in educational institutions and workplaces. However, these methods are often time-consuming, prone to errors, and lack real-time data access. This synopsis proposes an Arduino-based attendance system utilizing Radio Frequency Identification (RFID) technology to address these shortcomings. The system automates attendance marking, improves accuracy, and offers optional features like real-time monitoring and SMS notifications.

2. Project Purpose

The primary purpose of this project is to develop a reliable and efficient attendance management system that streamlines the process for both administrators and participants. It aims to eliminate the inefficiencies and inaccuracies associated with traditional paper-based methods while providing convenient and easily accessible attendance data.

3. System Functionality

The system revolves around RFID tags carried by users (students, employees, etc.). These tags contain unique identifiers that are read by a dedicated RFID reader module connected to the Arduino microcontroller. Alternatively, a keypad can be incorporated to allow for manual ID entry (optional). The retrieved ID is then verified against a database stored on the Arduino's memory or an external storage device (SD card).

Upon successful verification, the system performs the following actions:

- Records the attendance with date and time.
- Displays a confirmation message on a connected LCD screen (if available).
- Illuminates a green LED (if available) for visual confirmation.
- Optionally, sends an SMS notification to designated recipients (e.g., parents/guardians) regarding the user's attendance status.

In case of unsuccessful verification (e.g., unknown ID), the system can display an error message on the LCD (if available) and illuminate a red LED (if available) for notification.

4. Benefits

The Arduino-based attendance system offers several advantages over traditional methods:

- **Efficiency:** Automates attendance marking, significantly reducing the time required compared to manual processes.
- **Accuracy:** Eliminates errors associated with manual recording, such as missed entries or buddy punching.
- **Convenience:** Users only need to carry their RFID tag or enter their ID on the keypad for quick and contactless marking.

- **Detailed Records:** Attendance data is stored electronically, facilitating data analysis, reporting generation, and trend identification.
- **Scalability:** The system can be easily scaled to accommodate a growing number of users by adding more RFID readers.

5. Optional Features

The system can be further enhanced with additional components to provide advanced functionalities:

- **Real-time Monitoring:** Integrate the system with a computer to display real-time attendance data on a screen, allowing for immediate monitoring of attendance patterns.
- **Remote Access:** Store attendance records on a cloud platform for remote access and backup. This enables authorized personnel to access attendance data from any location with an internet connection.
- **Increased Awareness:** Configure the system to send SMS notifications to designated recipients (e.g., parents/guardians) upon a user's attendance. This provides real-time information about a student's or employee's attendance status.

6. Implementation

The project involves assembling the hardware components, including the Arduino Uno, GSM module (for SMS notification), RFID reader module, LCD display (optional), keypad (optional), and other necessary components. The software development process utilizes the Arduino IDE to write code that controls the system functionalities. Libraries like MFRC522.h and SoftwareSerial.h are used for interacting with the RFID reader and GSM module, respectively. The code will handle RFID tag reading, ID verification, data recording, and optional features like SMS notification.

7. Conclusion

The Arduino-based attendance system with SMS notification offers a reliable, efficient, and user-friendly solution for attendance management. It provides a significant improvement over traditional paper-based methods by automating the process, ensuring accuracy, and offering convenient features like real-time monitoring and SMS notifications. This system can be implemented in various settings, including educational institutions, workplaces, and event management, streamlining attendance tracking and enhancing data accessibility.

ARDUINO RFID BASED ATTENDANCE SYSTEM

Ritik
Dept of Computer Science
Netaji Subhas University Of technology
Delhi,India
ritik_ug21@nsut.ac.in

Vivek Singh
Dept of Computer Science
Netaji Subhas University Of technology
Delhi,India
vivek_singh.ug21@nsut.ac.in

Anil Kumar
Dept of Computer Science
Netaji Subhas University Of technology
Delhi,India
anil.kumar.ug21@nsut.ac.in

Ankit Yadav
Dept of Computer Science
Netaji Subhas University Of technology
Delhi,India
ankit.ug21@nsut.ac.in

Abstract— In today's digital age, automating routine processes like attendance tracking has become imperative for organizations seeking to improve operational efficiency and accuracy. This research paper presents an Arduino RFID-based attendance system designed for the Internet of Things (IoT) environment, offering a comprehensive solution to streamline attendance management in various sectors. Leveraging RFID technology, the system enables seamless identification and logging of individuals' attendance through RFID tags/cards assigned to them. The Arduino microcontroller serves as the central processing unit, interfacing with the RFID reader to capture tag data and communicate with a database or cloud platform for real-time attendance recording. The integration of IoT capabilities empowers administrators with remote access to attendance data, facilitating efficient monitoring and analysis. This system not only eliminates manual attendance processes prone to errors but also enhances security and scalability, making it a valuable tool for modern organizations aiming to optimize resource utilization and organizational management.

I. INTRODUCTION

A. Introduction to Domain

The domain of Arduino RFID-based attendance systems for IoT lies at the intersection of technology, education, and organizational management. In an era characterized by rapid digital transformation, traditional attendance tracking methods are being replaced by innovative solutions that leverage RFID technology and IoT principles. This domain addresses the challenges faced by institutions and enterprises in efficiently managing attendance records, ensuring accuracy, enhancing security, and optimizing resource utilization. By integrating Arduino microcontrollers, RFID readers, cloud platforms, and IoT connectivity, this domain offers a comprehensive framework for automating attendance processes, empowering administrators with real-time data access, and enabling informed decision-making. It represents a paradigm shift towards smarter, more streamlined attendance management solutions that align with the evolving needs of modern organizations and educational institutions.

Moreover, the integration of cloud platforms with Arduino RFID-based attendance systems enables data storage, retrieval, and analysis from anywhere, facilitating remote monitoring and decision-making. This domain's emphasis on efficiency, accuracy, and scalability makes it a valuable asset for organizations and institutions looking to modernize their attendance tracking processes and enhance overall operational effectiveness.

B. Problem Description

In traditional attendance tracking systems, manual processes such as taking roll calls or signing attendance sheets are time-consuming, prone to errors, and lack real-time data insights. This leads to challenges in accurately monitoring attendance, identifying patterns, and generating timely reports for decision-making purposes.

Furthermore, traditional methods are not scalable, especially in environments with large numbers of students or employees. The manual effort required for data entry, verification, and record-keeping becomes overwhelming, leading to inefficiencies and increased administrative burdens. Another challenge is the lack of security and accountability in traditional attendance systems. Paper-based attendance sheets or manual registers can be easily manipulated or falsified, leading to inaccuracies and potential disputes regarding attendance records.

Additionally, traditional systems do not offer remote access to attendance data, limiting the ability of administrators and stakeholders to monitor attendance

in real-time or access historical data for analysis and planning. In summary, the limitations of traditional attendance tracking methods include inefficiency, inaccuracies, scalability issues, lack of security, and limited data accessibility. These challenges highlight the need for a modern, automated, and technology-driven solution like Arduino RFID-based attendance systems for IoT.

C. Motivation/Objective

The motivation behind developing Arduino RFID-based attendance systems for IoT stems from the growing need for efficient, accurate, and scalable solutions in attendance tracking across various sectors. Traditional methods are becoming increasingly outdated and cumbersome, leading to inefficiencies and errors that can impact organizational productivity and decision-making. By embracing the power of RFID technology and IoT connectivity, organizations can streamline their attendance processes, gain real-time insights, and improve overall operational effectiveness. This motivation drives the innovation and implementation of modern attendance systems that offer convenience, reliability, and enhanced security, ultimately contributing to a more productive and data-driven work environment.

Certainly, here's another motivational paragraph:

The desire to revolutionize attendance tracking through Arduino RFID-based systems for IoT arises from a fundamental need for digital transformation in administrative tasks. Manual attendance processes not only consume valuable time and resources but also introduce human errors and inconsistencies. By adopting innovative solutions that leverage RFID technology and IoT principles, organizations can transition towards automated, accurate, and efficient attendance management. This motivation is fueled by the vision of creating smarter, more connected workplaces and educational institutions where data-driven decisions are enabled, administrative burdens are reduced, and operational excellence is achieved. The transformative potential of these systems inspires the pursuit of cutting-edge technologies that redefine traditional practices and pave the way for a more streamlined and agile future.

D. Contributions

The contributions of Arduino RFID-based attendance systems for IoT are multifaceted and impactful. Firstly, these systems significantly improve the accuracy of attendance tracking by automating the process and eliminating manual entry errors. This leads to more reliable attendance records and data for analysis and decision-making. Secondly, the scalability of these systems allows for seamless integration into various environments, whether in educational institutions with large student populations or corporate settings with numerous employees. This scalability ensures that the attendance system can adapt to the needs of different organizations without compromising performance or efficiency.

Additionally, these systems contribute to enhanced security by using RFID technology for identification, reducing the risk of attendance fraud or unauthorized access. Moreover, the integration of IoT capabilities enables real-time data monitoring and remote access to attendance information, empowering administrators with actionable insights and enabling proactive management strategies. Overall, the contributions of Arduino RFID-based attendance systems for IoT encompass improved accuracy, scalability, security, real-time monitoring, and enhanced administrative efficiency, making them invaluable tools for modern organizations striving for operational .

II. LITERATURE / RELATED WORK

1. Attendance and Information System using RFID and Web-Based Application for Academic Sector

By: Hasanein D. Rjeib, Nabeel Salih Ali, Ali Al Farawn, Basheer Al-Sadawi, Haider Alsharqi

Journal & Published: Article in International Journal of Advanced Computer Science and Applications, January 2018

Findings:

A student attendance and information system are designed and implemented to manage student's data and provide capabilities for tracking student attendance, grading student marks, giving information about timetable, lecture time, room number, and other student-related information. Also, the proposed system provides easiness for the staff where there is no need for extra paper works and additional lockers for saving data.

Research Gap

Much complicated being a web-based application. Only students' data is involved, can be used for other staffs and faculties.

2. A RFID based (IoT) automatic attendance system: A survey analysis

By: RKAR. Kariapper, MS. Suhail Razeeth

Journal & Published: Southeastern University of Sri Lanka, Oluvil, April 2019

Findings

Radio Frequency Identification (RFID) is a very advanced technology for an automatic attendance

system, and it provides very higher accuracy and speed than a traditional paper-based system. And it says that RFID is the best replacement for the traditional method without any doubt.

Research Gap

Eventually, from this study, I got to know that each system has its advantages and disadvantages. Some characteristics are good for some systems, and some are not. To overcome this, a hybrid model is necessary, which merely provides a higher efficient system without any disadvantage.

3. New Model of The Student Attendance Monitoring System Using RFID Technology

By: Mutammimul Ula, Angga Pratama, Yuli Asbar, Wahyu Fuadi, Riyadhul Fajri, Richki Hardi

Journal & Published: Journal of Physics: Conference Series CSINTESA 2019

Findings:

With the student attendance system using RFID technology, the management of the inputted data, and the archive of reports that often occur file loss no longer occur because it has been stored in a database. With the student attendance system using RFID technology.

Research Gap

Beneficial for other staffs also, high maintenance and cost implementation.

4. Fully Automated Classroom Attendance System

By: Eid Al Hajri, Farrukh Hafeez, Ameer Azhar N V

Journal & Published: International Journal of Interactive Mobile Technologies, August 2019

Findings:

The implemented system offers a number of benefits over the traditional system includes freedom of delivering a lecture with full focus without notifying student timing. As it is fully automated, the chance of error in the attendance entry is NIL. Fully Automated Classroom Attendance System metric identification makes the system invincible.

Research Gap:

Biometric identification can be installed; RFID reader range can be increased by replacing the high-range Rreader.paper. There are two types: component heads and text heads.Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure caption” for your Figure captions, and “table head” for your table title. Run-in heads, such as “Abstract”, will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

III. METHODOLOGY

A. Approach

System Functionality:

1. Initialization:
    1. Power on the system.
    2. Initialize the Arduino IDE and connect it to the Arduino Uno.
    3. Upload the program code to the Arduino.
    4. Initialize the LCD display (optional for visual feedback).
    5. Initialize communication with the RFID reader and keypad (if used).
    6. Initialize the GSM module for SMS communication.
2. Student Identification:
    1. The system continuously scans for an RFID tag using the RFID reader.
    2. Upon detecting a tag, the system reads its unique identifier (UID).
3. Validation (Optional):
    1. You can implement an optional validation step using a keypad.
    2. The student enters a PIN code on the keypad.
    3. The system compares the entered PIN with a pre-defined code.
    4. This step adds an extra layer of security, ensuring only authorized users can mark attendance.
4. Attendance Marking and SMS Notification:
    1. If the student's UID (or PIN, if enabled) matches the valid criteria:
        i) The system marks the student's attendance (store data locally or send it to a server for record keeping).
        ii) A pre-defined SMS message is created, including the student's name (optional) and attendance confirmation.

iii) The system sends the SMS notification to the student's parent's mobile number using the GSM module.

5. Display and Feedback:
    1. The system can display feedback on an LCD (optional) depending on the scenario:
        i) "Scanning..." while waiting for a tag.
        ii) "Valid Card" or "Invalid Card" based on the UID match.
        iii) "Attendance Marked" or "Invalid PIN" (if validation is enabled)
        iv) "Sending SMS..." and "SMS Sent" for notification status.
6. Continuous Operation:
    1. The system continues to scan for RFID tags and repeat the process for subsequent students.

Additional Considerations:

1. Power Supply: Ensure a reliable power source for the system's continuous operation.
2. Security: Store sensitive data (like PIN codes) securely in the code or a separate memory module.
3. Data Storage (Optional): You can implement local storage (SD card) or cloud storage to maintain attendance records.
4. Scalability: The system can be scaled to accommodate a larger number of students by adding more RFID readers or using a network infrastructure.

Benefits:

1. Efficient Attendance Marking: Automates attendance recording, eliminating manual processes.
2. Real-time Notification: Parents receive instant SMS updates about their child's attendance.
3. Reduced Errors: Minimizes errors associated with manual attendance recording.
4. Improved Security (Optional): Keypad validation provides an extra layer of security.

B. Algorithm

Initialization (setup() function):

1. Initializes the LCD display, turns on backlight.
2. Initializes serial communication for debugging purposes.
3. Initializes SPI communication for the RFID reader.
4. Initializes the MFRC522 library for RFID communication.
5. Displays a welcome message on the LCD for 2 seconds.
6. Clears the LCD.

Main Loop (loop() function):

1. Displays a message on the LCD indicating the system is scanning for a card.
2. Checks for a new card using the MFRC522 library. If no card is present, waits for a short time before checking again.
3. If a card is present, attempts to read its serial number. If unsuccessful, waits for a short time before checking again.
4. Clears the LCD before displaying the card UID.
5. Prints the card's UID to the serial monitor for debugging purposes.
6. Waits for 1 second before displaying a valid/invalid message.
7. Compares the scanned card UID with a predefined valid card UID (stored in the cardUID array).
8. Valid Card:
    0. Displays a welcome message on the LCD for Ritik.
    1. Prompts the user to enter a password using the keypad.
    2. Reads key presses from the keypad and displays them on the LCD and serial monitor (up to 4 digits).
    3. Compares the entered password with a predefined correct password ("4569").
    4. Correct Password:

) Displays a success message on the LCD for 2 seconds.

i) Creates a message string indicating attendance marked for Ritik.

ii) Calls the sendSMS function to send the message to a specified phone number.

iii) Waits for 2 seconds.

5. Incorrect Password:

) Displays an invalid password message on the LCD for 2 seconds.

9. Invalid Card:

0. Displays an invalid card message on the LCD for 2 seconds.

10. Clears the LCD.

Sending SMS (sendSMS() function):

1. Sends an AT command to configure the GSM module in text mode.
2. Waits for 1 second.
3. Sends an AT command to initiate sending an SMS, specifying the recipient's phone number.
4. Waits for 1 second.
5. Sends the SMS message content.
6. Waits for 1 second.

C. Hardware/Software

Hardware:
Power Adapter, Arduino uno, gsm, rfid reader, rfid card, keypad, LCD display, wires, dc to dc converter, sim module.

Software
Arduino IDE, C language used

IV. RESULT ANALYSIS

A. Experiment Setup

Assembly:
The assembly process involves connecting the Arduino Uno to power and a PC for programming. Components like the LCD display, SIM800L SIM module, membrane keypad, and RFID scanner are interfaced with the Arduino Uno using appropriate communication protocols. An I2C adapter facilitates communication between the Arduino Uno and the LCD display. Through this assembly, each component collaborates to form a cohesive IoT-based attendance system, primed for authentication and confirmation functionalities.

Programming:
The programming of the IoT-based attendance system involved the development of firmware and software modules to facilitate the functionalities of RFID card scanning, secret passcode entry, and message confirmation. We utilized C++ programming languages and frameworks tailored to the specific requirements of each hardware component. The firmware was programmed to handle the communication protocols and data processing tasks efficiently, while the software modules managed the user interface and interaction logic.

Testing Procedure:

1. User scans RFID card, system authenticates.
2. User inputs secret passcode via keypad, system verifies.
3. If passcode correct, system sends confirmation message via SIM module to mobile device.
4. Verify system responses, iterate for refinement.

B. Result

Fig 1: Success message on LCD display

C. Observation/Inferences

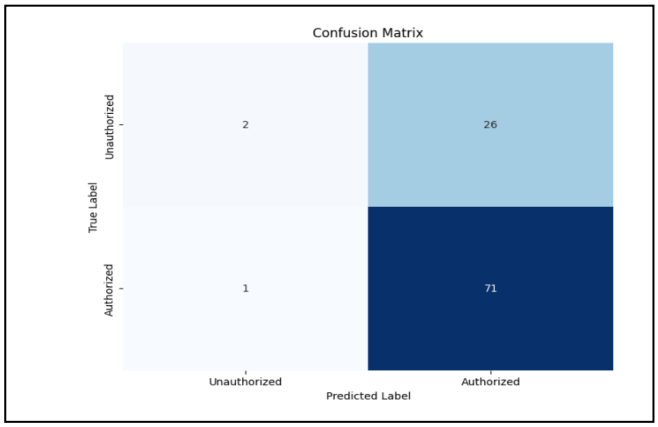

Fig 2: Confusion matrix

V. Conclusion and Future Work

In this paper, we have presented an IoT-based attendance system that utilizes a two-factor verification process for enhanced security. By integrating RFID card scanning and secret passcode entry, the system ensures accurate and reliable attendance tracking. Through experimentation, we have demonstrated the effectiveness of this approach in verifying user identity and generating confirmation messages upon successful authentication. This system offers potential applications in various educational, corporate, and organizational settings, where precise attendance records are essential for operational efficiency and security.

While our current implementation provides a robust foundation for an IoT-based attendance system, there are several avenues for future research and development. One potential direction is to explore the integration of biometric authentication methods, such as fingerprint or facial recognition, to further enhance security and user convenience. Additionally, incorporating machine learning algorithms could enable the system to adapt and improve its recognition capabilities over time, leading to more accurate and efficient attendance tracking. Furthermore, expanding the scalability and interoperability of the system to support larger networks and diverse hardware configurations would enhance its applicability across various environments. Overall, continued exploration and refinement of these technologies hold promise for advancing the capabilities and effectiveness of IoT-based attendance systems in the future.

References

[1] Uddin, M.S., Allayear, S.M., Das, N.C., Talukder, F.A.: A location based time andattendance system. Int. J. Comput. Theor. Eng 6(1), 1–2 (2014)

[2] Rajkumar, S., Prakash, J.: Automated attendance using Raspberry Pi. Int. J. Pharm. Technol.(IJPT) 8(3), 16214–16221 (2016)

[3] Al Hajri, Eid, Farrukh Hafeez, and Ameer Azhar NV. "Fully Automated Classroom Attendance System." Int. J. Interact. Mob. Technol. 13.8 (2019): 95-106.

[4] Kariapper, R. K. A. R., and Suhail Razeeth. "RFID Based (IoT) Automatic Attendance System: A Survey Analysis." Available at SSRN 3372734 (2019).

[5] Patel, R., Patel, N., Gajjar, M.: Online students attendance monitoring system in classroomusing radio frequency identification technology: a proposed system framework. Int.J. Emerg. Technol. Adv. Eng. 2(2), 61–66 (2012)

[6] Clark, M., Borg, S., Calleja, G., Chircop, F. and Portelli, R., 2005. School attendance improvement. Published by: Ministry of Education, Youth and Employment, pp.7-10.

[7] Moore, R., Jensen, M., Hatch, J., Duranczyk, I., Staats, S. and Koch, L., 2003. Showing up: The importance of class attendance for academic success in introductory science courses. The American Biology Teacher, 65(5), pp.325-329.

[8] Finkenzeller, K., 2010. RFID handbook: fundamentals and applications in contactless smart cards, radio frequency identification and near-field communication. John wiley & sons.

[9] Vishal Bhalla, Tapodhan Singla, Ankit Gahlot, Vijay Gupta, “Bluetooth Based Attendance Management System”, International Journal of Innovations in Engineering and Technology (IJIET), Vol. 3 Issue 1 October 2013.

[10] Liang, X. Q., Li, W. Y., & Lu, T. C. (2017, August). A Study of the Multi-Organization Integrated Electronic Attendance System. In International Conference on Intelligent Information Hiding and Multimedia Signal Processing (pp. 53-61).