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RFID-BASED ATTENDANCE SYSTEM USING ARDUINO UNO

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ABSTRACT

In educational institutions, the manual process of taking attendance for large classes is often time-consuming and prone to errors, impacting both teaching efficiency and student engagement. To address this challenge, we propose an RFID-based Attendance cum Security System, designed to streamline the attendance process while enhancing campus security. Our system leverages Radio Frequency Identification (RFID) technology to automatically record student attendance as they enter the classroom, eliminating the need for manual roll calls. Each student is issued an RFID tag, which is scanned by a reader installed at the classroom entrance, instantly logging their presence into a central database. In addition to attendance tracking, the system also functions as a security measure, ensuring that only authorized individuals gain access to restricted areas. This dual functionality is achieved through real-time data synchronization and integration with existing security protocols. Our project includes the design, implementation, and testing of the RFID system, highlighting its accuracy, efficiency, and ease of use compared to traditional methods. The results demonstrate significant time savings and reduced administrative burden for faculty, along with improved accuracy in attendance records. Furthermore, the security features enhance campus safety, making this solution a comprehensive approach to attendance management and access control. This paper discusses the technical aspects of the system, its deployment, and the benefits observed during pilot testing, showcasing its potential for wide adoption in educational institutions and beyond.

Keywords: RFID, Arduino UNO, ATMEGA328P.

I. INTRODUCTION

Attendance management is a crucial aspect in educational institutions, with universities like RGPV mandating a minimum of 75% attendance for students to be eligible for examinations. Traditionally, attendance is taken manually, which involves calling out names or signing on a paper sheet. This method is not only time-consuming but also insecure and inefficient, leading to various issues such as wasted time, improper documentation, and instances of students forgetting to mark their attendance or marking attendance for their absent peers.

An effective solution to these problems is the implementation of a Radio Frequency Identification (RFID) based attendance system. This technology can significantly streamline the attendance process in schools, colleges, and universities. By reducing the time spent on manual attendance collection, it enhances both efficiency and security. Each student is issued an RFID card, which they present to an RFID reader, thereby recording their attendance directly into the system's database.

This automated approach not only ensures accurate and secure attendance tracking but also integrates with a student database management system that minimizes errors and prevents manipulation. Additionally, the system includes features such as sending automated messages to students' mobile phones. These messages serve as backups in case of data loss and provide alerts to students with low attendance, thereby helping them meet the required attendance threshold and avoid potential academic penalties.

The adoption of RFID technology for attendance management addresses the need for a more efficient and secure system. It eliminates the drawbacks of manual methods, ensures accurate record-keeping, and supports better management of classroom participation data, which is essential for examination eligibility and final grade calculations.

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Various related works have explored the application of RFID and GSM technologies across different fields, particularly in attendance monitoring, underscoring the potential of these technologies to revolutionize attendance management in educational settings.

Radio Frequency Identification (RFID) involves using radio frequency waves to identify and track tags embedded in objects or living beings [1-3]. This wireless communication method employs electromagnetic and electrostatic coupling within the radio frequency spectrum to enable interaction between a reader and a tag through various modulation and encoding techniques [4]. Modulation involves altering the amplitude, frequency, or phase of a high-frequency carrier signal to transmit information, while encoding is the process of transforming information from one format to another. An RFID system typically comprises an RFID reader and a tag. Its primary advantage lies in its ability to quickly and uniquely identify individuals or items based on the embedded tag, usually in less than a second.

Types of Rfid's-Active RFID: Active RFID tags come equipped with their transmitter and power source, typically a battery. These tags are predominantly Ultra High Frequency (UHF) solutions, and their read ranges can reach up to 100 meters in certain cases.

Passive RFID: In passive RFID systems, the reader and its antenna send a signal to the tag, which then uses that signal to power itself and reflect energy to the reader. These systems include passive Low Frequency (LF), High Frequency (HF), and UHF options. The read ranges for passive tags are shorter compared to active tags, constrained by the power of the radio signal reflected to the reader, commonly known as tag backscatter.

Semi-passive RFID: Semi-passive tags, also known as semi-active or battery-assisted passive (BAP) tags, operate similarly to passive tags but are equipped with a battery. This battery helps extend the communication range and tag memory and sometimes includes sensors.

II. METHODOLOGY

This project is divided into software and hardware development. The software developmental program used for interfacing RFID to Arduino (ATMEGA 328P) microcontroller can simply be divided into four parts: Configuring the serial communication, reading the RFID card, fetching it from the memory location, and displaying it on the LCD which is executed using C language. The hardware comprises four main units: the Power Supply Unit, the Input Unit (RFID Tag and Reader), the Control Unit (ATMEGA 328PArduino Microcontroller and GSM Module), and the Output Unit (PC, LCD, and GSM). When the system is powered, the RFID reader starts monitoring and sensing any scanned card within its electromagnetic region. When a card is scanned near the reader, the reader will decode the details (card number) of the card and send the information to the central ATMEGA 328P Microcontroller for processing.

III. MODELING AND ANALYSIS

RFID is part of a category of technologies known as Automatic Identification and Data Capture (AIDC). AIDC techniques automatically identify objects, collect data about them, and enter that data directly into computer systems with minimal human involvement. RFID uses radio waves to achieve this.

An RFID system typically consists of three main components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags have an integrated circuit and an antenna to transmit data to the RFID reader, also known as an interrogator. The reader converts the radio waves into data that can be used more effectively. The data collected from the tags is then sent via a communication interface to a host computer system, where it can be stored in a database and analyzed later.

In this project, we designed an RFID-based attendance system using Arduino. Initially, a set of RFID card data is stored in the system. Although any number of RFID tags can be stored, we have stored data for only 10 RFID tags. When a person with a registered RFID card swipes it, the system records their arrival time using the EEPROM command and displays a "welcome" message on the LCD. When the same person swipes their RFID card again, the system records their departure time and displays a "See You" message. The time between the first and second swipes is calculated as the total working hours, which is then stored as data. Figure 1. shows the flow chart diagram of the working of the Rfid-based attendance system, Figure 2. shows the block diagram for the Rfid-based attendance system, and Figure 3. Shows the circuit diagram for the Rfid-based attendance system.

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The software development program for interfacing an RFID system with an Arduino (ATMEGA 328P) microcontroller can be divided into four main parts: configuring serial communication, reading the RFID card, retrieving the data from memory, and displaying the information on the LCD. These tasks are executed using the C programming language. The hardware consists of four key components: the Power Supply Unit, the Input Unit (RFID Tag and Reader), the Control Unit (ATMEGA 328P Arduino Microcontroller and GSM Module), and the Output Unit (PC, LCD, and GSM).

When the system is powered on, the RFID reader continuously monitors any cards within its electromagnetic field. Upon scanning a card, the reader decodes the card details (card number) and sends the information to the central ATMEGA 328P microcontroller for processing. The microcontroller processes and verifies the card number to determine its validity. If valid, access is granted, and the student's name and registration number are displayed on the LCD. This information can be accessed at any time by lecturers using programmed staff tags to review student attendance.

The project components are powered by a 5-volt power supply. The RFID reader module is connected to the Arduino to read data from RFID cards/tags. A Real-Time Clock (RTC) Module DS3231 is used to display the current time and date on the LCD, as well as the arrival and departure times of users. The LCD shows outputs such as the current date and time, user information, the number of staff present or absent, and menu options from 1 to 4.

Red and green LEDs indicate arrival and departure, respectively, and a buzzer sounds whenever an interruption is detected. A crucial part of the system is the EEPROM (Electrically Erasable Programmable Read-Only Memory), which stores data whenever users swipe their cards over the RFID reader. Figure 5. Represents the interfacing of the components of Rfid based attendance system.

Microcontroller ATmega328P – 8-bit AVR family microcontroller Operating Voltage 5V Recommended Input Voltage for Vin pin 7-12V Analog Input Pins 6 (A0 – A5) Digital I/O Pins 14 (Out of which 6 provide PWM output) DC Current on I/O Pins 40 mA DC Current on 3.3V Pin 50 mA Flash Memory 32 KB (2 KB is used for Bootloader) SRAM 2 KB EEPROM 1 KB Frequency (Clock Speed) 16 MHz Communication IIC, SPI, USART.

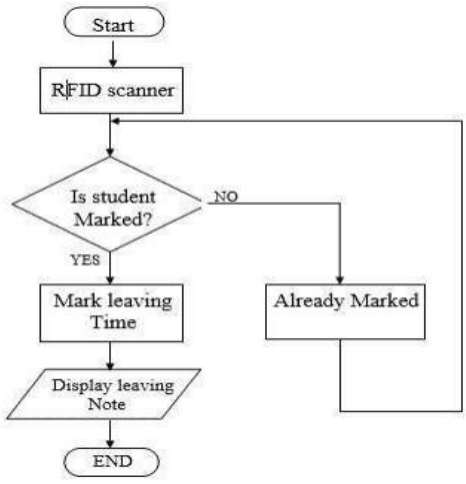

Figure 1: Flow chart diagram of the working of Rfid-based attendance system.

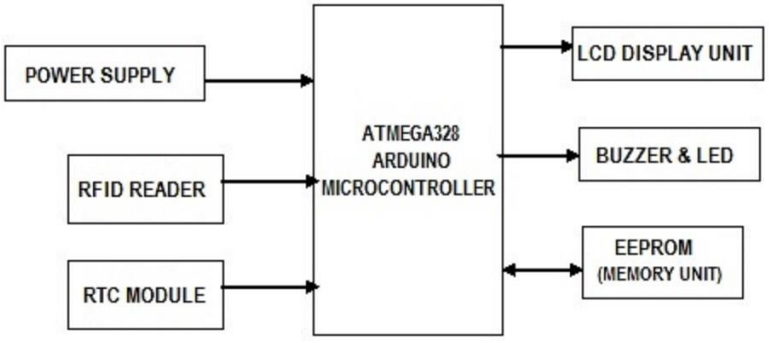

Figure 2: Block diagram of the working of the Rfid-based attendance system.

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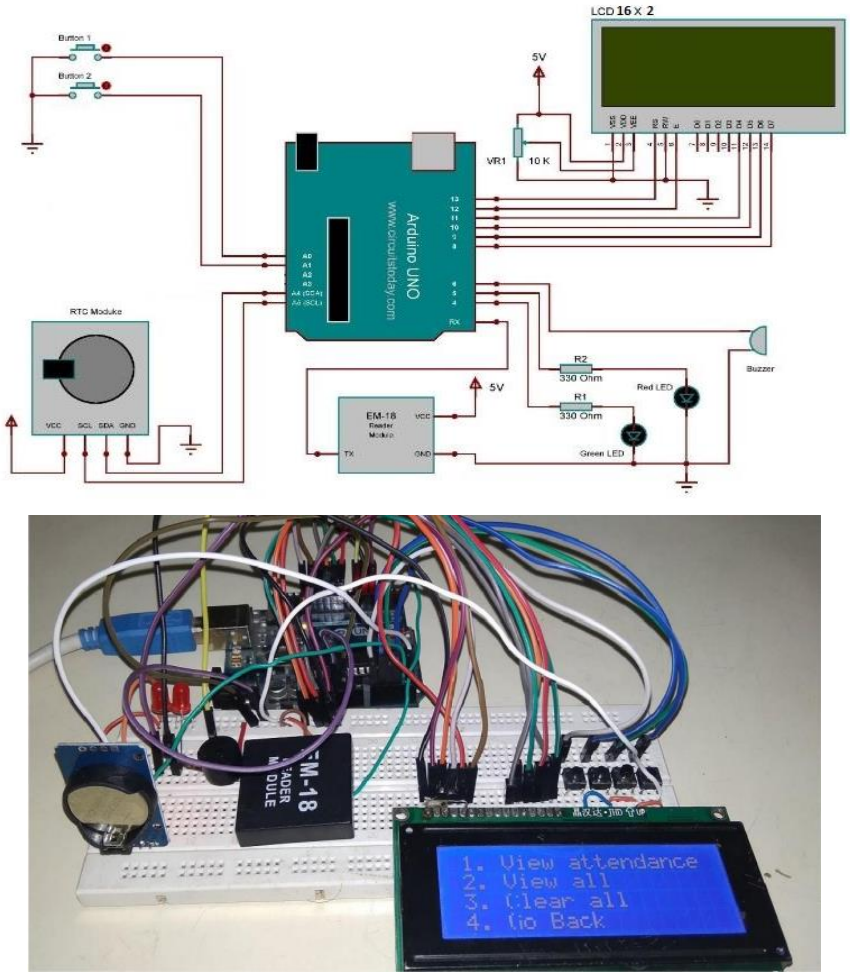

Figure 3: circuit diagram of Rfid-based attendance system using Arduino Uno.

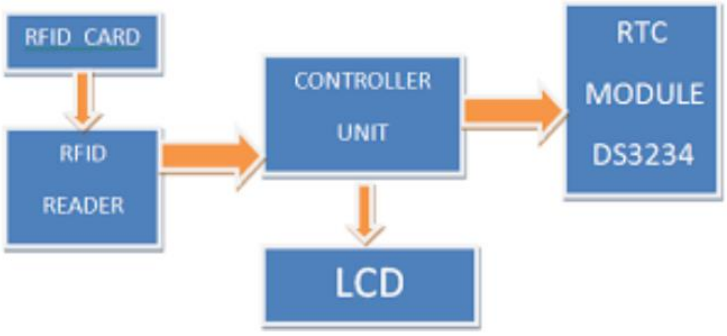

Figure 4: Interfacing of the components of the Rfid-based attendance system using Arduino Uno.

IV. RESULTS AND DISCUSSION

RFID-based attendance system using Arduino. First, we store a set of RFID card data in our system. You can store any number of RFID data, but we have only stored 10 RFID tag numbers.

When the person with the correct RFID card comes & swipes his RFID card, his arrival time will be stored on the system using the EEPROM command displaying a “welcome” message on LCD.

When the same person swipes his RFID card for the second time, the system will save it as his leaving time displaying “See You”. The interval between the first card swap and the second card swap is the total working hours that are stored as data. Figure 5. Shows the LCD of the working of the RFID-based attendance system using Arduino Uno.

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Figure 5: LCD of the working of Rfid Rfid-based attendance system

V. CONCLUSION

The successful implementation of our RFID-based attendance system demonstrates its effectiveness and reliability. The primary objective of developing an efficient and automated attendance system was achieved, providing a substantial improvement over the traditional method. This project offers a convenient and efficient solution for attendance marking, suitable for academic institutions and organizations alike. The system's capacity to manage attendance data efficiently can be further enhanced by integrating additional components and functionalities. For example, incorporating a GSM module would allow the system to send SMS notifications to parents whenever a student's card is scanned, providing real-time attendance updates. Adding a keypad for password verification during card scans could enhance security. Future enhancements could significantly broaden the system's applications and improve its functionality. Integrating facial recognition technology could bolster the system's biometric security. Connecting the system to a PC with software capable of reading data from the microcontroller would facilitate better data management. Cryptanalysis of the communication link between the card and reader could be explored to enhance security further. Additionally, the RFID system could be adapted for various innovative uses, such as tagging animals for monitoring purposes, enhancing car security by enabling engine start with RFID cards and developing eco-friendly applications. The system could also find applications in gaming zones and other interactive environments. In summary, this project presents a valuable and adaptable solution for attendance management, with numerous possibilities for future enhancements and applications. Its successful implementation underscores its potential for broad adoption and continued development in various fields.

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