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Examination Guide Using Rfid And Fingerprint Module

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Abstract: This paper presents a student identification system that integrates biometric fingerprint recognition with RFID passive tags to enhance secure attendance management in educational institutions. The system leverages the unique biometric characteristics of each student, combined with an RFID tag embedded in their ID card, to authenticate and monitor attendance. The proposed solution addresses the shortcomings of traditional attendance systems, such as manual errors, proxy attendance, and low accuracy, by providing an automated, secure, and easy method for recording attendance. Additionally, the system incorporates a GSM module to send daily SMS notifications to guardians, informing them of their child's attendance status. A web-based application is also developed to allow students and instructors to view real-time attendance records and location tracking on campus. The system's dependability and efficacy have been proven by successful implementation and testing in an actual educational setting. Because RFID technology is widely used in attendance systems because it is precise and effective.

Index Terms **- Arduino, Attendance Management, GSM Module, RFID, Fingerprint Sensor.**

I. INTRODUCTION

In modern educational institutions, attendance management remains a critical yet time-consuming task. Traditional methods, such as manual roll calls, are prone to errors, inefficiencies, and the risk of proxy attendance. These challenges highlight the need for a more robust and automated system that ensures accuracy, security, and convenience. Attendance is not only a measure of student presence but also a key factor influencing academic and non-academic outcomes. Recognizing this, various technologies, including RFID and biometric systems, have been explored to streamline attendance management. While RFID-based systems offer automation, they face limitations such as privacy concerns, accessibility issues for individuals with disabilities, and maintenance costs associated with lost or damaged tags. On the other hand, biometric systems, which rely on unique physiological traits like fingerprints, provide higher accuracy, security, and cost-effectiveness. In order to provide a safe and effective attendance management solution, this study suggests a hybrid system that combines the advantages of RFID and biometric technology. The proposed system utilizes an Arduino-based framework integrated with a GSM module to send real-time SMS notifications to guardians, ensuring transparency and communication. A web application further enhances the system by providing students and instructors with access to attendance records and location tracking.

II. LITERATURE REVIEW

[1]. Exam advice is one of the many secure systems that have used RFID technology. RFID systems, such as those by SASTRA University (2011) and Alam and Khan (2018), automate identification but face privacy and maintenance challenges. Fingerprint systems, studied by Adeyemo et al. (2020) and Zohra et al. (2018), offer high accuracy and eliminate proxy attendance. Hybrid systems, like those by Singh and Patel (2020) and Rajan Patel et al. (2017), combine RFID and fingerprint modules for enhanced security and efficiency. Despite advancements, challenges like privacy and accessibility persist, necessitating further research for scalable and adaptable solutions.

[2]. RFID technology is widely used for secure and efficient systems, including examination guidance. Mohamed et al. (2009) applied RFID for e-passport security, while Nambiar (2009) highlighted its role in supply chain management. Liu and Chen (2009) improved production efficiency using RFID. In education, RFID SensNet Lab (2005) and Zhang and Ji (2006) developed automated attendance systems, and Martin et al. streamlined exam processes with RFID. Parvathy et al. (2011) and Naveen Raj et al. (2013) advanced RFID for exam hall maintenance, emphasizing cost-effectiveness and efficiency. These studies demonstrate RFID's potential in creating secure, automated examination systems.

[3]. RFID technology has been extensively used. adopted for attendance systems due to its efficiency and accuracy. Razak and Wen (2017) developed an RFID-based system, while White et al. (2007) found RFID outperformed barcodes with fewer errors. Schapranow et al. (2009) addressed RFID security, suggesting encryption for protection. Gatsheni et al. (2007) and Srinidhi and Roy (2015) combined RFID with biometrics for enhanced security. Sajid et al. (2014) proposed facial recognition, and Ramachandra and Peter (2023) explored NFC for attendance. Agrawal and Bansal (2013) and Nainan et al. (2013) highlighted RFID's cost-effectiveness. Shoewu et al. (2015) and Lim et al. (2009) demonstrated RFID's potential in automating attendance, reducing errors, and saving time. These studies collectively emphasize RFID's role in creating secure and efficient attendance systems.

[4]. RFID technology has been extensively used. adopted for secure systems, including examination guidance. Mohamed et al. (2009) used RFID for e-passport security, while Nambiar (2009) highlighted its role in supply chain management. Liu and Chen (2009) improved production efficiency using RFID. In education, RFID SensNet Lab (2005) and Zhang and Ji (2006) developed automated attendance systems.

[5]. Secure attendance systems frequently incorporate biometric and RFID technologies. Alam and Khan (2018) proposed an RFID- based system for schools, while Maheshwari et al. (2021) demonstrated its efficiency. Adeyemo et al. (2020) and Zohra et al. (2018) highlighted fingerprint systems' accuracy. Singh and Patel (2020) combined RFID and fingerprint recognition for enhanced security. These studies show the potential of integrating RFID and biometrics for secure, automated attendance systems.

III. PROPOSED SYSTEM ARCHITECTURE

The suggested system is an ESP32 microcontroller-based attendance tracking system designed to automate student attendance using RFID, GSM module fingerprint identification. This system consists of three main components: input modules, processing unit, and output modules, combined with a power supply. The ESP32 functions as the brain of the system which manages inputs and outputs more effectively.

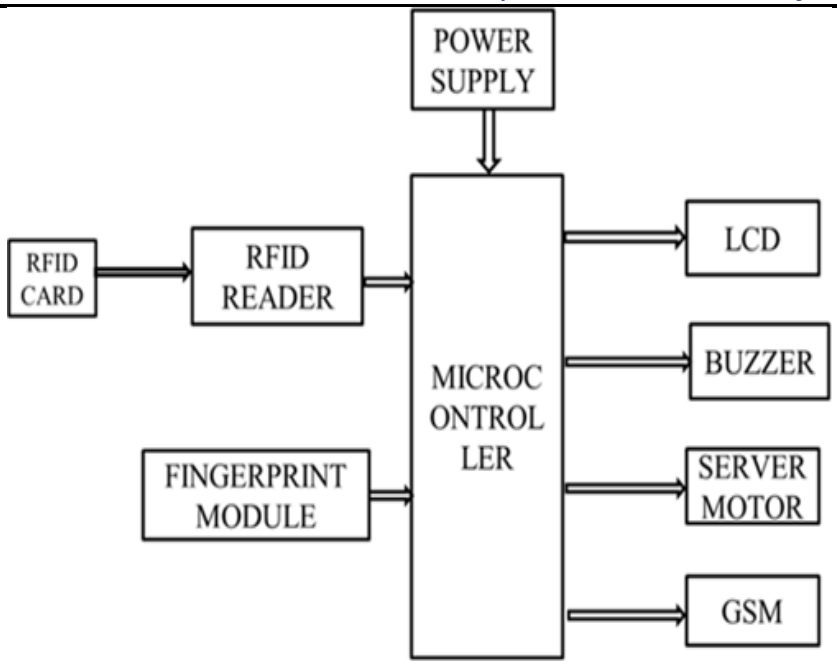

fig 1. proposed system architecture

The system operates using RFID cards and fingerprint sensors as input modules to identify students. When a student places their RFID card near the RFID reader or scans their fingerprint on the sensor, the ESP32 microcontroller processes the data. If the identification is valid, the system marks the student as "present" and updates the attendance record. To provide real-time feedback, the system includes output modules such as an LCD display, LEDs, and a buzzer. The LCD screen shows the student's name or ID, subject name, room number confirming successful attendance and identifying the examination seat allotment. The buzzer serves as an additional alert mechanism. The GSM module, which notifies parents via SMS when their child is deemed present but not attending the tests, is one of the system's most crucial components. This keeps parents updated on their child's attendance and guarantees real-time communication. The technique is particularly helpful in educational institutions where manually recording attendance is laborious and ineffective. The power module efficiently controls the various power requirements of the ESP32, RFID reader, fingerprint sensor, LCD display, GSM module, and other components.

A. Hardware Details

A.1 ESP32 MICROCONTROLLER

ESP32 is a series of low-cost, low-power system-on-chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 is a versatile and powerful microcontroller that has gained popularity in the maker and IoT communities. Commonly found either on PCBs or on a range of development boards with GPIO pins. ESP32 is created and by Espressif Systems, a Chinese company located in Shanghai, and developed by TSMC using their 40 nm process. It is next to the ESP8266 microcontroller. The ESP32 comes with both flash memory for program storage and RAM for program execution. The ESP32 is designed to function with low power consumption, ensuring it is suitable for battery-powered IoT devices.

A.2 RC522 RFID MODULE

The RC522 RFID module is a popular RFID (Radio Frequency Identification) reader and writer module commonly used with Arduino and other microcontroller platforms. It operates at 13.56 MHz frequency and communicates with microcontrollers via SPI (Serial Peripheral Interface) protocol. The module enables reading and writing RFID tags that comply with ISO14443A standard. It is designed to function with low power consumption, making it suitable for battery-powered applications. This module supports RFID tags compliant with the ISO14443A standard, which is a widely used standard for proximity cards and key fobs.

A.3 R307 FINGERPRINT SCANNER

The R307 Fingerprint Recognition Module is a technology that integrates fingerprint sensing and recognition capabilities into various applications. It utilizes biometric technology to accurately capture and identify fingerprints, making it suitable for a wide range of security and authentication applications. The module consists of a sensor, microcontroller, and onboard memory for storing fingerprint templates. The module features a user-friendly interface for easy configuration and operation.

A.4 SG90 SERVO MOTOR

Servo motors in modern technology, serving as components in various applications ranging from robotics to industrial automation, aerospace. By their precision, speed, and versatility, Servo motors operate based on the principle of closed-loop control systems. They consist of three primary components: a motor, a feedback device (such as an encoder or resolver), and a control system. The control system compares the desired position with the actual position provided by the feedback device. In servo motors, control of motion parameters is essential, such as robotics, industrial automation, aerospace, and automotive engineering.

A.5 I2C LCD DISPLAY

A liquid-crystal display (LCD) is a flat-panel display which electronically modulates optical device that uses the lightmodulating properties of liquid crystals combined with polarizers to display information in the panel. Using I2C simplifies the wiring and reduces the number of pins required for communication between the microcontroller and the LCD display. LCD displays typically support a set of commands that control various aspects of the display, such as clearing the screen, positioning the cursor, controlling the backlight, and printing characters. I2C is a widely used communication protocol supported by many microcontrollers and devices. This means that an I2C LCD display can be easily interfaced with various microcontroller platforms such as Arduino,
Raspberry Pi, ESP8266, etc.,

A.6 SIM800C GSM Module

A GSM module is a device which allows electronic devices to communicate with each other over the GSM network. GSM is a standard for digital cellular communications, which means that it provides a platform for mobile devices to communicate with each other wirelessly. The GSM module is a device that enables a device to send and receive data over the GSM network. The GSM network is an effective and essential component of modern communication systems. It is a standard used by mobile devices to communicate with each other wirelessly. The GSM network provides a reliable and secure platform for communication, which makes it a preferred choice for many applications. A GSM module functions by connecting to the GSM network through a SIM card.

B. SOFTWARE REQUIRED

B.1 ARDUINO IDE

Arduino Integrated Development Environment (IDE) is a primary software platform for programming Arduino boards. It provides a user-friendly interface for writing, compiling, and uploading code to Arduino microcontrollers. Arduino IDE is an open-source platform developed in Java, making it compatible with various operating systems, including Windows, macOS, and Linux. Its simplicity and ease of use make it ideal for beginners and professionals alike in the field of electronics and embedded systems. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins.

B.2 GOOGLE FIREBASE REALTIME DATABASE

Google Firebase Realtime Database (RTDB) revolutionizes the way developers handle data synchronization and management in their applications. In today's interconnected world, where real-time updates and collaboration are paramount, Firebase RTDB offers a robust solution for building responsive and scalable applications across various platforms. Google Firebase Realtime Database (RTDB) is a cloud-hosted NoSQL database that enables developers to store and synchronize data in real-time across various clients. It forms an integral part of the Firebase platform, offering a scalable and efficient solution for building responsive applications with collaborative features.

IV. Work Flow

The flowchart above represents an RFID and fingerprint-based attendance monitoring system designed to ensure secure and accurate identification of the students in the exam hall. The identification process starts with the students scanning their RFID card to the reader. The RFID reader reads the cards and if the RFID card is found to be invalid, the system immediately notifies and terminates the process by displaying invalid RFID card. The student need to procced with the valid card. If the RFID card is valid, the system proceeds to the next level of authentication, which involves fingerprint verification if the students. Here the students input their fingerprint which need to match with the one which is stored. This extra layer of security ensures that only the rightful student of the RFID card can mark the attendance, preventing any identity fraud, proxy attendance or any type of misconduct.

If the fingerprint of the student does not match with the stored biometric data, the system displays an "ID doesn't match" message, indicating that the fingerprint provided does not belong to the student assigned to the RFID card. On the other hand, if the fingerprint is matched successfully, the system records the attendance by marking the individual as present, and displays the details of student and the exam.

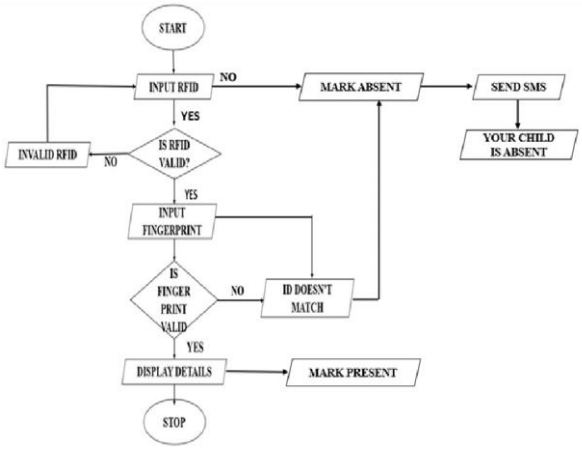

figure 2 flow chart

When no RFID is detected or an unregistered RFID card is used, the system automatically marks the student as absent and send an SMS notification to inform parents or guardians about the absence of the student to the exam. This feature is very useful where parents can be immediately informed if their child has not attended exam. The combination of RFID and fingerprint authentication makes the attendance system highly secure and eliminates issues such as card swapping, unauthorized access, proxy attendance or any misconduct during examination. The flowchart highlights an effective and automated method for attendance tracking, thus reducing manual effort and errors associated with the traditional attendance systems.

V. IMPLEMENTATION AND RESULT

The implementation of the RFID and fingerprint-based attendance system involves the integration of both hardware and software components to for secure and tracking accurate attendance. Here in this system, Embedded C language is used in the Arduino IDE to write the source code. The system is simulated to verify the students by asking to input the card and fingerprint authentication. The key feature of the system is its automated absence SMS notification mechanism to the parents. The results of the implementation of proposed system significantly improves the accuracy and security of tracking attendance. This feature also ensures real-time monitoring, especially in educational institutions, organizations and workplaces. Overall, the system is proved to be a time-saving, efficient, and secure solution for examination management.

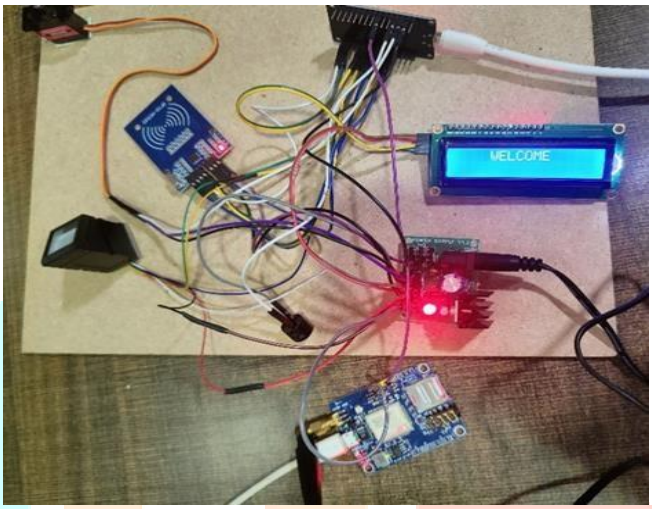

figure 3 project prototype

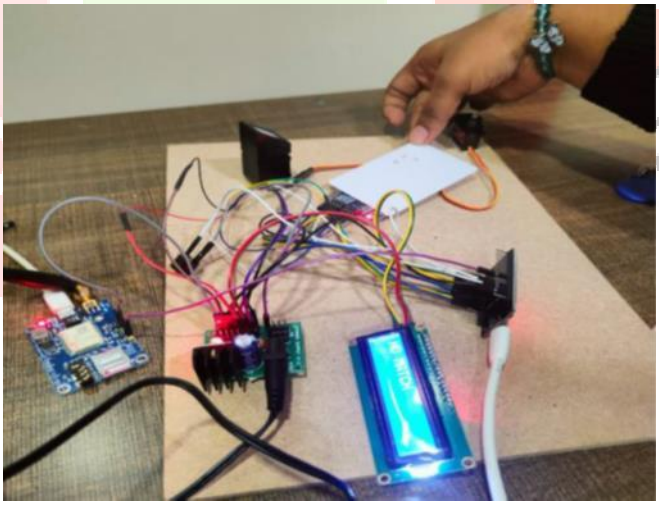

figure 4 rfid card reader

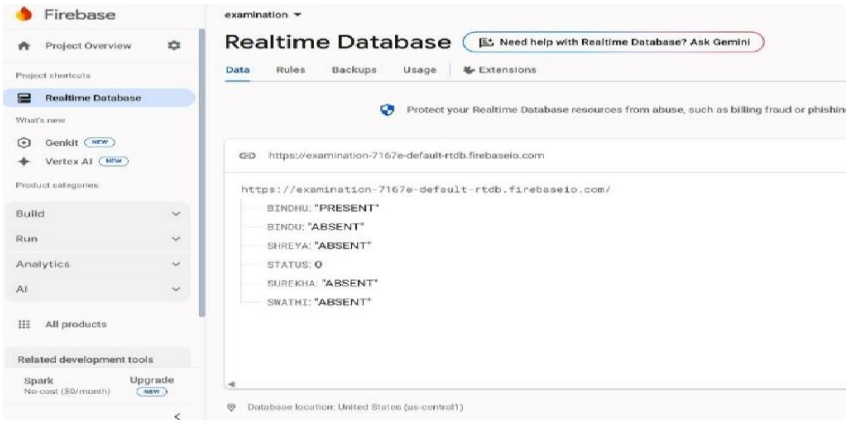

figure 5 attendance entry

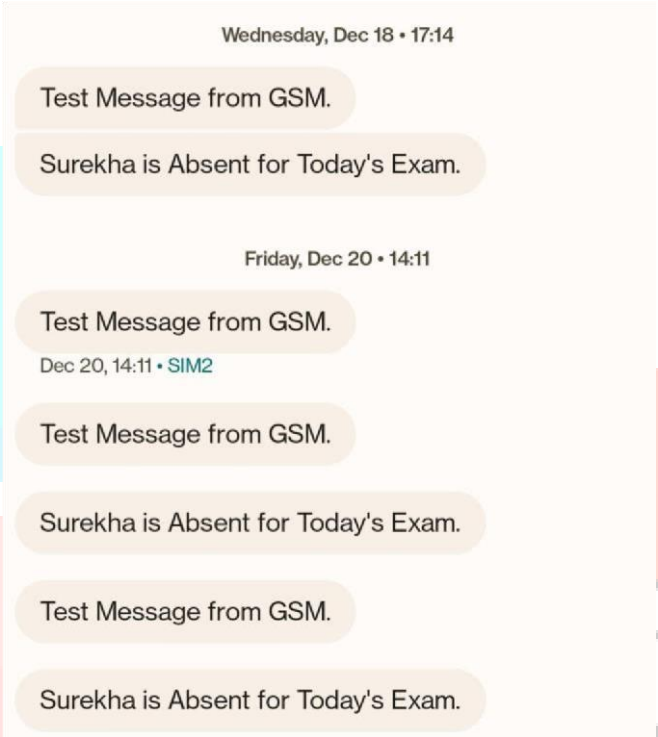

figure 6 text message

As seen in Table below, four students are included. Each student is given a RFID card to scan. When the correct card is scanned it asks for the fingerprint authentication. When both the card and the fingerprint match and verified the below details of the students is displayed. The attendance status is also updated in the database as present. If both are invalid then it updates as absent and SMS notification is sent to the parent's mobile.

table 1 student authentication status table

STUDENT NAME	STUDENT USN	SUBJECT CODE	ROOM ALLOATED	ATTENDANCE STATUS
BINDU	014	21EC71	R418	ABSENT
SHREYA	072	21EC71	R421	PRESENT
SUREKHA	086	21EC71	R420	PRESENT
SWATHI	087	21EC71	R420	ABSENT

VI. CONCLUSION

The Examination Guide System is a secure way to manage exams. It ensures only authorized students take the exam, preventing cheating. RFID tags and fingerprint recognition verify student identities accurately. The system reduces workload, making exams faster and more efficient. The GSM module sends real-time alerts to authorities and parents, ensuring quick action. This system makes exams more secure, efficient, and reliable. This system also helps us to reduce stress and anxiety for students and also for teachers and we can save the time by providing accurate and reliable results. It also improves communication between students and teachers. It reduces paper work and administrative burdens. This system sets a new standard for the education sector. It makes sure that every student gets the information quickly just by tapping RFID tags and fingerprint recognition. Overall this system helps to save time, work load and stress.

I.FUTURE WORKS

1. Add more security features: We can add more biometric features like face recognition or iris scanning to make the system even more secure.
2.Make it cloud-based: We can move the system to the cloud so that it's easier to access and manage.
3.Create a mobile app: We can develop a mobile app for students to access their exam schedules, results, and other important information.
4.Use artificial intelligence: We can use AI to improve the system's accuracy and efficiency.
5.Increase storage capacity: We can expand the system storage capacity to accommodate more student data and records 6. Improve accessibility: We can make the system accessible on various devices, including smartphones and tablets.

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