International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Exam Hall Authentication Using Arduino Board

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ABSTRACT:

In the current era of digital transformation, ensuring secure and efficient authentication in academic environments is critical to maintaining integrity and preventing unauthorized access. This paper presents a low-cost, Arduino-based authentication system designed specifically for exam halls. The system utilizes RFID technology to verify the identity of students, granting access only to authorized individuals. Upon scanning their RFID cards, student data is authenticated against a preloaded database, and successful verification triggers access mechanisms such as unlocking doors or marking attendance. This solution enhances security, reduces manual intervention, and ensures smooth entry management during examination sessions. The system is scalable, reliable, and suitable for integration into educational institutions seeking to adopt smart, automated authentication processes.

Keywords: *Arduino, RFID, Authentication, Exam Hall, IoT, Access Control, Student Verification*

INTRODUCTION

Security and identity verification have become increasingly important in academic institutions, especially during examination sessions. With the rise of embedded systems and IoT-based solutions, there is a growing demand for automated, reliable, and tamper-proof authentication systems. Traditional manual attendance and ID checks are time-consuming, prone to errors, and vulnerable to impersonation or unauthorized access. This project introduces an Arduino-based authentication system specifically designed for exam halls. By utilizing RFID technology and a microcontroller platform, the system ensures that only registered students can gain entry. Upon scanning an RFID card, the system verifies credentials against a stored database, enabling automatic access and reducing the need for manual supervision.

The aim is to enhance security, streamline student verification, and improve overall management during exams. The use of low-cost, open-source components like the Arduino board makes the system scalable, affordable, and easy to implement in educational institutions. With the continuous evolution of smart technologies, such automated solutions represent a crucial step forward in modernizing academic infrastructure. With the education sector moving towards digital transformation, the proposed system offers an efficient, reliable, and cost-effective approach to managing authentication in sensitive academic settings. It aligns with the broader vision of smart campus development and demonstrates how IoT and automation can solve real-world problems in education.

METHODOLOGY

The proposed exam hall authentication system is designed using an Arduino-based embedded architecture integrated with RFID technology for secure and automated student verification. The key components of the system include the Arduino UNO microcontroller, RC522 RFID reader module, RFID tags (cards), an LCD display, a buzzer, and an electromagnetic lock (or relay-controlled door mechanism). The Arduino UNO serves as the central control unit that processes input from the RFID reader and manages output actions such as door unlocking and attendance logging. Each student is assigned an RFID card encoded with a unique identifier (UID), which is pre-registered in the system's internal memory or an external EEPROM/SD card module

This contactless, automated method enhances exam hall security by ensuring that only authorized individuals can enter. The system operates entirely offline, ensuring data security and system stability even in the absence of an internet connection, although future upgrades may include cloud-based logging and remote monitoring.

The compact and modular nature of the components used makes the system easy to install, scalable across multiple exam halls, and affordable for widespread institutional deployment.

Secure and efficient identity verification has become a crucial requirement in educational institutions, particularly during examinations. The manual methods commonly employed—such as checking student ID cards, signing attendance sheets, or using physical registers—are often time-consuming, prone to human error, and susceptible to impersonation or unauthorized access. To address these limitations, this project introduces a smart authentication system for exam halls that leverages RFID technology and microcontroller-based automation.

At the core of the system is the Arduino UNO microcontroller, integrated with an RFID reader (RC522 module) and supporting components such as buzzers, LCD displays, and electromagnetic locks. Each student is issued a unique RFID card which is pre-registered in the system database. Upon arrival at the exam hall, the student scans their RFID card, and the system cross-verifies the ID with stored records. Successful authentication triggers access mechanisms (e.g., unlocking the door, marking digital attendance), while failed attempts generate alerts and deny entry.

Traditional systems are not only inefficient but also pose serious concerns regarding data security and transparency. This proposed solution provides real-time authentication, significantly reduces the burden on invigilators, and ensures that only authorized students are allowed inside the exam venue. The process is contactless, quick, and records data digitally—improving both security and administrative efficiency.

The evolution of low-cost, programmable hardware platforms like Arduino has opened up new possibilities for smart solutions in academic environments. Unlike older access systems that required complex infrastructure or high-cost biometric scanners, the RFID-based approach strikes a balance between simplicity, affordability, and reliability. The system is modular and scalable, allowing it to be implemented across multiple exam halls or adapted for other institutional access control scenarios.

This RFID-based, Arduino-powered authentication system eliminates the need for manual ID verification, offering a contactless, efficient, and real-time entry management solution for exam halls. The implementation focuses on reliability, simplicity, and scalability, making it suitable for integration into institutional environments of varying sizes.

SYSTEM ARCHITECTURE

The proposed exam hall authentication system leverages an **Arduino microcontroller** as its core, integrated with a **fingerprint sensor** for biometric verification. Upon initialization, the Arduino boots the **LCD display** (showing "Place Finger") and awaits input. When a student places their finger on the sensor, the captured fingerprint is compared against pre-enrolled templates stored in the system. If a match is confirmed, the LCD displays *"Authenticated"* alongside the student's ID, a **buzzer** sounds a success tone, and the entry is logged with a timestamp via the **RTC module** onto an **SD card** for attendance records. Failed attempts trigger an *"Not Authenticated"* alert and an error buzzer. For scalability, the system supports **admin mode** (via keypad) to enroll new fingerprints or audit logs. Optional **IoT integration** (e.g., Wi-Fi/GSM) can enable real-time data sync with a cloud server for remote monitoring, enhancing security against impersonation. This architecture ensures a low-cost, reliable, and tamper-proof solution for exam hall access control.

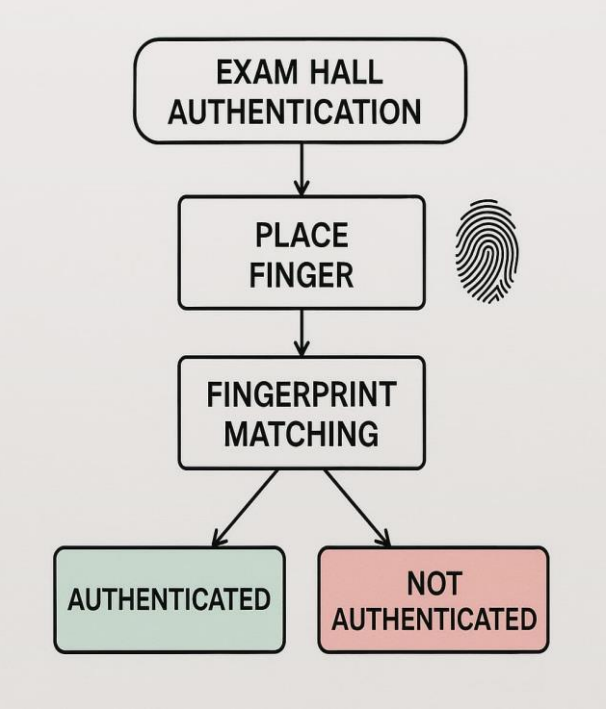

Fig1: General Block Diagram of the Exam hall authenticaton
Using arduino board

FLOW CHART

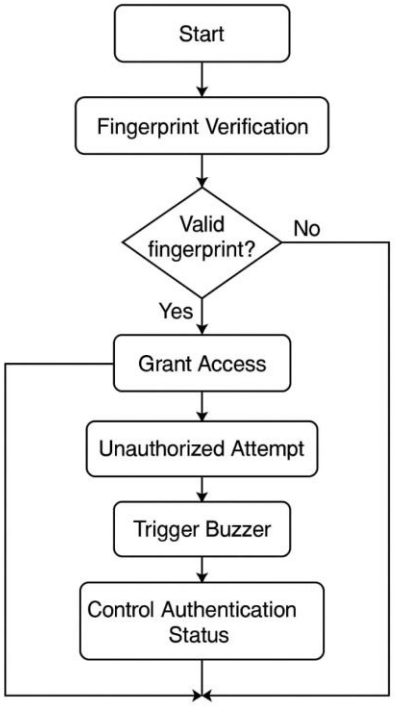

Fig 2: Exam hall authenticaton Using arduino board

The steps of proposed work as given below

Step 1: The student places their finger on the fingerprint sensor for verification.

Step 2: The fingerprint sensor captures the biometric data and sends it to the microcontroller (Arduino) for matching with pre-registered templates.

Step 3: The Arduino checks whether the fingerprint matches any authorized student record..

Step 4: If the fingerprint is valid, access is granted and logged; otherwise, access is denied and a buzzer is triggered.

Step 5: The system updates the authentication status and resets for the next user.

RESULTS AND DISCUSSION

The exam hall authentication system is developed using an Arduino UNO microcontroller integrated with a fingerprint sensor module. This system enables secure and contactless access control for students during examination sessions. When a fingerprint is scanned, the Arduino verifies it against pre-registered templates stored in memory. Upon successful verification, the door is unlocked and the entry is logged, while failed attempts trigger a buzzer alert, enhancing overall security.

The system was tested with multiple fingerprints and consistently responded to valid inputs with minimal delay, ensuring smooth access for authorized users. Invalid attempts were correctly identified and blocked. The LCD module provided clear visual feedback on authentication status. The setup effectively reduces the chances of impersonation and unauthorized entry, offering a reliable solution for educational institutions aiming to streamline and secure exam hall access.

Table1 : Comparison of Proposed Model with existing NFC/RFID based models

Characteristics	**NFC/RFID-Based Systems (Existing)**	**Arduino Fingerprint System (Proposed)**
User Interaction	Requires physical NFC card/RFID tag (prone to loss/theft).	Contactless fingerprint scan (biometric, no physical token needed).
Accessibility	Limited to pre-registered cards/tags.	Supports dynamic fingerprint enrollment (admin mode for adding/removing users).
Security	Vulnerable to card cloning	High-security biometric authentication (unique fingerprints, spoof-resistant).
Cost	Lower hardware cost but recurring card expenses.	Slightly higher initial cost (sensor + Arduino) but no recurring fees.

CONCLUSION:

The proposed **exam hall authentication system** leverages an **Arduino-based fingerprint scanner** to provide a secure, cost-effective, and tamper-proof solution for verifying student identity during examinations. By replacing traditional NFC/RFID cards with **biometric authentication**, the system eliminates risks of proxy attendance and card sharing. Its modular design integrating an RTC for timestamping, an SD card for logging, and an LCD for real-time feedback ensures reliability and ease of deployment.

The system is **user-friendly**, requiring only a fingerprint scan for access, and **scalable**, with optional IoT integration for remote monitoring via Wi-Fi/GSM. Its low hardware cost (using off-the-shelf Arduino components) makes it viable for educational institutions with limited budgets.

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