ID based exam hall authentication

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Sanjida Noshin Omi
Department of Computer Science and Engineering
BRAC University
Dhaka, Bangladesh
sanjida.noshin.omi@g.bracu.ac.bd

Ahmed Mustayeen
Department of Computer Science and Engineering
BRAC University
Dhaka, Bangladesh
ahmed.mustayeen@g.bracu.ac.bd

Using Phru
Department of Computer Science and Engineering
BRAC University
Dhaka, Bangladesh
using.phru@g.bracu.ac.bd

Moriyam Akter Riana
Department of Computer Science and Engineering
BRAC University
Dhaka, Bangladesh
moriyam.akter.riana@g.bracu.ac.bd

I. Abstract

Authentication during examinations has always posed significant challenges, often relying on manual supervision that is prone to errors and fraudulent practices. This project proposes an ID-based exam hall authentication system using secure and registered identification cards. Students scan their unique ID card, which is validated by an Arduino-based microcontroller. Upon successful verification, a relay-driven lock mechanism activates, and feedback is provided through an LED indicator. The system supports multiple enrolled IDs and includes both enrollment and verification phases. Moreover, an administrative function integrates, allowing authorized personnel to manage records, cancel or modify a student's identity using an admin ID card. The primary objective is to reduce impersonation, cheating, and unauthorized access while improving efficiency and reliability. The proposed solution enhances the security and integrity of examination halls by providing fast, accurate, and auditable authentication, ensuring a fair and transparent examination environment.

II. Work Overview

The project implements a secure access control system for examination halls by integrating hardware and software components. The system operates in two main phases. In the Enrollment Phase, each student's ID card is registered and securely stored in the system's database. During the Authentication Phase, on exam day, students scan their ID cards. The microcontroller compares the scanned ID with the stored records. If a match is found, the door unlocks via a servo motor and the LED flashes once. If authentication fails, the system denies entry, the door remains locked, and the LED flashes twice to indicate rejection.

To strengthen supervision and flexibility, an administrative feature is provided, enabling authorized personnel to update or remove student records using an admin ID. The implementation ensures real-time verification, reduces impersonation risks, and improves the reliability of attendance records, thereby enhancing both security and operational efficiency within examination halls.

III. Implementation

(1) The project "ID Based Exam Hall Authentication" uses an ID card scanner to automate and secure the process of verifying student identities during examinations. The central component is the Arduino Uno, which processes scanned data from the ID card scanner and checks it against a list of pre-registered student IDs stored in memory.

When a student scans their ID card, the Arduino verifies if the ID is valid. If authentication is successful, the servo motor operates to unlock or open the gate, allowing entry. At the same time, a confirmation message is displayed on the 16×2 LCD (I2C), and a LED provides additional feedback. If the ID is invalid or unauthorized, access is denied, and a warning signal is triggered.

This system works similarly to access control systems in offices or secure facilities but is applied here to an exam environment. By using unique ID cards instead of manual verification, the system minimizes impersonation, prevents unauthorized entry, and improves the fairness and transparency of the examination process.

(2)We used the following code to run the Arduino:

```
#include <SPI.h>
#include <MFRC522.h>
#include <EEPROM.h>
```

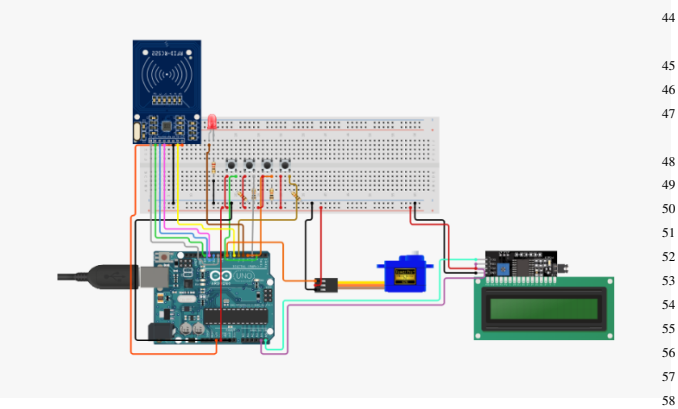

Fig. 1. Circuit Diagram

```
#include <Servo.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

// ----------------- Pin Definitions -----------------
#define SS_PIN    10     // RFID Slave Select
#define RST_PIN   9      // RFID Reset
#define S1 A0            // Push Button: Remove Mode (Admin only)
#define S2 A1            // Push Button: Enroll/ Normal Toggle
#define S3 A2            // Push Button: Show Stored IDs
#define LED_PIN 7        // LED Indicator
#define SERVO_PIN 8      // Servo Motor Pin

// ----------------- Global Variables -----------------
MFRC522 mfrc522(SS_PIN, RST_PIN);
Servo myServo;
LiquidCrystal_I2C lcd(0x27, 16, 2);

bool enrollMode = false;        // Track enroll/ normal mode
int idViewIndex = -1;           // Show stored IDs
bool adminAuthPending = false;  // Waiting for Admin card
bool deleteAwaitTarget = false; // Waiting for card to delete

// ----------------- Setup Function -----------------
void setup() {
   // Initialize serial communication, SPI, RFID, LCD, Servo
   // Set pin modes for push buttons and LED
   // Show startup message on LCD
}

// ----------------- Main Loop -----------------
void loop() {
   // 1. Check push buttons
   //    - S1 : Enter Admin authentication for Remove Mode
   //    - S2 :Toggle between Enroll and Normal mode
   //    - S3 : Show total stored IDs or step through them

   // 2. Read RFID card (if present)
   //     If in Enroll Mode : Add new card to EEPROM
   //     If in Normal Mode : Check access (grant/ deny)
   //     If Admin Mode : Authenticate Admin card, then allow deletion
}

// ----------------- Helper Functions -----------------

// Convert RFID UID to string
String getTagID() { ... }

// Check if a card is already enrolled
bool isCardEnrolled(String tag) { ... }

// Enroll new card (write to EEPROM)
void enrollCard(String tag) { ... }

// Delete card (requires Admin authentication first)
bool deleteCardByTag(String tag) { ... }

// Show total stored IDs or display one by one
void showNextID() { ... }

// Blink LED: once = Access Granted, twice = Access Denied
void blinkLED(int times) { ... }
```

(3) Challenges I May Face During This Project

Integrating the ID card scanner and making it work seamlessly with Arduino can be challenging, especially if it uses RFID. Proper library support and correct wiring must be ensured.

Data Storage Limitations Since Arduino Uno has limited

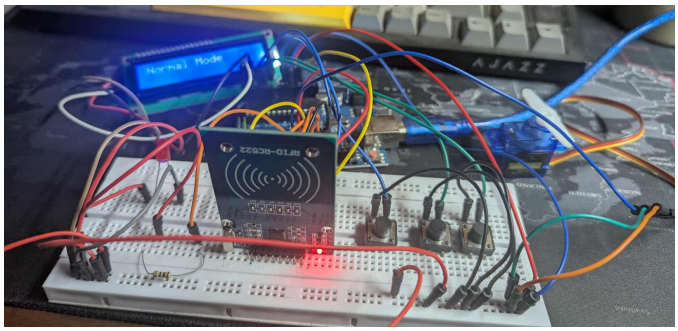

Fig. 2. Circuit Setup

memory, storing many student IDs might not be possible. For large numbers of students, external memory (EEPROM/SD card) or a database system might be required.

False Readings or Scanner Sensitivity The scanner may sometimes fail to read an ID card properly due to card wear, orientation, or scanning speed, which could cause delays at entry points.

Power Supply Requirements The servo motor, scanner, buzzer, and LCD together may need more power than the Arduino can supply directly. An external power source or regulator may be necessary to avoid malfunctioning.

Security Concerns If the IDs are stored in plain text on Arduino, they could be copied or spoofed. For better security,

encrypted IDs or unique authentication tokens should be used.

Hardware Reliability Loose connections in breadboards and jumper wires could lead to faulty readings or system crashes. For practical use, a soldered PCB would be more reliable.

Scalability Issues While the prototype works well for small groups, scaling it to thousands of students across multiple exam halls would need advanced hardware, networking, and database integration.

IV. Conclusion

The ID-based exam hall authentication system has been designed and implemented to address the challenges of ensuring secure and reliable student verification during examinations. By integrating Arduino-based control, ID card scanning, servo-operated locking mechanisms and LED feedback, the system establishes a strong foundation for minimizing impersonation, unauthorized access and manual verification errors. This approach enhances the integrity, objectivity and transparency of the examination process while improving overall efficiency in managing exam hall access.

Future enhancements can involve the implementation of biometric authentication, such as fingerprint or facial recognition to serve as a multi-factor verification framework. Additionally, the integration of a centralized database will enable large-scale deployment across institutions, while IoT-based monitoring can provide real-time supervision and automated alerts. The adoption of cloud storage for attendance and access logs, combined with the development of web and mobile interfaces for administrative control will further strengthen scalability, flexibility, and ease of management, making the system adaptable to a wide range of academic environments.

References

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