Established – 1961 Subject: Internet of Things

SEVA SADAN'S

R. K. TALREJA COLLEGE

OF

ARTS, SCIENCE & COMMERCE ULHASNAGAR – 421 003

CERTIFICATE

This is to certify that Mr./Ms. Siddhi Pramod Chorge of S.Y. Computer Science (SYCS) Roll No. 2524005 has satisfactorily completed The Internet Of Thing Mini Project entitled Smart Door Lock using RFID during the academic year 2025 – 2026, as a part of the practical requirement. The project work is found to be satisfactory and is approved for submission.

PROF. INCHARGE **HEAD OF DEPT**

Mr.Sahil Shukla **Mrs.Laxmi Jeswani**

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1. Introduction

1.1 Overview of the Problem

In daily life, security is very important for homes, offices, and other places. Most of the time, we use normal locks and keys to secure doors. But keys can be lost or duplicated easily. If someone finds or copies the key, they can enter without permission. So, traditional lock systems are not always fully secure.

Because of this problem, electronic security systems are becoming more popular. One of the simple and effective methods is using RFID technology for door locking.

1.2 Purpose of the Project

The main purpose of this project is to create a smart door lock system using RFID and Arduino. In this system, instead of using a normal key, we use an RFID card to unlock the door.

When the correct RFID card is scanned, the system checks the card ID and opens the door using a servo motor. If an unknown card is scanned, the door will not open. This makes the system safer and more convenient.

1.3 Importance and Real-Life Application

This project is useful because it improves security and reduces the risk of unauthorized access. RFID-based systems are already used in many places such as offices, schools, hotels, and parking areas.

Using RFID technology makes entry faster and easier. It also reduces the need to carry multiple keys. This type of system can be used in small homes, labs, lockers, and offices where security is required.

1.4 Objectives of the System

The objectives of this project are:

- To design a door lock system using RFID technology.
- To allow access only to authorized RFID cards.
- To display system messages on an LCD screen.
- To control a servo motor for locking and unlocking.
- To create a simple and affordable security system using Arduino.

2. Requirement Specification

2.1 Hardware Requirements

The following hardware components are required to build this project:

- Arduino Uno board
- RC522 RFID module
- RFID card or tag
- 16x2 LCD display with I2C module
- Servo motor
- Jumper wires
- Power supply (USB cable)

The Arduino acts as the main controller of the system. The RFID module reads the card information. The LCD displays system messages, and the servo motor is used to lock and unlock the door.

2.2 Software Requirements

The software required for this project includes:

- Arduino IDE
- C/C++ programming language
- Required libraries:
    - SPI library
    - MFRC522 library
    - LiquidCrystal_I2C library
    - Servo library

The Arduino IDE is used to write, compile, and upload the code to the Arduino board.

2.3 Functional Requirements

Functional requirements describe what the system should do. In this project:

- The system should detect when an RFID card is scanned.
- It should read the unique ID (UID) of the card.

- It should compare the scanned UID with the stored authorized UID.
- If the UID matches, the door should unlock.
- If the UID does not match, access should be denied.
- The LCD should display messages such as “Scan your card”, “Access Granted”, or “Wrong Card”.
- The system should allow locking and unlocking using the authorized card.

2.4 Non-Functional Requirements

Non-functional requirements describe how the system should perform. These include:

- The system should respond quickly when a card is scanned.
- It should be reliable and work continuously without errors.
- The system should consume low power.
- The design should be simple and easy to understand.
- The system should be cost-effective and affordable.

3. System Design

3.1 Block Diagram

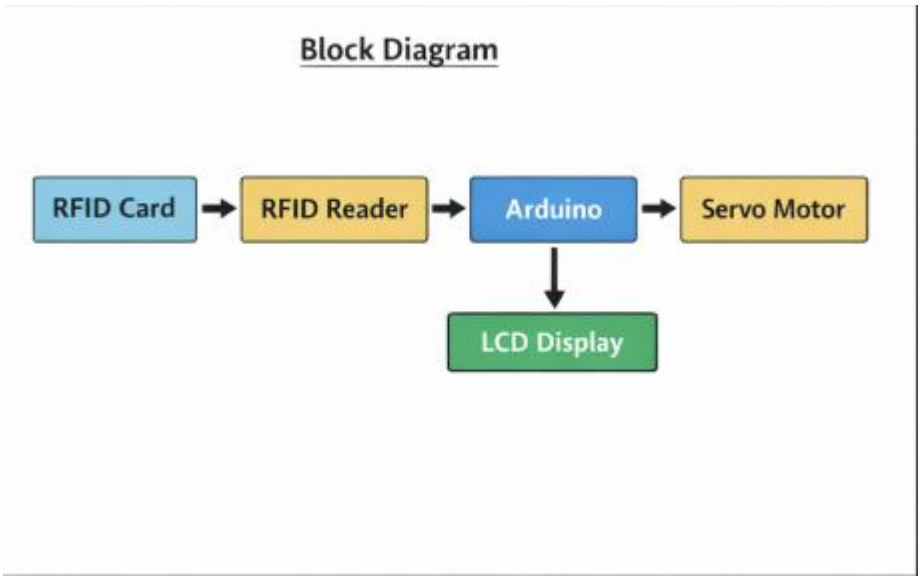
Explanation

The block diagram represents the overall structure of the RFID-based door lock system. It shows how different components are connected and how data flows in the system.

In this system:

- The RFID card acts as the input device.
- The RFID reader reads the card's unique ID.
- The Arduino Uno acts as the main controller.
- The LCD displays system messages.
- The Servo motor controls the door locking mechanism.

When a card is scanned, the RFID reader sends the UID to the Arduino. The Arduino checks whether the UID matches the stored authorized UID. If it matches, the servo motor unlocks the door and the LCD displays "Access Granted". Otherwise, access is denied.



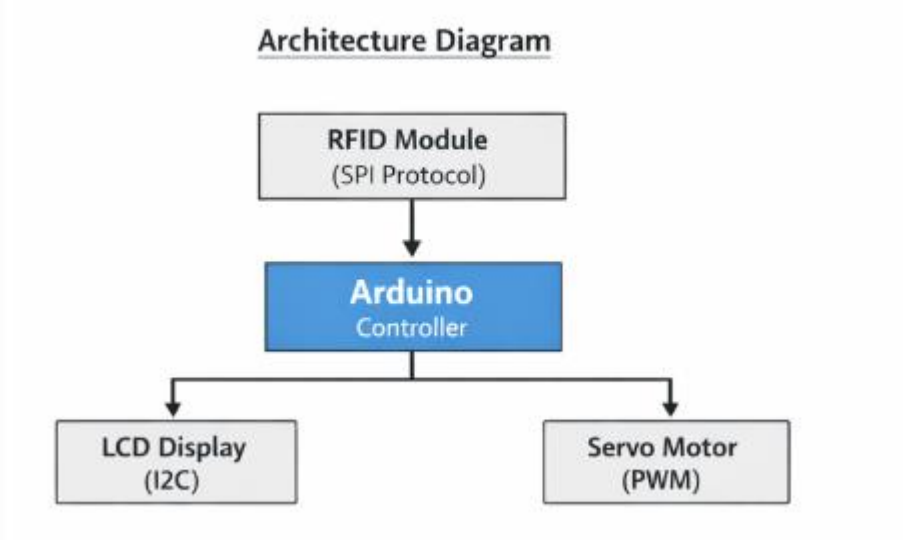
3.2 Architecture Diagram

Explanation

The architecture diagram explains how different modules communicate with the Arduino.

- The RFID module communicates with Arduino using **SPI communication**.
- The LCD communicates using **I2C communication**.
- The Servo motor is controlled using a **PWM signal**.
- Arduino acts as the brain of the system.

It processes input from the RFID reader and sends output signals to the LCD and Servo.



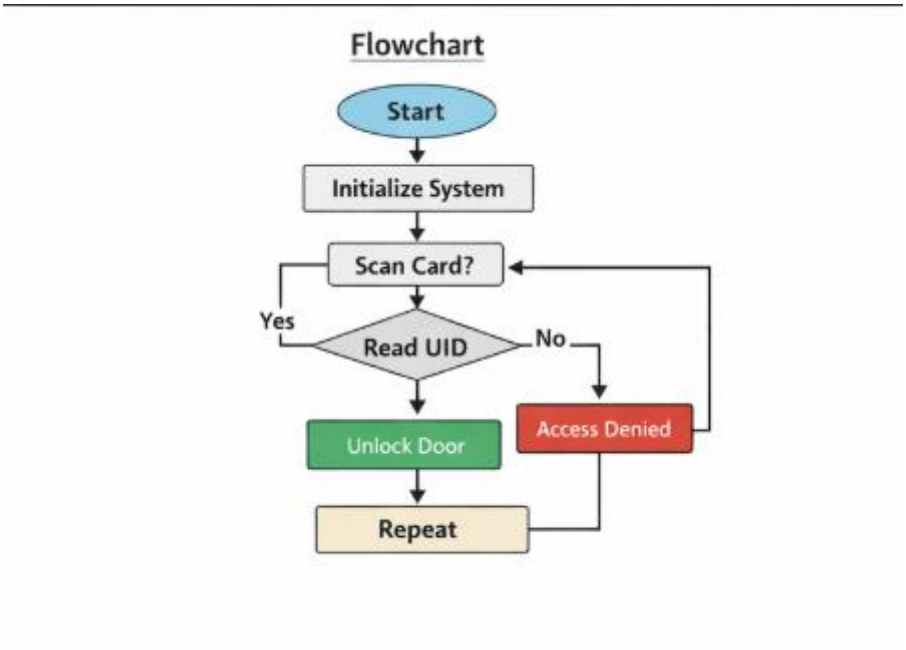
3.3 Flowchart

Explanation

The flowchart describes the step-by-step working of the system.

1. The system starts.
2. Arduino initializes all components.
3. The LCD displays “Scan your card”.
4. The system waits for a card.
5. When a card is scanned, the UID is read.
6. The UID is compared with the stored UID.
7. If matched → Door unlocks.
8. If not matched → Access denied.

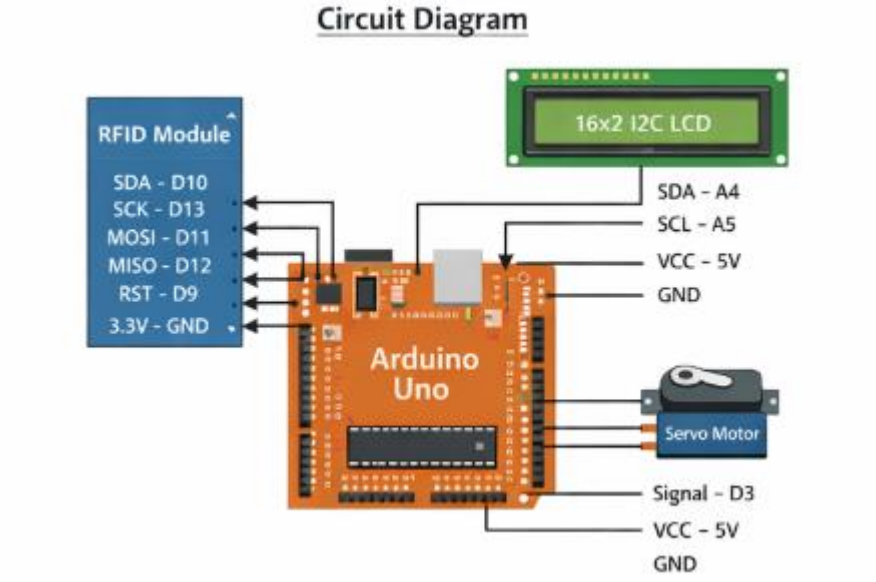
9. System returns to scanning mode.



3.4 Circuit Diagram

Explanation

The circuit diagram shows how all hardware components are connected physically to the Arduino.



4. Implementation

4.1 Technology Used

In this project, we used Arduino and RFID technology to create a smart door lock system.

The main technologies used are:

- **Arduino Uno** – It acts as the main controller of the system.
- **RFID Technology** – Used for identifying authorized users.
- **Embedded C/C++ Programming** – Used to write the logic in Arduino IDE.
- **Servo Motor Control** – Used to open and close the lock.
- **I2C Communication** – Used for LCD display.
- **SPI Communication** – Used for RFID module.

The system is designed to be simple, low-cost, and easy to implement.

4.2 Programming Logic

The programming logic of the system works step by step:

1. First, all components (RFID, LCD, Servo) are initialized in the setup() function.
2. The LCD displays “Scan your card”.
3. The system continuously checks if a new RFID card is placed near the reader.
4. When a card is detected, the UID of the card is read.
5. The scanned UID is compared with the stored authorized UID in the program.
6. If the UID matches:
    - The servo motor rotates to unlock the door.
    - LCD displays “Door Opened”.
7. If the UID does not match:
    - The servo does not move.
    - LCD displays “Wrong Card”.
8. After a few seconds, the system returns to scanning mode.

This logic ensures that only authorized users can unlock the door.

4.3 Sensor Integration

In this project, the RFID module works as the input sensor.

- The RFID reader detects radio frequency signals from the RFID card.

- It reads the unique identification number (UID) of the card.
- This UID is sent to the Arduino through SPI communication.
- Arduino processes this data and decides whether access should be given.

The RFID module is properly connected to Arduino using SPI pins (D10–D13).

4.4 Communication Protocols

Two main communication protocols are used in this system:

1. SPI (Serial Peripheral Interface)

- Used between Arduino and RFID module.
- Allows fast communication.
- Uses pins: MOSI, MISO, SCK, and SS.

2. I2C (Inter-Integrated Circuit)

- Used between Arduino and LCD display.
- Uses only two wires:
    - SDA (Data)
    - SCL (Clock)

Using these protocols reduces wiring complexity and improves performance.

4.5 Code Explanation

The code is divided into two main parts:

1. setup() Function

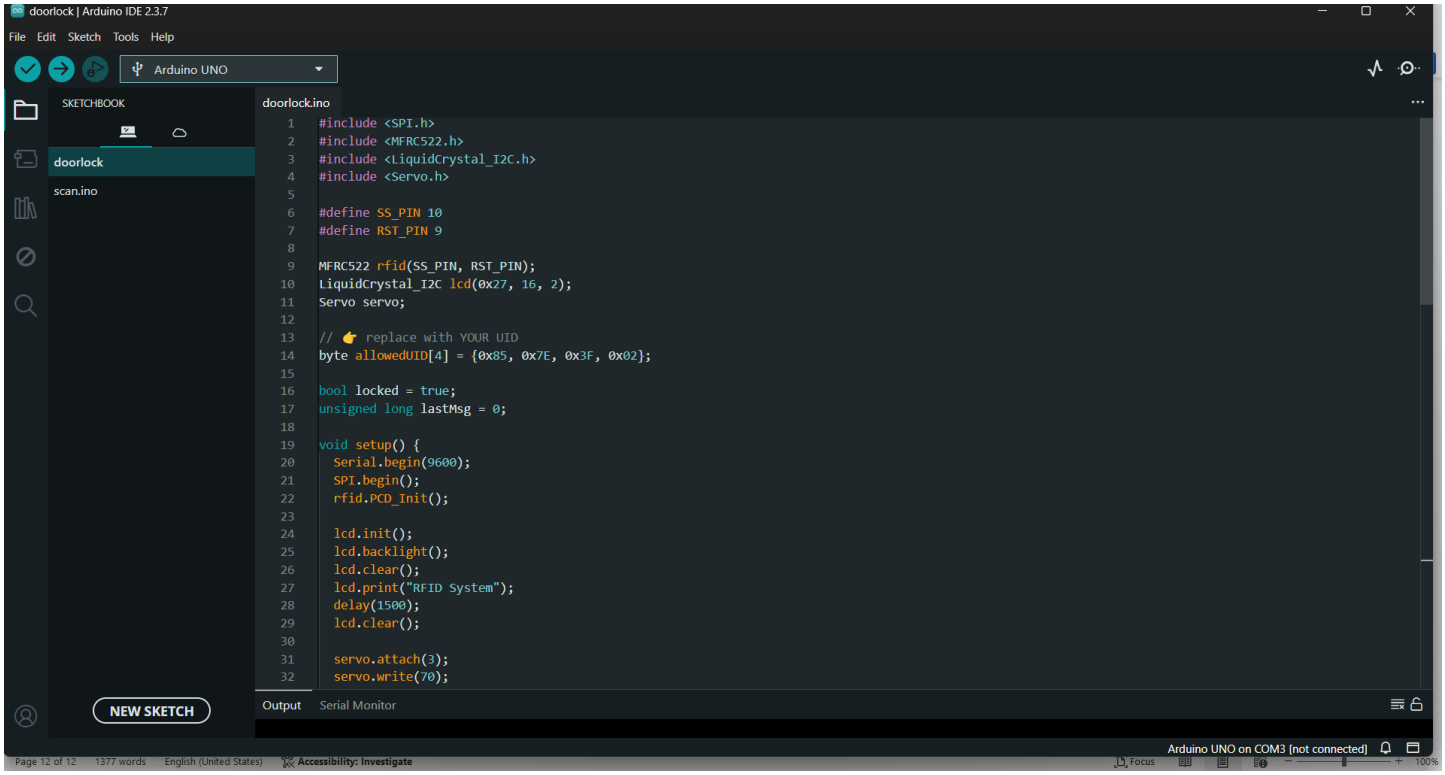
- Initializes Serial communication.
- Starts SPI communication.
- Initializes RFID module.
- Initializes LCD display.
- Attaches servo motor.
- Displays starting message.

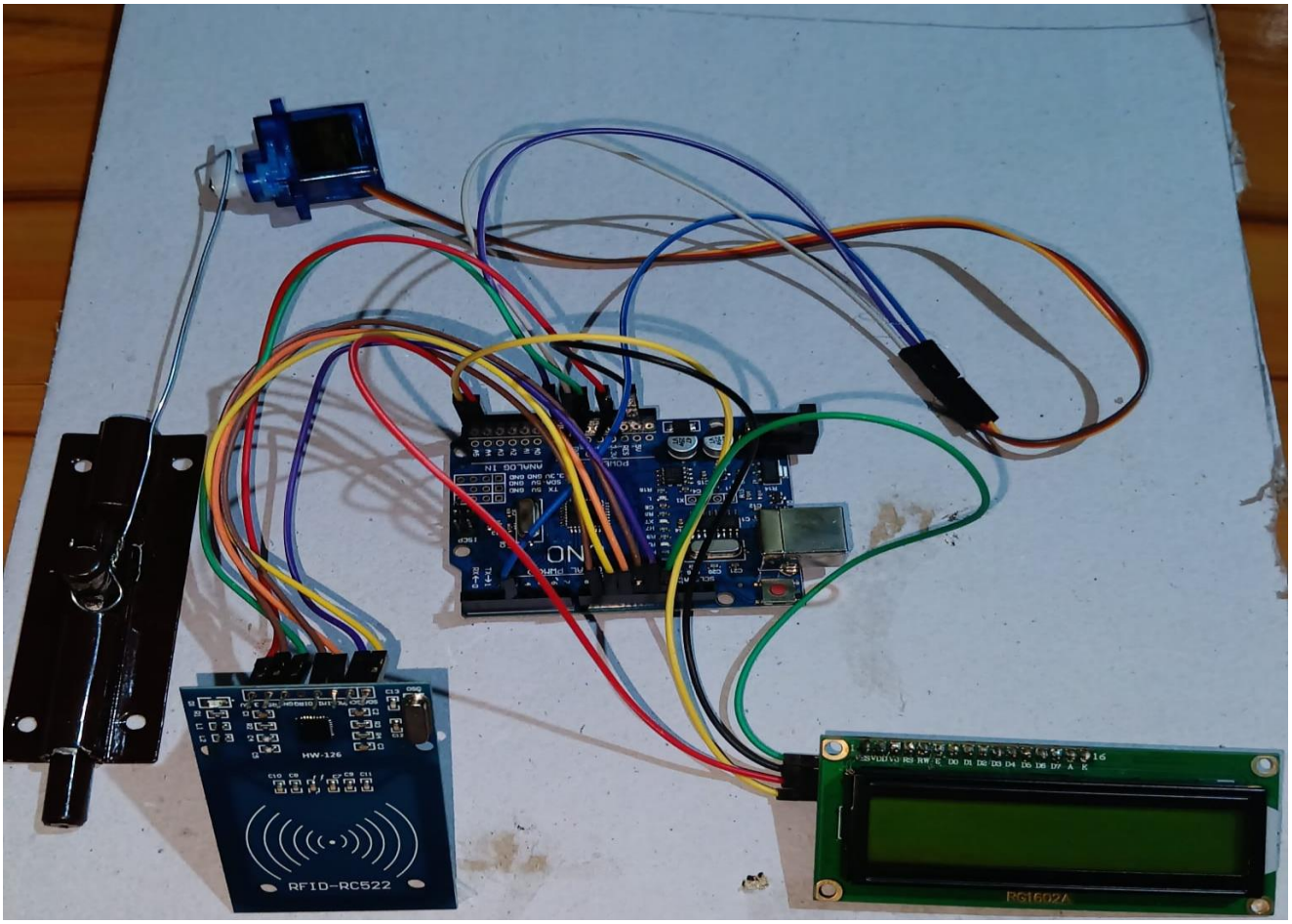
2. loop() Function

- Displays “Scan your card”.
- Checks if a new card is present.
- Reads card UID.

- Compares UID with stored UID.
- If matched:
    - Servo rotates to open.
    - LCD shows “Door Open”.
- If not matched:
    - LCD shows “Wrong Card”.
- System waits for a few seconds and resets.

Screenshots:




RFID-RC522
HW-126
RG1602A

5. System Testing and Result

5.1 Test Cases

To check whether the system works properly, different test cases were performed.

Test Case 1 – Authorized Card

- **Input:** Valid RFID card scanned.
- **Expected Result:** Door unlocks and LCD displays “Access Granted”.
- **Actual Result:** Door unlocked successfully and correct message displayed.
- **Status:** Passed ✅

Test Case 2 – Unauthorized Card

- **Input:** Invalid RFID card scanned.
- **Expected Result:** Door should not unlock and LCD should display “Access Denied” or “Wrong Card”.
- **Actual Result:** Door remained locked and correct message displayed.
- **Status:** Passed ✅

Test Case 3 – No Card Present

- **Input:** No card near RFID reader.
- **Expected Result:** LCD should display “Scan your card”.
- **Actual Result:** System continuously displayed scan message.
- **Status:** Passed ✅

Test Case 4 – Repeated Scanning

- **Input:** Authorized card scanned multiple times.
- **Expected Result:** Door should toggle between lock and unlock properly.
- **Actual Result:** System worked correctly without errors.
- **Status:** Passed ✅

5.2 Input / Output Verification

Input Devices:

- RFID Card (User input)

Output Devices:

- Servo Motor (Door lock/unlock)
- LCD Display (Status messages)
- Serial Monitor (UID display)

When a card is scanned:

- The RFID reader reads the UID.
- Arduino compares it with stored UID.
- Based on verification:
    - Servo rotates (Unlock/Lock)
    - LCD displays appropriate message.

All inputs and outputs were verified during testing and matched expected behavior.

5.3 Performance Analysis

During testing, the system showed:

- Quick response time (within 1–2 seconds).
- Stable performance without system crash.
- Accurate card detection.
- Reliable locking and unlocking action.

The only observation was that the servo motor requires stable power supply. When powered properly, the system runs smoothly.

Overall, the system performs efficiently for small-scale security applications.

5.4 Result Screenshots

Figure 5.1: Serial Monitor Output

Figure 5.2: Scan Card Display

Figure 5.3: Access Granted Display

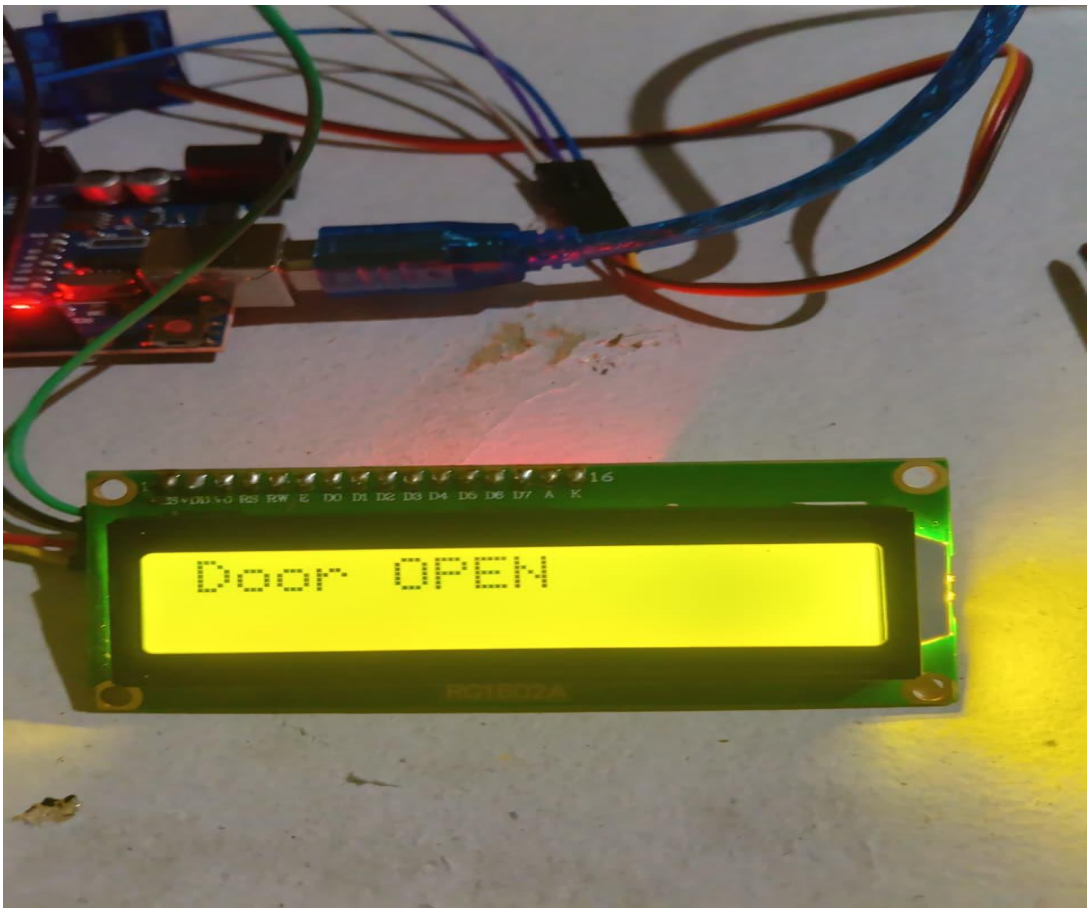


Figure 5.4: Access Denied Display

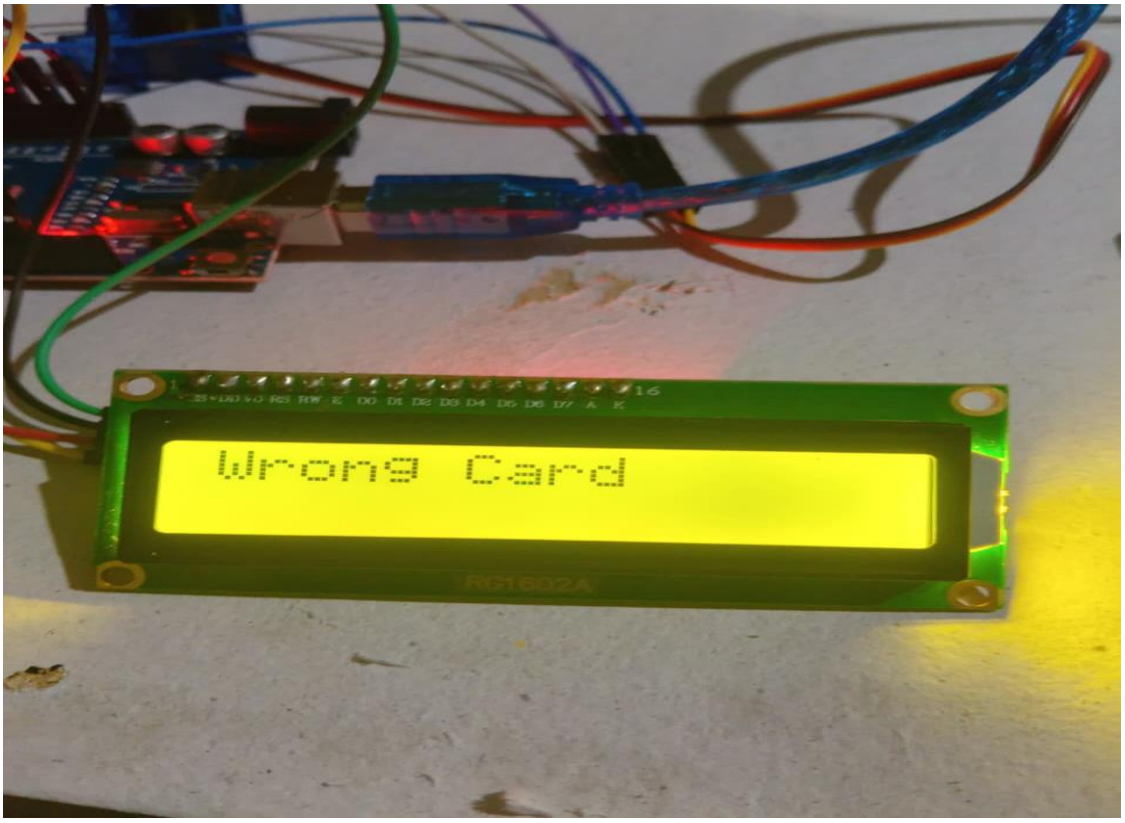
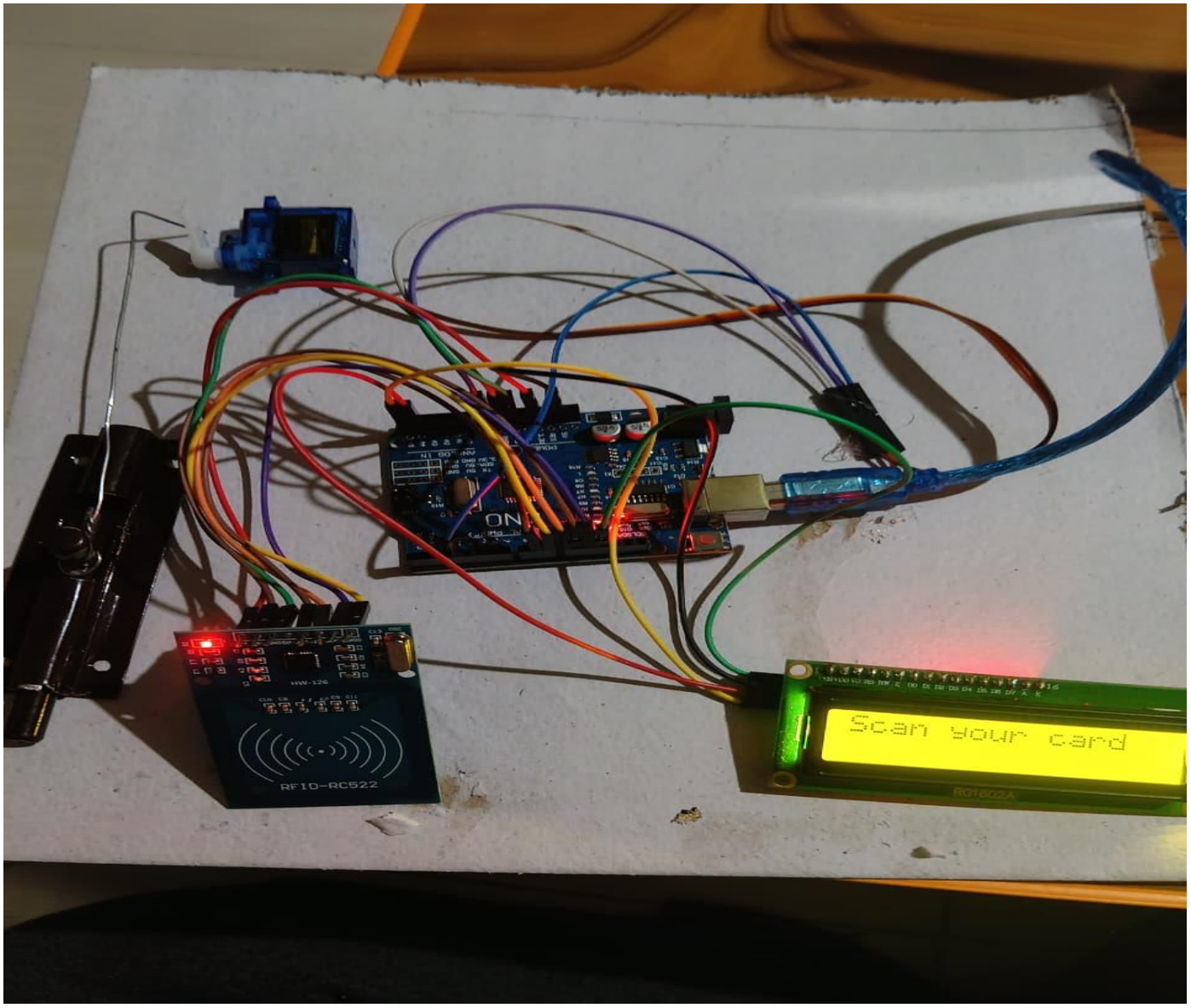


Figure 5.5: Hardware Setup



6. Future Scope and Conclusion

6.1 Possible Improvements

Although the current system works properly, some improvements can make it more advanced and secure.

- Multiple RFID cards can be added instead of storing only one card.
- A buzzer can be added for sound indication when access is granted or denied.
- A keypad can be added for password-based backup authentication.
- An LED indicator can be added for visual signals.
- A better locking mechanism can be used instead of a simple servo motor.

These improvements can make the system more practical for real-life use.

6.2 Scalability

The current system is designed for small-scale applications like home doors or small offices. However, it can be expanded for larger systems.

- A database can be connected to store many users.
- The system can be integrated with computers or servers.
- Multiple RFID readers can be used for different entry points.
- Cloud storage can be used to keep access records.

With proper upgrades, this system can be used in schools, offices, companies, and industries.

6.3 Future Enhancements

In future versions, the system can include:

- Wi-Fi or IoT module (like ESP8266) for remote monitoring.
- Mobile app integration for checking access logs.
- Face recognition or biometric authentication for higher security.
- SMS or email alert system when unauthorized access is attempted.
- Automatic door closing mechanism after a fixed time.

These enhancements will make the system smarter and more secure.

6.4 Final Conclusion

The RFID-based door lock system successfully demonstrates how electronic components and programming can be used to improve security. The system allows access only to authorized users and prevents unauthorized entry.

It is simple, cost-effective, and easy to implement using Arduino. The project helped in understanding RFID technology, communication protocols, and hardware integration.

Overall, this project provides a basic but effective security solution and can be further improved for advanced real-world applications.

7. References

Books

1. Simon Monk – *Programming Arduino: Getting Started with Sketches*
2. Michael Margolis – *Arduino Cookbook*

Websites

1. Arduino Official Website – https://www.arduino.cc
2. Circuit Digest – https://circuitdigest.com
3. Random Nerd Tutorials – https://randomnerdtutorials.com
4. GitHub – https://github.com

Project Source Website

Srituhobby – "How to Make a RFID Door Lock with Arduino"

Available at: https://srituhobby.com/how-to-make-a-rfid-door-lock-with-arduino/

Accessed on: 20 February 2026

8. Glossary

RFID (Radio Frequency Identification)

A technology that uses radio waves to read information stored in a card or tag without physical contact.

RFID Tag / Card

A small card that contains a unique identification number (UID). It is used to get access to the system.

RFID Reader (MFRC522)

A device that reads the data stored inside the RFID card and sends it to the Arduino.

UID (Unique Identification Number)

A unique number stored inside every RFID card. It is used to identify authorized users.

Arduino

A microcontroller board used to control and manage all the components in the project.

Microcontroller

A small programmable electronic device that controls hardware components based on the written program.

Servo Motor

A motor used to rotate the lock mechanism to open or close the door.

LCD (Liquid Crystal Display)

A display screen used to show messages like “Scan Card”, “Access Granted”, or “Access Denied”.

I2C Module

A communication module used to connect the LCD to Arduino using fewer wires.

SPI (Serial Peripheral Interface)

A communication protocol used for data transfer between Arduino and the RFID module.

Embedded System

A combination of hardware and software designed to perform a specific task.

Access Control System

A security system that allows only authorized users to enter a restricted area.

Authentication

The process of verifying whether a user is authorized or not.