# RFID Door Lock System

Shorya Kumar
*shorya22101@iiitnr.edu.in*
*221010244*
*ECE*

Aditya Raj
*aditya22101@iiitnr.edu.in*
*221010203*
*ECE*

Amritanshu Yadav
*amritanshu22101@iiitnr.edu.in*
*221010208*
*ECE*

*Abstract*—**The RFID door lock system project aims to develop an advanced access control mechanism using RFID technology. To utilize RFID tags and readers, the system provides enhanced security, convenience, and efficient access control. The system features real-time access monitoring, customizable access privileges, and remote administration. It eliminates the need for physical keys, reduces the risk of unauthorized access, and enables seamless and contactless entry. The project provides some unauthentic action by beeping buzzer. The RFID door lock system offers improved safety.**

## I. INTRODUCTION

RFID technology utilizes electromagnetic fields to automatically identify and track tags attached to Ras-pi and Servo motor. These tags contain unique identifiers that can be read wirelessly by RFID readers. By incorporating RFID technology into door lock systems, it becomes possible to enhance security, streamline access control processes, and improve overall convenience.

Traditional lock systems that rely on physical keys have inherent limitations, including the risk of lost or stolen keys, difficulty in managing access privileges, and the inability to track entry and exit activities in real-time. To overcome these challenges, the use of Radio Frequency Identification (RFID) technology has gained significant attention in the field of access control uses of gpio extension board and ribbon cable make easy to hold raspberry.[1]

One of the key advantages of the RFID door lock system is its ability to offer seamless and contactless entry. Users can simply approach the door equipped with the RFID reader, and upon successful authentication, the door lock mechanism is activated, granting access without the need for physical keys or manual intervention. This contactless approach not only enhances convenience for users but also reduces the risk of transmitting germs or pathogens, making it particularly relevant in the context of public health and hygiene.

To ensure the integrity and confidentiality of data exchanged between the RFID reader and the electronic door lock, the system incorporates robust encryption algorithms. This prevents unauthorized interception or manipulation of communication, adding an additional layer of security to the system.

On authorized action the buzzer will beep 3 times and continuously using 5 times the lock is permanently get locked.

In summary, the RFID door lock system project aims to leverage RFID technology to overcome the limitations of traditional lock systems. By incorporating advanced features such as real-time access monitoring, customizable access privileges, and robust security measures, the system offers an efficient and reliable solution for enhancing security and access control in a wide range of environments.

## II. RELATED WORKS

RFID (Radio Frequency Identification) door lock systems offer a secure and convenient method of access control. They utilize RFID technology to authenticate individuals and grant or deny access to a specific area or facility. Here are some applications of RFID door lock systems:

1. Residential Security: RFID door lock systems can be installed in homes, apartments, or gated communities to provide secure access control. Residents can use RFID cards or key fobs to unlock doors, eliminating the need for traditional keys. This system offers convenience and eliminates the risk of unauthorized key duplication.

2. Commercial Buildings: In office buildings, coworking spaces, or industrial complexes, RFID door lock systems can be used to regulate access to different areas within the premises. Employees can use their RFID cards or badges to gain entry into authorized zones, such as offices, conference rooms, or restricted areas.

3. Educational Institutions: RFID door lock systems are beneficial in schools, colleges, and universities. They can control access to classrooms, laboratories, dormitories, and other restricted areas. Staff, students, and authorized personnel can use RFID cards or student IDs to gain access, enhancing security and preventing unauthorized entry.

4. Healthcare Facilities: RFID door lock systems find applications in hospitals, clinics, and healthcare facilities to secure sensitive areas like operating rooms, drug storage areas, and medical supply rooms. Access can be granted to authorized personnel only, preventing unauthorized individuals from entering critical areas.

5. Government and Military Installations: Government offices, military bases, and sensitive government facilities require stringent access control. RFID door lock systems can be implemented to control entry into restricted areas, ensuring that only authorized personnel with proper clearance can access sensitive information or resources.

6. Hospitality Industry: Hotels and resorts can benefit from RFID door lock systems to streamline guest access. RFID key cards can be issued to guests, allowing them to unlock their rooms and access hotel facilities such as pools, fitness centers, and business centers.

7. Data Centers: Data centers store critical and confidential information. RFID door lock systems can enhance security by allowing only authorized personnel to enter the data center premises. This prevents unauthorized access to servers, networking equipment, and other sensitive resources.

8. Retail Stores: In retail environments, RFID door lock systems can secure stockrooms, inventory storage areas, and other restricted spaces. Authorized staff members can use their RFID cards or badges to gain access, preventing theft, and improving inventory management.

Overall, RFID door lock systems provide an efficient and secure means of access control across various sectors. They offer convenience, enhance security, and provide an audit trail of access events, making them a popular choice for organizations looking to manage and regulate access to their premises effectively.

## III. LITERATURE SURVEY

RFID Technology: Explore literature that provides an overview of RFID technology, its working principles, different RFID tag types (passive, active, etc.), frequencies, and communication protocols. Understand the advantages, limitations, and applications of RFID technology.

RFID in Access Control Systems: Investigate how RFID technology is used in access control systems, particularly in door lock applications. Look for studies that discuss the integration of RFID readers, tags, and backend systems to enable secure access control.

RFID Door Lock Systems: Examine literature on RFID-based door lock systems specifically. Identify different design approaches, architectures, and components used in such systems. Understand the various security mechanisms, authentication methods, and encryption techniques employed in RFID door lock systems. System Implementation and Integration: Look for case studies or research papers that describe the implementation and integration of RFID door lock systems. Gain insights into the hardware setup, software development, and integration challenges faced in real-world scenarios.

User Experience and Acceptance: Explore studies that evaluate user experiences, perceptions, and acceptance of RFID door lock systems. Understand user feedback, concerns, and suggestions related to usability, security, and convenience aspects. Security and Vulnerability Analysis: Investigate research that discusses security vulnerabilities, threats, and countermeasures associated with RFID-based access control systems. Identify studies that propose enhancements to mitigate potential risks and attacks.

Comparative Analysis and Best Practices: Look for comparative studies that evaluate different RFID door lock system designs, technologies, or implementation approaches. Identify best practices, recommendations, and lessons learned from existing projects to inform your own system development.

## IV. DESIGN AND WORKING PRINCIPLE

RFID technology utilizes electromagnetic fields to automatically identify and track tags attached to Ras-pi and Servo motor. These tags contain unique identifiers that can be read wirelessly by RFID readers. By incorporating RFID technology into door lock systems, it becomes possible to

| Parts | Quantity |
|---|---|
| Raspberry Pi | 1 |
| GPIO Extension | 1 |
| LCD Display | 1 |
| I2C Module | 1 |
| RFID Card | 1 |
| RFID Module | 1 |
| Servo Motor | 1 |
| Buzzer | 1 |

enhance security, streamline access control processes, and improve overall convenience.

## V. IMPLEMENTATION

Firstly, identify these components. Secondly, connect the GPIO Extension board to the breadboard. And then, connect the GPIO ribbon cable to the extension board. Thirdly, connect the RFID module to the GPIO extension board. For that, use the circuit diagram below. Next, place the buzzer on the breadboard. And then, connect it to the extension board. Also, connect the LCD and relay module to the extension board. Please use the circuit diagram above. Now, connect the keyboard, mouse, monitor, ethernet cable, and SD card(OS installed) to the Raspberry Pi board. Then, connect the GPIO ribbon cable to the Raspberry Pi board and provide a power supply to the board. Ok, now let's install the RFID library into Raspberry Pi OS. Follow the instructions below for that. First, open the terminal and run the following commands one by one. At this point, the Raspberry Pi board must be connected to the Internet.[1]

1. sudo apt install python3-dev python3-pip

2. sudo pip3 install spidev

3. sudo pip3 install mfrc522

OK, the RFID library is ready for this project. Now, enable I2C and SPI communication. Because the LCD screen and RFID module required these communication methods. If you want to know whether I2C is working or not, run the following code on the terminal. Then, we can see the I2C address. i2cdetect -y 1; Now let's create the python script for this project. Follow the below steps for that. First, let's get the RFID tag ID. For that, copy and paste the following program on the Thonny IDE. Then, save this script and click the run button.

No need to install I2C library. It is included in the file above. But keep these scripts in one folder. Now, place the RFID tag on the RFID reader. Then, we can see the tag ID on the LCD screen and shell. And then, copy and paste this ID to the main python script. Finally, the RFID Door Lock System is ready.

## VI. PROPOSED ARCHITECTURE

Raspberry Pi: The Raspberry Pi is a series of small single-board computers developed by the Raspberry Pi Foundation. It is designed to promote basic computer science education and provide an affordable platform for various projects. Raspberry Pi boards are credit card-sized and feature a processor, memory, input/output pins, and various connectivity options. They can be used for a wide range of applications, such as programming, robotics, home automation, media centers, and more.[2]

An LCD display, or Liquid Crystal Display, is a type of flat-panel display technology commonly used in electronic devices such as televisions, computer monitors, smartphones, tablets, and various other devices. LCDs work by manipulating the properties of liquid crystals, which are materials that have the ability to control the passage of light. The display consists of multiple layers, including a backlight, a layer of liquid crystals, and a grid of electrodes. When an electric current is applied to the electrodes, it affects the orientation of the liquid crystals, which in turn determines the amount of light that can pass through. By selectively controlling the orientation of the liquid crystals, different colors and shades can be produced, resulting in the display of images and text.[3]

I2C, which stands for Inter-Integrated Circuit, is a popular serial communication protocol used to connect and communicate between electronic devices. It was developed by Philips (now NXP Semiconductors) in the 1980s and has since become a widely adopted standard in the electronics

industry.I2C is a multi-master, multi-slave protocol, which means multiple devices can communicate on the same bus. It uses two wires for communication: SDA (Serial Data Line): This bidirectional line carries the actual data between devices.[3]

SCL (Serial Clock Line): This line carries the clock signal, which synchronizes the data transfer between devices.

RFID Tags: RFID tags are small electronic devices that contain a microchip and an antenna. They come in various forms, such as cards, labels, or embedded in objects. Each tag has a unique identifier, which can be read wirelessly by an RFID reader. RFID Readers: RFID readers are devices equipped with antennas that emit radio waves and receive signals from nearby RFID tags. They communicate with the tags by sending radio frequency signals and capturing the responses. Readers can be fixed or handheld, and they can be connected to a computer or integrated into a system. Radio Communication: When an RFID tag comes into the range of an RFID reader, it receives the reader's radio waves and powers up. The tag then sends back a response that contains its unique identifier and, depending on the type of tag, additional data such as sensor readings or product information. Data Processing: The RFID reader captures the response from the tag and forwards the information to a backend system for processing. This system can store the data, perform real-time analysis, trigger actions based on the received information, or integrate it with other systems.

Servo motors offer several advantages:

Precise Control: Servo motors can accurately control the position, speed, and acceleration of the motor shaft, making them suitable for applications that require precise motion control.

Compact Size: Servo motors are often compact and lightweight, making them ideal for applications where space is limited. Easy to Use: Servo motors are relatively easy to integrate and control. They typically operate on standard voltage levels and can be controlled with simple PWM signals. Wide Range of Sizes and Torque Ratings: Servo motors come in various sizes and torque ratings, allowing them to be used in a wide range of applications, from small hobby projects to industrial automation. Servo motors are commonly used in applications such as robotic arms, CNC machines, camera gimbals, model airplanes, RC (radio-controlled) vehicles, and many other systems that require precise control of movement and position.
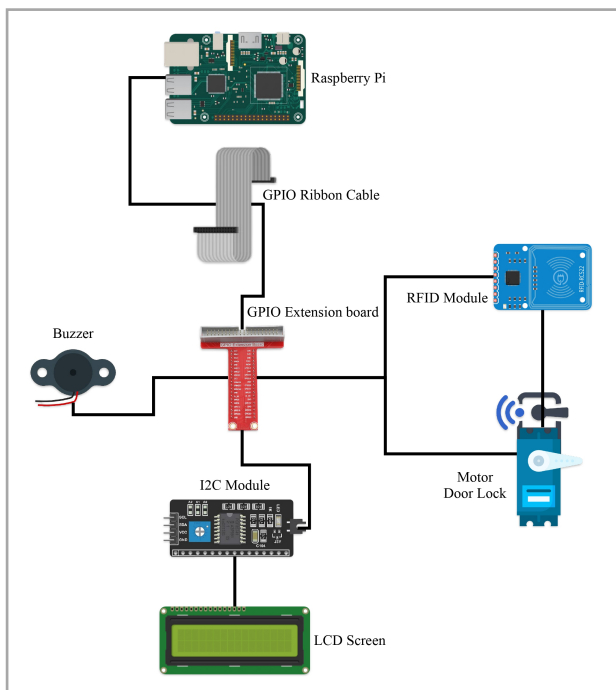


## VII. CONCLUSIONS AND FUTURE SCOPE

In conclusion, the alarm circuit plays a crucial role in various applications where timely detection and notification of triggering events are paramount. By integrating sensors, signal processing components, and alarm outputs, the alarm circuit effectively detects specific events and generates audible or visual alarm signals to alert users or relevant monitoring systems. Its versatility and adaptability make it a valuable component in a wide range of environments, including residential, commercial, industrial, and public settings.

The alarm circuit offers several advantages, including enhanced safety, security, and early warning capabilities. Its ability to quickly detect and respond to events such as motion, temperature changes, or environmental hazards can help prevent accidents, deter intruders, and mitigate potential risks. Additionally, the alarm circuit's customization options allow it to be tailored to specific requirements, ensuring optimal performance and reliability in different applications.

Designing and implementing an alarm circuit requires careful consideration of the application's unique needs. It involves selecting appropriate sensors, designing the circuit layout, and incorporating signal processing components to ensure accurate event detection and minimize false alarms. Prototyping, testing, and compliance with safety standards are essential steps in the development process to ensure the alarm circuit's functionality and reliability.

Looking ahead, there are several areas in which the development and application of alarm circuits can be further explored. Advanced sensor integration, such as incorporating advanced motion sensors, environmental sensors, or specialized detectors, can expand the range of events or hazards that the alarm circuit can detect. Wireless connectivity and integration with IoT platforms can enable remote monitoring, control, and notification capabilities, enhancing the overall functionality and accessibility of the system.

The application of machine learning and AI-based algorithms can enhance the alarm circuit's capabilities in differentiating between normal and abnormal events, reducing false alarms, and improving accuracy. Additionally, exploring energy-efficient design techniques, integrating with smart home or building automation systems, and developing user-friendly interfaces can contribute to more sustainable, integrated, and user-centric alarm circuit solutions.

As technology continues to advance, the scope for alarm circuits is poised to expand further. Continued research and development efforts in this field will lead to more advanced and sophisticated alarm circuit solutions that cater to the evolving needs of different industries and applications, ultimately enhancing safety, security, and peace of mind for individuals and organizations alike.

## VIII. REFERENCES

1. https://srituhobby.com/how-to-make-an-rfid-door-lock-system-with-raspberry-pi-board/

2. https://www.circuitbasics.com/raspberry-pi-lcd-set-up-and-programming-in-python/

3. https://www.google.com/url?sa=t&source=web&rct=j&url=https://microdigisoft.com/interfacing-16x2-lcd-display-using-i2c-module-with-raspberry-pi/&ved=2ahUKEwiu7dfG--f_AhWFWGwGHZ0oDv0Qo7QBegQIBhAB&usg=AOvVaw3pbM9TZ-WjuDhZCTm6EG7y