

Intelligent RFID-Enabled Door Security System for Enhanced Protection

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Abstract

In today's technology-driven world, there is an increasing demand for systems that combine convenience with strong security and efficiency. The Integrated Smart Door Sensor System is an advanced solution that uses RFID technology along with intelligent monitoring to secure residential and commercial spaces. By allowing access only to authorized users, it overcomes the limitations of traditional locking systems. In addition to access control, the system employs sensors and smart algorithms to identify security threats such as unauthorized entry, forced access, and unusual activity near the door. When such events occur, it instantly sends real-time alerts to owners or security personnel, enabling quick action. This system meets the need for modern, adaptive security by providing enhanced protection along with a reliable and easy-to-use method for managing access.

Keywords: RFID-based Access Control, Smart Door Security System, Intelligent Threat Detection, Real-time Alerts, Unauthorized Access Prevention, Automated Security Solutions

1. Introduction

The RFID-enabled door locking system is an advanced security solution designed to provide improved protection, user convenience, and effective access management across residential, commercial, and industrial settings. It integrates Radio Frequency Identification (RFID) technology with GSM communication and a microcontroller to enable intelligent and dependable control of door access.

The system is built around the Arduino Uno microcontroller, which acts as the main control unit. It coordinates the functioning of various components such as the RFID reader, GSM module, LCD display, buzzer, and a DC motor that operates the locking mechanism. When a user places an RFID card or tag near the reader, the embedded unique identification code is

captured and transmitted to the Arduino. This code is then verified against a stored list of authorized IDs.

If the identification matches, the system activates the DC motor to unlock the door and displays a confirmation message on the LCD screen. In contrast, if the access attempt is unauthorized, the door remains locked, and the buzzer can be triggered to signal an alert. The buzzer may also be configured to respond to repeated failed attempts or emergency conditions.

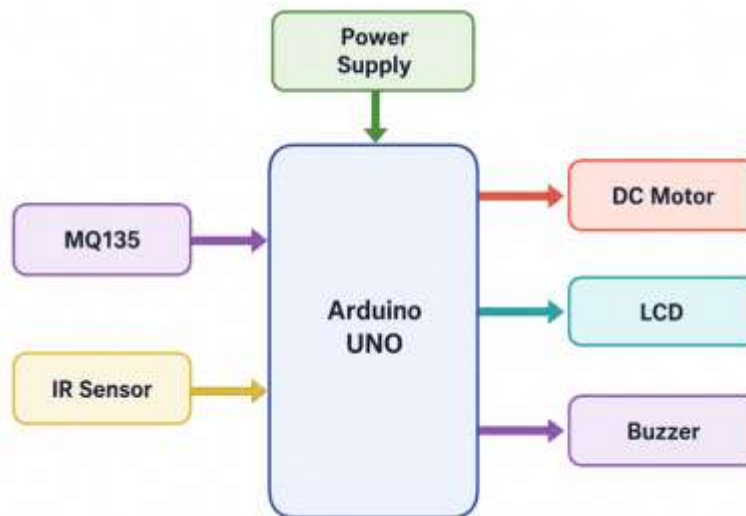


Figure 1: Block diagram

2. RFID

Radio Frequency Identification (RFID) is a wireless technology used to identify and track objects, people, or animals through radio waves. A typical RFID system consists of three main components: an RFID tag (transponder), an RFID reader (interrogator), and a backend system for processing the collected data. The RFID tag contains a microchip and an antenna that stores a unique identification number and transmits it to the reader. Unlike barcode systems that require direct visibility, RFID can detect multiple tags simultaneously without line-of-sight, making it faster and more efficient. This feature makes RFID highly suitable for applications such as retail, inventory management, and asset tracking. Each tag carries a unique ID, ensuring precise identification of items or individuals.

In access control applications, RFID is widely used to allow entry only to authorized users, often through RFID-enabled ID cards. It is also extensively used in logistics and supply

chain management to monitor goods in real time. RFID tags are classified into passive tags, which rely on the reader's signal for power, and active tags, which have an internal power source for longer communication range. Continuous improvements have enhanced RFID's reliability, cost-effectiveness, and versatility across industries.

3. Existing System

Conventional lock-and-key mechanisms have been widely used as a basic means of securing homes and workplaces. They operate using physical keys designed to fit specific locks, making them simple and cost-effective. Despite their popularity, these systems have notable drawbacks. If keys are lost or stolen, they can be duplicated easily, increasing the risk of unauthorized access. Managing multiple keys can also be inconvenient and confusing for users.

In addition, traditional locking systems offer limited flexibility, as modifying or revoking access permissions is not straightforward. They are also vulnerable to tampering techniques and forced entry, which reduces their effectiveness in protecting valuable assets. With growing concerns about safety and security, many users are shifting toward smart locking solutions. These modern systems provide improved protection, better access control, and greater convenience compared to conventional locks.

4. Proposed Method

The RFID-based door locking system is a modern solution developed to overcome the drawbacks of traditional locking methods. It uses Radio Frequency Identification (RFID) technology to enable secure and efficient communication between RFID cards or tags and a reader. By eliminating the need for physical keys, the system offers a more reliable and user-friendly approach to access control. Its main objective is to improve security while simplifying access management and reducing the risk of unauthorized entry.

The system uses strong authentication techniques to ensure that only authorized users can access the door. This is achieved through secure data transfer and verification processes that confirm user identity. Along with enhanced security, the system improves convenience by removing the need to carry or manage physical keys. It also keeps real-time records of access activities, allowing administrators to monitor usage and control permissions effectively. Its

flexible design supports easy expansion, enabling the addition or removal of users and access rights as needed.

Compared to conventional locks, this system provides better security through reliable authentication and protected communication. It also offers greater flexibility, allowing quick updates or removal of access permissions. In addition, it reduces maintenance efforts such as rekeying or lock replacement, making it a cost-effective and practical solution for both residential and commercial applications.

5. Results and Discussion

When the system is powered on, it completes an initialization sequence and becomes ready to operate. During startup, all components—including the microcontroller, LCD display, RFID reader, GSM module, and servo motor—are activated and synchronized. After successful initialization, the LCD shows the registered mobile number to confirm proper startup. At the same time, an SMS is sent to the authorized user, indicating that the RFID-based door locking system is active. The system then enters standby mode, waiting to detect RFID tags.

Successful Authentication: When a registered RFID card is placed near the reader, the system quickly reads and verifies the tag's unique ID against its stored database. If the ID matches, access is granted. The LCD displays a message such as "Valid card open," confirming authorization. Simultaneously, the servo motor is triggered to unlock the door, allowing entry. An SMS notification is also sent to the registered mobile number, informing the user that authorized access has occurred. This ensures both convenience and continuous monitoring of entry events.

Unsuccessful Authentication: If an unregistered or invalid RFID card is detected, the system immediately denies access. The LCD displays "Invalid" to indicate rejection. At the same time, the buzzer is activated to alert the user. Additionally, an SMS is sent to the registered mobile number, notifying the user of the failed access attempt. This immediate response ensures that unauthorized activities are quickly identified and addressed.

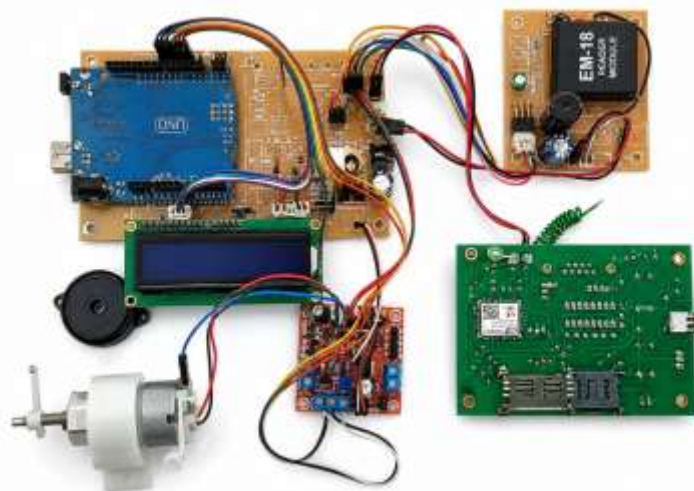


Figure 2: Experimental Setup

6. Conclusion

The RFID-based door locking system combined with GSM technology provides a modern and efficient solution for access control. By integrating RFID with GSM communication, the system ensures enhanced security, user convenience, and flexible operation. It permits entry only to authorized users through dependable authentication methods while enabling real-time monitoring for continuous supervision. The system can also quickly detect and respond to unauthorized access attempts, improving overall safety.

Its modular and scalable structure allows it to be used in various environments such as homes, offices, industries, and other secure areas. The system is easy to use and can be expanded or upgraded with additional security features when required. With its reliable performance, simple integration, and instant alert capabilities, it serves as an effective solution for improving security and protecting valuable assets and premises.

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