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RFID Based Solenoid Door Lock Using Arduino

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ABSTRACT :

This paper presents the design and implementation of an RFID-based solenoid door lock system using an Arduino microcontroller. The system integrates Radio Frequency Identification (RFID) technology with a solenoid locking mechanism to provide a secure and efficient access control solution. The core idea behind the system is to use an RFID reader to scan unique tags, which are linked to authorized users. When a valid RFID tag is detected, the Arduino verifies the identity and activates the solenoid lock, allowing the door to open. Unauthorized tags are rejected, ensuring security.The proposed system is built using an Arduino Uno as the central controller, which communicates with the RC522 RFID reader for identification and the solenoid lock for access control. The RFID tags store unique identification data, and only authorized tags, stored in the Arduino's memory, can open the door. The system is highly customizable, allowing the addition or removal of authorized tags through a user-friendly interface. This solution is cost-effective, easy to implement, and scalable for use in various applications, such as residential and office security systems. The paper discusses the system's design, implementation, and performance evaluation, demonstrating that this RFID-based approach provides a reliable and efficient security mechanism for modern access control needs.

INTRODUCTION

With the increasing demand for automated security systems, access control technologies have evolved significantly, offering enhanced convenience, efficiency, and security. Among these technologies, Radio Frequency Identification (RFID) has gained popularity due to its contactless nature and ease of integration with microcontroller systems. The RFID-based solenoid door lock system presented in this paper leverages RFID technology along with the Arduino microcontroller to create a robust, reliable, and cost-effective solution for door access control. Access control is a critical aspect of modern security systems, whether in residential, commercial, or industrial environments. Traditional mechanical locks have several limitations, such as the risk of lost keys, unauthorized duplication, and vulnerability to physical tampering. In contrast, RFID-based systems provide a higher level of security and convenience by allowing authorized users to gain access with just a swipe of a card or tag.

The Arduino platform is widely known for its ease of use, flexibility, and low cost, making it an ideal choice for building prototype systems like the RFID-based solenoid door lock. This system utilizes an RFID reader (RC522) to detect RFID tags and relay the tag's unique identifier to the Arduino. If the tag matches an authorized entry in the stored list, the Arduino sends a signal to a solenoid lock, disengaging it and allowing the door to open.

This paper aims to explore the design, development, and implementation of an RFID-based solenoid door lock using Arduino, focusing on its advantages over traditional lock-and-key systems. Furthermore, the study highlights the flexibility of this system in terms of scalability and potential applications in various fields, including smart homes, offices, and secure facilities. The proposed solution is both easy to install and maintain, offering a user-friendly interface for managing access credentials and ensuring an efficient, secure locking mechanism.

RELATED WORK

Several researchers have developed RFID-based door lock systems using Arduino and other microcontrollers. Some projects used GSM modules for SMS alerts (Kumar & Sharma, 2019), while others combined RFID with fingerprint sensors for added security (Joshi & Mehta, 2020). IoT-based systems with remote monitoring via NodeMCU were also explored (Verma et al., 2021). These works highlight the effectiveness of RFID for secure, contactless access control. Our project builds on these concepts with a simple, low-cost solenoid lock system using Arduino.

METHODOLOGY

The proposed RFID-based solenoid door lock system is developed using an Arduino microcontroller, an EM-18 RFID reader, and a solenoid lock. The RFID reader continuously scans for RFID tags within its range. When a tag is brought near, it reads the unique identification number (UID) from the tag and sends it to the Arduino via serial communication.

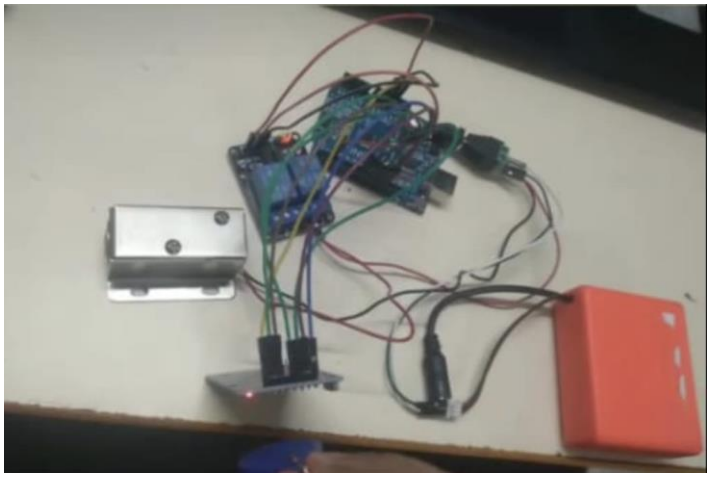
The Arduino is programmed with a set of authorized UIDs. It compares the scanned UID with the stored ones. If the UID matches any of the authorized entries, the Arduino activates a relay module connected to a 12V solenoid lock. This energizes the solenoid and unlocks the door for a short duration,

typically 5 seconds, after which the lock is deactivated automatically to secure the door again. If the UID does not match, the system denies access, and the lock remains in the closed position. For feedback, an LED or buzzer can be used to indicate successful or failed access attempts.
The system is powered using a 12V adapter, which supplies power to both the solenoid and the Arduino through appropriate voltage regulation. This method ensures secure, contactless access control suitable for homes, offices, and other private areas.

EXPERIMENTS

Result

This experiment demonstrates a secure door lock system using RFID and Arduino.



When an RFID tag is scanned by the EM-18 reader, its unique ID is sent to the Arduino. If the ID matches a pre-stored authorized ID, the Arduino activates a relay, which powers the solenoid lock and unlocks the door for a few seconds. If the ID is not recognized, access is denied. The system uses a 12V power supply for the solenoid and provides a simple, contactless, and reliable access control solution.

CONCLUSION

The RFID-based solenoid door lock system using Arduino was successfully designed and implemented. It provides a simple, low-cost, and reliable solution for secure access control. The use of RFID technology ensures contactless identification, while the Arduino microcontroller efficiently manages authentication and lock control. The system accurately allows access to authorized users and denies entry to unauthorized ones. Overall, the project demonstrates an effective method to enhance security in homes, offices, and restricted areas.

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