JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

RFID based Door Unlock System

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ABSTRACT

With the rising interest in security, frameworks with high reliability and fast response times have become critical for industries and enterprises. Radio-frequency identification (RFID) is emerging as a significant future technology, garnering substantial attention from the scientific community and various industrial sectors. In this work, an RFID-based door access control system utilizing Arduino has been developed. This system employs RFID ID tags and an RFID reader to match the data on the tag with the data in a database program. The verification process determines whether the data is correct or incorrect, which subsequently controls the movement of the door. A servo motor, receiving signals from the Arduino board, is used to open the door. The door's operation is based on a flag set by the Arduino's response; when the flag is set to 1, the door opens, and when set to 0, the door remains closed. Additionally, an LED indicator, also controlled by the Arduino board, provides visual feedback on the door's status. This integration of RFID technology with Arduino ensures a secure and efficient access control system suitable for various applications.

I. INTRODUCTION

With cutting-edge innovation, unique access control systems have become essential to mitigate security threats to various organizations. Access control systems restrict access to a property, structure, or space to authorized individuals. In the field of information and privacy security, door access control systems play a crucial role in protecting organizations. In our interconnected world, where data can be accessed globally, the risk of data breaches and hacking has become a significant concern. Consequently, having a form of personal identification (ID) to access sensitive data is imperative. Security access systems are particularly useful for homes, offices, and commercial buildings.

Over the years, various systems have been introduced to track individual movements. Among common personal ID methods, password and ID card techniques are the most prevalent. However, passwords can be easily hacked, and ID cards can be lost, making these methods unreliable. With technological advancements, the focus on system security has become a major concern for various organizations, leading to the adoption of advanced locks as a critical component of security systems. Numerous types of security systems are now available to safeguard our premises. These advanced systems not only enhance security but also provide convenience and peace of mind by ensuring that only authorized individuals can gain access to secure areas.

II. LITERATURE SURVEY

The literature on RFID door unlock systems encompasses a range of topics, from the fundamentals of RFID technology to its applications and security considerations. Works such as Klaus Finkenzeller's "RFID Handbook" provide comprehensive insights into the workings of RFID systems and their diverse applications, including access control. Security aspects are addressed in publications like "Security and Privacy in RFID and Applications" by Paris Kitsos and Yan Zhang, which delve into the challenges and solutions related to safeguarding RFID systems from unauthorized access and data breaches. Additionally, research articles and academic papers often explore specific aspects of RFID door unlock systems, such as their integration with smart home technologies or their usability in industrial environments, contributing to a rich body of literature that informs the development and deployment of these systems.

III. PROBLEM FORMULATION

The problem formulation involves designing an RFID door unlock system that effectively addresses key challenges in access control. The primary objective is to ensure efficient and secure entry while accommodating scalability, integration with existing infrastructure, usability, reliability, and cost-effectiveness. This entails thorough requirement analysis to understand the specific access control needs of the environment. Subsequently, a comprehensive system architecture is developed, outlining the hardware components, software modules, and communication protocols required. Careful selection of RFID readers, tags, microcontrollers, and actuators is crucial to meet system requirements. Software development involves coding for RFID tag detection, data verification, access control logic, and database communication. Rigorous testing and validation procedures are conducted to ensure the system's functionality, security, and reliability under various conditions. Ultimately, the goal is to create an RFID door unlock system that enhances security and access control while providing a seamless user experience and minimizing implementation costs.

IV. METHODOLOGY

The methodology section describes the design and implementation of the RFID door lock system using an Arduino Uno microcontroller. The system consists of hardware and software components. The hardware components include an Arduino Uno, an RFID module, a relay module, a Servo motor, some jumper wires, a buzzer, a solenoid door lock, and an adapter. The software components include a program for interfacing the fingerprint sensor with Arduino. The system was designed and implemented using the Arduino software, and the programming language used was C.

V. NEED FOR A RFID DOOR UNLOCK SYSTEM

The need for an RFID door unlock system is driven by the demand for enhanced security, convenience, and efficiency in access control. RFID systems offer quick, contactless entry, reducing the risk of unauthorized access and eliminating the issues associated with lost keys or forgotten passwords. They are user-friendly, easily scalable, and can be integrated with other smart systems for comprehensive automation. Additionally, RFID systems provide real-time monitoring and centralized control, ensuring a high level of security while minimizing maintenance costs and human error. This technology is adaptable to various environments, making it an ideal solution for both residential and commercial settings.

VI. SYSTEM DESIGN

A. Arduino UNO

The Arduino UNO is the best board for electronics and coding. In the beginning with the platform, this UNO is the most robust board that can be started playing with. The UNO is the most used and documented board of the whole Arduino family. This microcontroller is the central processing unit of the system. It controls all the other components and processes data.

B. RFID Module

RFID is contracted as Radio Frequency Identification. It makes a remote correspondence and empowers information to move between the RFID tag and the RFID reader. This module can read and compose information without direct contact. The RFID label comprises kilobytes of rich data in it. The RFID reader is a functioning segment. The RFID tag, then again, is a detached segment that is situated on the item we need to distinguish. It has an antenna attached to a microchip. So as we place the tag near the scope of the RFID reader then some voltage is created in the reception apparatus curl and voltage acts as power. In our work, we have utilized RC522 MODULE to get to the door control framework

C. Solenoid Door Lock

The Solenoid Lock is a compact and powerful locking mechanism designed for various applications that require secure access control. It operates at 12V DC and consumes 18W of power, making it suitable for a range of electronic locking systems. This solenoid lock is known for its reliability, durability, and efficient performance. It features a solenoid coil that, when energized, generates a magnetic field, allowing the lock to engage or disengage. The lock mechanism is designed to securely hold or release a latch or bolt, providing a reliable locking and unlocking mechanism.

D. Servo Motor

A servomotor controls the angular position, speed, and acceleration. It comprises a reasonable engine coupled to a sensor for position feedback. Servomotors have various applications in the fields of mechanical autonomy, computerized production, and so on. The engine in our work is to open and close the door consequently when the RFID per user recognizes the RFID tag of the client.

E. Jumper Wire

A jump wire is an electrical wire, or a group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. The overall design of the system is explained through the block diagram shown below. It describes all the components needed to implement a system. Figure 1 shows the block diagram of Obstacle obstacle-avoiding voice-controlled system.

F. Buzzer

It is a two-pin device that gives sound components to our work. The piezo signal produces sound dependent on the switch of the piezoelectric impact. In our work, we have utilized a buzzer.

G. Buzzer

The program can be written in a programming language for a compiler to produce binary code. This code editor has salient features like syntax highlighting. It provides one-click mechanisms to compile and upload programs to an Arduino board. Our undertaking gives the Arduino incorporated advancement condition (IDE), which is a cross-stage application written in the programming language C. It has begun from the IDE for the dialects Handling and Wiring.

VII. WORKING

The working principle of the RFID door unlock system begins with the deployment of RFID tags assigned to authorized individuals. Each RFID tag contains unique identification data stored in its memory. As an individual approaches the door, their RFID tag comes within the range of the RFID reader. The RFID reader emits radio waves, powering the RFID tag and prompting it to transmit its data back to the reader. The reader then verifies the tag's data against the stored database of authorized users. If the data matches, the system triggers the door unlocking mechanism, typically a servo motor, to open the door. Simultaneously,

visual indicators such as LEDs may illuminate, and an audible alert like a buzzer may sound to signify successful access. Conversely, if the tag's data does not match or is not found in the database, access is denied, and the door remains locked. The system logs access attempts, recording timestamps and user identifiers for security monitoring and audit purposes. This process ensures efficient and secure access control, streamlining entry for authorized individuals while maintaining robust security measures against unauthorized access.

VII. CONCLUSIONS

In conclusion, RFID-based security and access control frameworks represent a significant advancement in modern security solutions. These systems offer superior speed, efficiency, and security compared to traditional biometric methods, thanks to their contactless communication and ability to operate without a direct line of sight. The integration of Arduino technology enhances their accessibility, customization, and reliability, making them adaptable to various needs and environments. By reducing human effort and error, and enabling the simultaneous reading of multiple RFID tags, these frameworks ensure high operational efficiency. As a result, RFID technology provides a robust and innovative approach to safeguarding sensitive areas and information, proving to be an indispensable tool in the realm of security automation.

VIII. RESULT

RFID-based security and access control frameworks offer a rapid and highly secure solution compared to other biometric systems. They enable contactless communication and operate without requiring a direct line of sight. Utilizing Arduino, these systems become easily accessible and can function indefinitely. Users have the flexibility to modify functionalities within the Arduino code to tailor the system to their specific needs. The RFID control system significantly reduces human effort and errors. Moreover, it can read multiple RFID tags simultaneously, leading to high efficiency.

In summary, RFID-based systems are superior in speed and security, offering seamless, contactless access control. The integration with Arduino adds to their versatility and reliability, making them a valuable asset in modern security infrastructure.

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