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IoT based Smart RFID Door Lock System

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Abstract:

This paper presents an IoT-based RFID door lock system that enhances security and convenience by integrating RFID technology for authentication and IoT for remote access management. The system uses RFID cards for authorized access and allows users to control and monitor door locks via a mobile app, leveraging the ESP8266 microcontroller and IoT platforms like Blynk. It features real-time notifications, access logs, and configurable user permissions, making it ideal for residential and commercial use. The solution is cost-effective, scalable, and efficient, offering a smart alternative to traditional locking systems..

Index Terms –IoT (Internet of Things),RFID (Radio Frequency Identification),Access Control, Smart Door Lock Microcontroller (ESP8266), Blynk App, Relay Module, Security Systems, Wireless Communication, Embedded Systems, Automation, Sensor Technology, Remote Monitoring, User Authentication, Buzzer Indication Electronic Locking Systems, IoT-based Security Solutions.

I. INTRODUCTION

In today's digital age, ensuring security in residential and commercial spaces is of paramount importance. Traditional locking mechanisms, while widely used, are susceptible to vulnerabilities such as key loss, duplication, and unauthorized access. To address these challenges, modern security systems are increasingly leveraging emerging technologies like the Internet of Things (IoT) and Radio Frequency Identification (RFID) to create smarter, more secure, and user-friendly solutions.

The IoT-based RFID door lock system combines the strengths of these technologies to provide a seamless and efficient access control mechanism. RFID technology offers a reliable and contactless method for identifying authorized users, while IoT integration allows for real-time monitoring, remote control, and enhanced functionality. By utilizing a microcontroller-based platform such as the ESP8266, this system bridges hardware and software to enable connectivity with cloud services and mobile applications.

This paper explores the design and implementation of an IoT-enabled RFID door lock system, detailing its hardware architecture, software development, and integration with IoT platforms like Blynk. The system not only enhances security but also introduces features such as remote access management, instant alerts for unauthorized attempts, and customizable user permissions. These capabilities make it suitable for various applications, ranging from smart homes to small-scale enterprises, where security and convenience are critical.

The introduction of this technology underscores the growing importance of smart security systems in today's interconnected world and highlights the potential for IoT to revolutionize traditional access control methods.

II. CONSTRUCTION

The construction of the accident prevention system for mountain roads involves assembling a device capable of detecting obstacles and vehicles in real time, using ultrasonic sensors and a microcontroller to trigger warning alerts. Below is an overview of the components and circuit assembly, as depicted in the provided image.

COMPONENTS AND ASSEMBLY

1. **Hardware Components:**
2. **Microcontroller: An ESP8266** microcontroller serves as the central processing unit, managing RFID data, controlling the locking mechanism, and connecting to the IoT platform
3. **RFID Reader: The MFRC522** module is used to detect RFID cards or tags and read their unique identification numbers.
4. **Relay Module: A relay** acts as a switch to control the door locking mechanism. It toggles the door's state between locked and unlocked based on authentication.
5. **Buzzer: An buzzer** provides audio feedback for authorized and unauthorized access attempts.
6. **Power Supply: A regulated power** source is used to power the microcontroller and other components.
7. **Connections:**
    - Connections in Short
    - 1. Microcontroller (ESP8266): Central unit connected to all components.
    - 2. RFID Reader (MFRC522):
    - SDA → D4 (ESP8266)
    - RST → D3 (ESP8266)
    - VCC → 3.3V (ESP8266)
    - GND → GND (ESP8266)
    - 3. Relay Module:
    - Input → D1 (ESP8266)
    - VCC → 3.3V (ESP8266)
    - GND → GND (ESP8266)
    - 4. Buzzer:
    - Positive → D2 (ESP8266)
    - Negative → GND (ESP8266)
    - 5. Power Supply:
    - Provides 3.3V to ESP8266 and connected components.
    - 6. Wi-Fi: ESP8266 connects to a network for IoT communication.
    - This setup enables RFID detection, relay control, and IoT functionality.

CIRCUIT CONSTRUTION

Circuit Construction

To construct the circuit for the IoT-based RFID door lock system, follow these steps:

1. Microcontroller (ESP8266):Use the ESP8266 as the central unit to connect all components.

2. RFID Reader (MFRC522):Connect the SDA pin of the RFID reader to D4 (GPIO2) on the ESP8266.Connect the RST pin to D3 (GPIO0) on the ESP8266.Connect the MOSI, MISO, and SCK pins to the corresponding SPI pins on the ESP8266.Power the RFID reader by connecting VCC to the ESP8266's 3.3V pin and GND to GND.

3. Relay Module: Connect the IN pin of the relay to D1 (GPIO5) on the ESP8266.Connect VCC to the ESP8266's 3.3V pin and GND to GND. Wire the relay's output terminals to the door lock mechanism.

4. Buzzer: Connect the positive pin of the buzzer to D2 (GPIO4) on the ESP8266.Connect the negative pin of the buzzer to the ESP8266's GND pin.

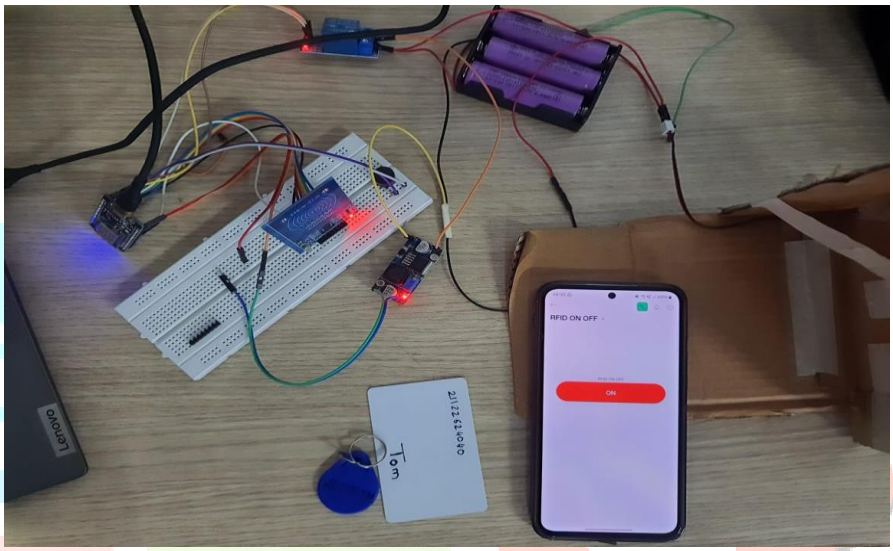
5. Power Supply: Use a regulated 5V power adapter to power the ESP8266 via its Vin pin and GND. Ensure that the 3.3V output pin is used to power the RFID reader and relay.

6. Wi-Fi Configuration: Set up the ESP8266 to connect to your Wi-Fi network for IoT functionality.

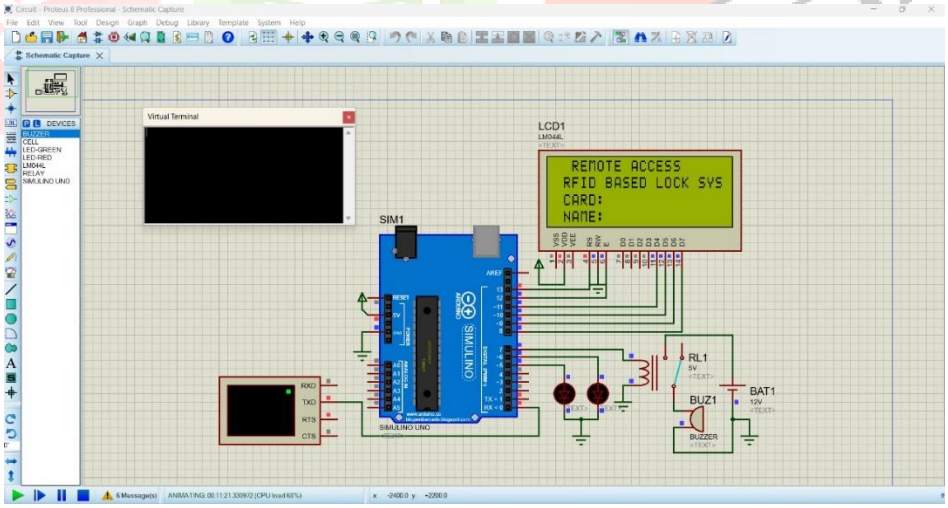
7. Door Lock Mechanism: Connect the relay module to an electronic door lock (e.g., solenoid lock) and ensure the lock is powered appropriately.

8. Integration and Testing: Upload the firmware to the ESP8266 using the Arduino IDE. Test the system by scanning RFID cards and monitoring responses on the Blynk app. Ensure all connections are secure and insulated to prevent short circuits. Use a breadboard for prototyping and a PCB for a permanent setup.

III. IC PIN DIAGRAM AND PIC



V. Circuit diagram (Proteus)



VI. Circuit working:

The RFID reader detects a card and sends its unique ID to the ESP8266 microcontroller. The ESP8266 compares the ID with a predefined list of authorized IDs. If the card is authorized, it activates the relay to unlock the door and signals success with a short buzzer beep. If unauthorized, the relay remains inactive, and the buzzer gives a long beep to indicate access denial. The system also allows remote control and monitoring through the IoT platform.

1. Sensor Operation

RFID Sensor Operation

The RFID sensor (MFRC522) emits a high-frequency signal to detect RFID cards or tags within its range. When a card is brought near the sensor, the signal is reflected back to the receiver, allowing the microcontroller (ESP8266) to read the unique ID of the card. The microcontroller compares this ID with the stored authorized IDs to determine if the cardholder is authorized to access the door.

2. Microcontroller Processing

The microcontroller (ESP8266) processes the data received from the RFID sensor. It checks the RFID card ID against a predefined list of authorized IDs.If the card ID matches an authorized entry, the microcontroller activates the relay to unlock the door.If the card ID does not match, access is denied, and the system sends an alert (through the buzzer).

3. Access Control System

The system uses the RFID sensor to grant or deny access to users:
Authorized Users: The relay is activated, unlocking the door. A short beep from the buzzer confirms the access granted.
Unauthorized Users: The relay remains off, and a long beep from the buzzer signals an access denial.

4. Remote Control via IoT

The system is integrated with an IoT platform (e.g., Blynk) to allow remote control and monitoring. Users can manually unlock or lock the door via a mobile app using a virtual button, adding an extra layer of control and convenience.

5. Power Supply and Circuit Control

The system is powered by a stable 5V power supply that powers the ESP8266 microcontroller, RFID sensor, relay module, and buzzer. This ensures reliable performance and smooth operation of the entire system, even with continuous usage.

6. LED and Buzzer Indication

- The buzzer provide auditory feedback to the user:
- Buzzer: Provides feedback for both successful and denied access (short beep for access granted, long beep for access denied)..

VII. Conclusion

The IoT-based RFID door lock system provides an efficient, secure, and user-friendly solution for access control. By integrating RFID technology with IoT capabilities, the system offers seamless authentication, remote monitoring, and real-time access management. Its compact design, low power consumption, and scalability make it ideal for residential and commercial applications. This smart locking system not only enhances security but also simplifies access control, demonstrating the potential of IoT in modern security systems. Future enhancements could include biometric integration, advanced encryption, and energy optimization for wider adoption.

VIII: References

[1] Here's an example of how you can format the references for your project based on common academic citation styles:

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