Task11.1 Project Artefact Report

The prototype report needs to outline your design approach, the architecture of your solution, and the working mechanism of the system. It also needs to present testing plans and any user manual to install and/or using your embedded solutions. A background and problem statement should be included for completeness, which can be modified from your project proposal.

Project Overview

Current industry practices for door lock systems face several challenges. The initial setup cost of RFID door lock systems, including hardware and installation, can be significant, posing a barrier for customers with limited budgets seeking a simple setup. Traditional key-based systems are still widely used but pose security risks such as key duplication and loss. Numeric keypad systems, which allow users to enter a code to gain access, eliminate the need for physical keys but may be easily accessed by unauthorized individuals. There are notable gaps and opportunities for improvement in embedded systems. One major opportunity is developing user-friendly interfaces for RFID door lock systems to enhance usability and accessibility. This can be achieved by incorporating features such as displays, sound alerts, and status indicators for seamless interaction and configuration. Additionally, there is a need to create cost-effective solutions by utilizing simpler, less expensive components and modernised designs that still works with ordinary lock, making these systems affordable for a wider range of customers. Advanced features such as IFTTT notifications can be integrated to send real-time alerts to users about access events and potential unauthorized attempts. Finally, ensuring compatibility with a variety of existing door lock mechanisms and facilitating easy installation and setup are crucial for widespread adoption.

Existing Work

In the course of developing this project, I have completed several foundational tasks that significantly contribute to the overall functionality and reliability of the RFID door lock system. One key achievement is setting up a simple IFTTT trigger, following the guide from Task 2.1P, to send notifications for various events such as door unlock, door lock, and door unlock failure attempts. Embedding this trigger into my project allowed me to effectively test and verify the notification mechanism, ensuring real-time updates for users. Additionally, I repurposed a simple LED light to indicate the door's status, providing immediate visual feedback on whether the door is locked or unlocked. This LED enhances user experience by offering a clear, visible status update and adds an extra layer of security, making it easy to ascertain the door's condition at a glance. These initial steps have laid a strong foundation for further development, enabling the integration of more advanced features and ensuring a robust and user-friendly RFID door lock system.

Requirements

The project must meet the following key requirements: it should be cost-effective, utilizing simpler and less expensive components without compromising functionality. The system must include user-friendly interfaces with intuitive displays, sound alerts, and status indicators for easy interaction and configuration. Advanced features such as real-time notifications via IFTTT services should be incorporated to alert users about access events and potential unauthorized attempts. Compatibility with various existing door lock mechanisms and easy installation processes are essential to ensure broad accessibility and usability.

Problem Statement

The primary problem addressed by this project is the high cost and complexity of existing RFID door lock systems, which pose a barrier to widespread adoption among budget-conscious customers. Additionally, the lack of user-friendly interfaces and advanced notification features in current solutions limits their accessibility and usability. This project aims to develop a cost-effective, user-friendly RFID door lock system that integrates advanced features such as real-time notifications and compatibility with various existing door lock mechanisms, ensuring easy installation and setup.

Design Principles

The design of the RFID door lock system follows several key principles: simplicity, cost-effectiveness, and user-friendliness. Simplicity is achieved through the use of streamlined designs and fewer components, reducing complexity and cost. The system is built with affordability in mind, using inexpensive yet reliable components. User-friendliness is a core focus, with intuitive interfaces and straightforward procedures to ensure that users with minimal technical knowledge can easily activate and configure the door lock. Features such as on-device displays provide immediate feedback, showing lock status and other relevant information directly at the door. Additionally, the system is designed to automatically recognize existing RFID cards or add new users, ensuring optimal performance without user intervention.

Prototype Architecture

The prototype architecture includes several key components: an Arduino board as the central processing unit managing system operations, an LCD1602 module to display information such as lock status and RFID card recognition, and an RC522 RFID module to read RFID cards and determine access permissions. A servo motor controls the locking mechanism by moving the sliding lock, which is attached to the motor using metal wire for mechanical operation. The physical locking mechanism secures the door, and a passive buzzer produces audible alerts for locking and unlocking events. RFID cards are used by individuals to gain access to the door, while jumper wires and resistors connect components and control current flow within the circuit. The IFTTT service sends notifications to designated recipients, enhancing the system's functionality.

Testing Approach

The testing approach for this project involved systematically setting up and verifying each essential component to ensure they functioned correctly. Initially, I planned to use an LCD for displaying status messages. However, this plan had to be modified when the LCD stopped working during the complete project setup. As a result, I relied solely on LED lights for visual indications, while using the serial monitor to prompt messages to the user. Additionally, I configured different tones and effects for the buzzer to align the sounds with the door's status, ensuring that each event had a distinct audible indication. Similarly, I ensured the LED lights provided clear, distinct signals for various events, such as door lock, unlock, and failed attempts. Finally, I experimented with different angles for the Micro Servo to optimize the locking and unlocking mechanism, ensuring the door operated efficiently. This thorough testing approach helped refine the system's functionality and reliability, addressing any issues encountered during the setup process.

User Manual

To set up the code, start by wiring the components according to the provided pinout map. Ensure all connections are secure. Download and install the RFID and I2C libraries in your Arduino IDE. Open the (UID\_scan.ino) file, compile, and upload it to your Arduino board to set up a new RFID card or tag. When you scan your card, the serial monitor will display the UID number, which you should save. Next, open either (RFID\_COMPLETE.ino) or (RFID\_COMPLETE\_LCD.ino), depending on whether you are using an LCD. Navigate to the "AUTHORISED CARD SECTION" in the code and replace the placeholder UID in the condition statements (e.g., if (ID.substring(1) == "B3 49 D4 24" && led1 == 0)) with your saved UID. If you want to authorize multiple RFID cards, repeat this step, duplicating the relevant code snippets and replacing them with the new UIDs.

For the lock setup, use the micro servo to measure the angle required for it to push and pull the lock, ensuring it fully locks and unlocks. Attach a metal wire around the lock handle, extending it to the micro servo and inserting it into the servo’s hole. Before securing the setup with screws or glue, test the mechanism to ensure it operates smoothly.

Conclusion

Overall, the project successfully achieved the vision I had and is working as intended. However, there were some challenges along the way, particularly with the LCD display, which failed to function as expected during the complete project setup. This issue prevented me from showcasing the fully intended project with the LCD display. Despite this setback, I have included the code for the LCD functionality so that users can test it if they have a working LCD module. Reflecting on the project, if given a second chance, I would create an actual mini door to better demonstrate the system's look and functionality from the user's perspective. This addition would provide a more realistic and perceptible presentation, enhancing the overall demonstration. In conclusion, while the project encountered some hurdles, it fulfilled its primary goals and provided valuable insights for a more secure door.