Project Report for EE321 Microprocessors

Aden Duru Çelik -Barış Andiç
duru.celik@ozu.edu.tr-baris.andic@ozu.edu.tr

Department of Electrical and Electronics Engineering
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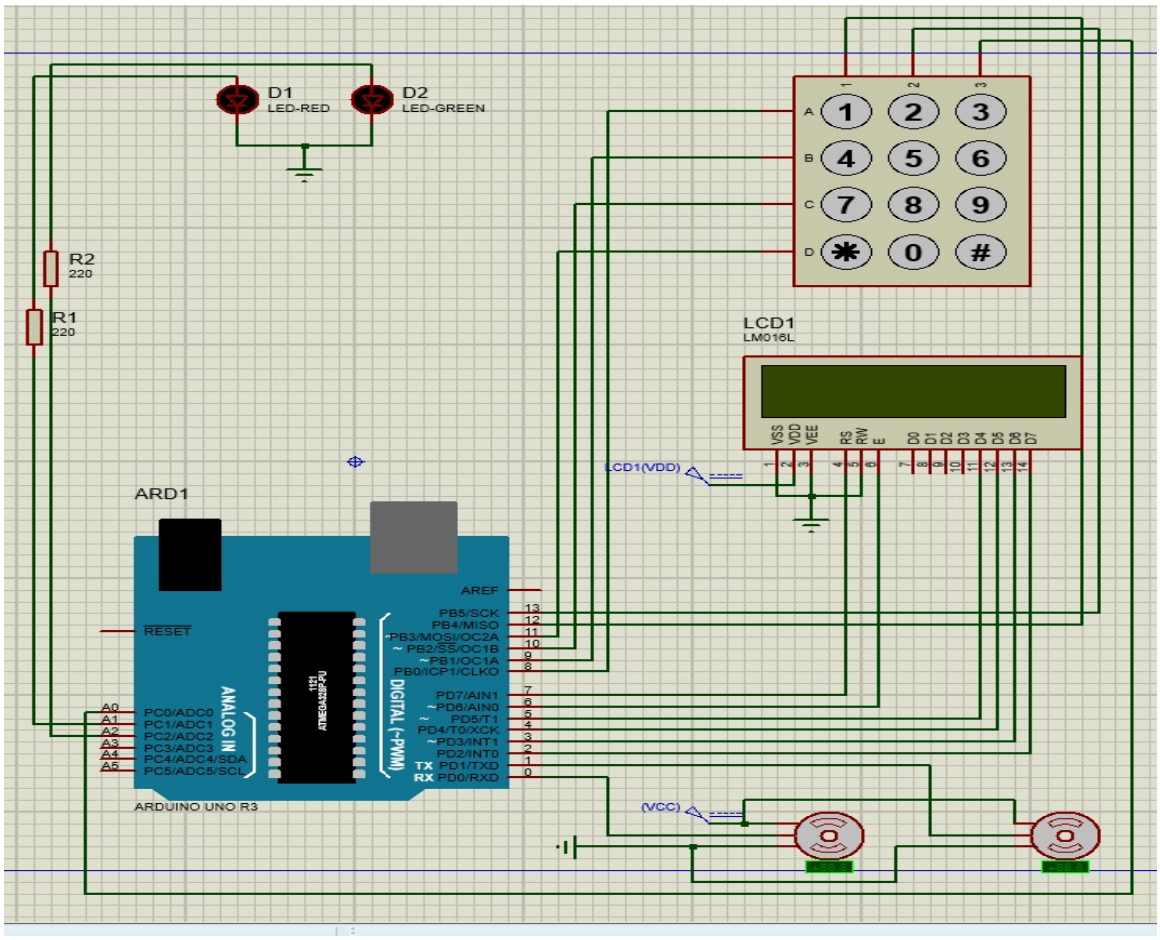
1. Introduction

This project, a simplified model of a real-life hotel safe system was used in the Proteus environment within the scope of the EE321 course to create a safe system, and the system was programmed based on the ARDUNIO UNO R3 microcontroller board. In the project, a two-compartment safe that works with a password system is designed using a microcontroller bord, LCD display, numeric keypad, two servo motors and two emergency LEDs (one green, the other red). The system contains four different passwords: the main password, section A password, section B password and bait password. The aim is for the user to be able to open the correct passwords, close the sections, change the passwords and see the unsuccessful login attempts.



2-Hardware and Software Structure

The hardware components of the project include a ARDUINO UNO R3 microcontroller board, a 2x16 LCD display, a 4x3 key matrix digital keypad, two servo motors, a red LED and a green LED. The user interface is provided via the LCD display and the input operations are performed via the keypad. The motors represent Sections A and B. The servo motor provides one full rotation for the opening movement. Since we are using a servo motor, the motor cannot turn 2 full turns because servo motors can turn 180 degrees, so we cannot get 2 full turns. When we designed this, we did it by thinking that 2 full turns of the mechanical part correspond to 180 degrees in the servo motor.The LED is a security indicator activated by a trap password. The software development process preferred the Arduino programming environment. Passwords can be changed by the user. The entered passwords are masked and hidden with asterisks on the LCD screen. The program menu is system-based and is made according to the selection between operations. In a user transaction package, the system asks the user to enter the relevant password, the relevant operations are performed for correct entries and the error and lock setup are activated for incorrect entries.

3-State Machine and Transitions

The system works with a state machine logic and basically has three main states: Main Menu, Master Lock and Time Lock. In the Main Menu state, the LCD screen displays the message “Main Menu” and the user is presented with four different operation options: Section A control, Section B control, password change and reporting. Each operation works with a specific password control within itself.

The Master Lock state is activated when the user enters the wrong password three times in a row. In this case, the system can only be accessed again with the master password. The LCD screen displays the phrase “System Locked ”. If the wrong password is entered even in this case, the system does not respond.

The Time Lock status locks the system for a period of 20 seconds after an incorrect password is entered. During this period, the LCD displays a warning message saying “No access %d sec”. After this temporary lock period expires, the user is directed back to the main menu.

If the user enters the correct password, the relevant motor is moved and the compartment is opened. If the user enters the bait (trap) password, the engine rotates in the same way, but the red LED flashes to signal an emergency. In this way, the system is made available only to authorized persons and security is increased. In addition, the green LED lights up when the correct entry is made.

4-Software Structure

In the system software, sections such as user menu, password entry, motor control and LED control are structured in a way that is separated by more than one function. When the user logs in, he/she is directed according to the menu he/she has selected and the necessary password screen appears. The numbers entered in the password entry screens are masked with an asterisk (‘*’) character. The entry process continues until four digits are entered. When the entry is completed, the password is checked.

Master, A, B and bait passwords are defined in the system. The default passwords initially registered in the system are as follows: master password 1111, section A password 2222, section B password 3333 and bait password 4444. The green LED turns on and off except for the bait password. After the user logs in with the master password, he/she can update these passwords using the “Change Password” menu.

In case of incorrect entries, the system gives a “Wrong Password” warning and the error counter is increased by one. After three consecutive failed attempts, the system enters Master Lock mode. The LED is activated when the bait code is entered. This LED flashes for 10 times, giving a secret emergency signal. During the password entry process, every input from the user is checked by the system, and if the system reaches 3 failed attempts, it can only be opened with the master code. In this way, it is made more difficult for malicious users to access the system.

5-User Manual

When the system is opened, the user is greeted by a main menu. Here, four basic operations can be performed with the keys 1, 2, 3 and 4. The control screen of Section A opens with the key “1”, where the password A is entered. The control screen of Section B opens with the key “2” and the password B is entered. The master password is requested with the key “3” and if entered correctly, the password change screen opens. Here, the user specifies which password he wants to change (1: master, 2: A, 3: B, 4: bait) in order and enters the new password. The number of unsuccessful entries in the system can be viewed with the key “4”.

If the user enters an incorrect password, the system gives an error message. The system locks after three incorrect entries. In this case, only the master password opens the system. Each incorrect entry is counted in the system and displayed to the user on the LCD if necessary. If a time lock is applied, the system will go into a 20 second waiting period. No input will be accepted during this period.

The bait password is a special security measure. When this password is entered, the system appears to be operating normally, but a hidden emergency LED is activated. This LED lights up for 10 times and can be used to call for help in the event of a possible threat. This is an important function that increases the security level of the system.

6-Conclusion

In this project, the hotel safe system developed in the Proteus environment has a realistic and functional structure in terms of hardware and software. Important concepts such as ARDUINO UNO R3 microcontroller programming, communication with LCD and keypad, motor and LED control and state machines have been successfully implemented in this project. A structure similar to real-life security systems has been created with the menu structure, password security, lock system and trap password created considering user interaction.

Thanks to this project, experience has been gained in both embedded system programming and user interface design. At the same time, awareness has been provided on how security can be increased, how system states can be controlled and why error management is important. The project has been a successful and educational study in terms of both hardware knowledge and software logic.