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An RFID Based Access Control System

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Abstract

RFID (Radio Frequency Identification) technology has experienced phenomenal development in recent years. The applications of RFID technology are found in areas such as product tracking, security systems, and inventory control. This paper describes design and implementation of an RFID based access control system. To enhance the system security, this system uses a keypad PIN (Personal Identification Number). The control function for this system is provided by an Arduino UNO microcontroller chip.

Keywords: *RFID, tag, PIN, microcontroller*

1. Introduction

Radio Frequency Identification technology has contributed to many advancements in human and asset tracking [1]. RFID is based on electronic data exchange through use of radio frequency (RF) signals [1].

RFID is a key tool for tracking and monitoring objects that are identified with RFID tags in real time [3]. RFID access systems are commonly found as card readers that grant access to workspaces, parking lots, and sometimes to vehicles. The applications of RFID also include production-line management, inventory control, product tracking, and security systems. The design of a complete RFID system titled "Real Space Physical Object Tracking System (RSPOTS)" is described in [2]. This RFID based system can physically locate an individual object from anywhere in the world through the use of a secured Internet connection. An RFID-based access human transporter is discussed in [4]. This transporter is based on a Segway-like scooter using passive RFID access. This system has an adjustable handle bar, lean steering using car struts, an IPOD holder, and speakers.

This paper presents the design and construction of an RFID access control system which is used to gain access to an area such as a secure room. Specifically, this RFID based access control system reads an RFID card and unlocks a door to permit access. The access configuration includes a keypad for increased security. The system has a small LCD screen to convey information to the user. By presenting a valid RFID device along with the correct PIN (Personal Identification Number) tied to the card, a servo rotates to activate a locking mechanism.

2. System Design Approach

As discussed in [5], the RFID based system design has the following components:

- Hardware Design
- Software Development
- System Implementation and Testing
- Documentation

The hardware selected for the RFID based system design and implementation consists of an Arduino microcontroller and the sensors, motors, and indicators associated with it. The functional block diagram for the RFID system is shown in Figure 1. The key component of this system is Arduino UNO microcontroller. The RFID reader provides all the needed functionality for a secure access control when coupled with a PIN (Personal Identification Number). As discussed in [6], a key weakness of passive RFID tags is their lack of ability to implement strong crypto

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primitives for security functions. The PIN integrated in this system will enhance the system security functionality while still allowing the data on the RFID to be transmitted to the reader.

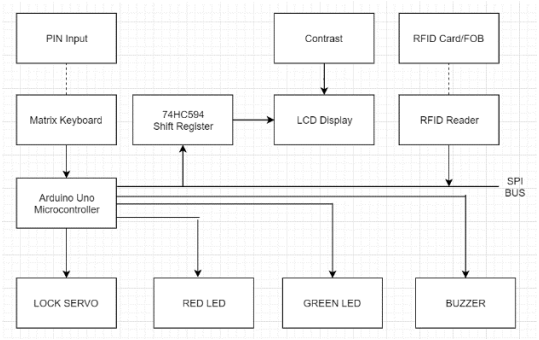

Fig.1: Functional Block Diagram

A thorough literature search reveals several examples of the design and implementation of RFID systems similar to the one described in this paper. Many of these are either solo RFID readers or a combination of only two of the key components. RFID reader, LCD screen, and Matrix keyboard. The reason why all the key components listed here are usually not integrated into the RFID based system while using an Arduino UNO microcontroller is the limited number of pins available on the microcontroller chip. The pin requirements are as follows:

- RFID: 5 pins
- LCD: 6 pins
- Matrix Keyboard: 8 pins
- Auxiliary functions (such as, LED, buzzer, and motor): 4 pins.

Thus, the total number of pins that are required come out to be 23. This number far exceeds the 18 pins available on an Arduino UNO microcontroller chip.

The system design approach used here provides an improvement over the previously designed similar RFID based system through the implementation of the LCD screen and the RFID reader using the SPI bus on the Arduino UNO. Using the SPI bus and a shift register, the LCD will require only one additional pin as a slave select while sharing same MOSI and SCK pins as the RFID reader which also uses the SPI bus. This configuration releases five pins resulting in the total number of pins needed to be 18.

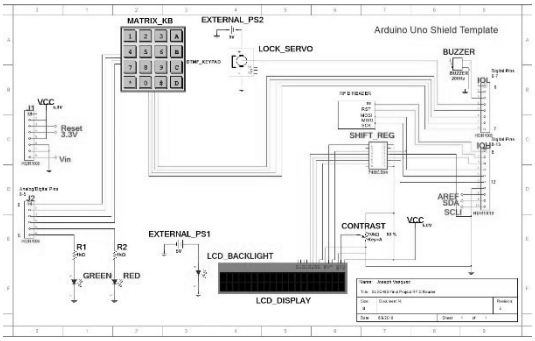

Fig. 2: Hardware Schematic

Figure 2 shows the hardware schematic and Figure 3 presents the programming flow chart for the RFID based System. The hardware and the software developed for this system provide the following system functions:

- Provides access when presented with a valid RFID MiFare Card coupled with the correct PIN associated with the card.
  - Access is defined by the actuation of the servo motor.
- Denies access in any of the following situations:
  - Invalid card.
  - Incorrect PIN.
  - Taking too long to enter the PIN.
- Provides audible and visual indications:
  - LCD messages as appropriate.
  - Denial melody.
  - Approval melody.
  - Red LED on denial.
  - Green LED on approval.
  - Individual tones on card presentation and keyboard input.

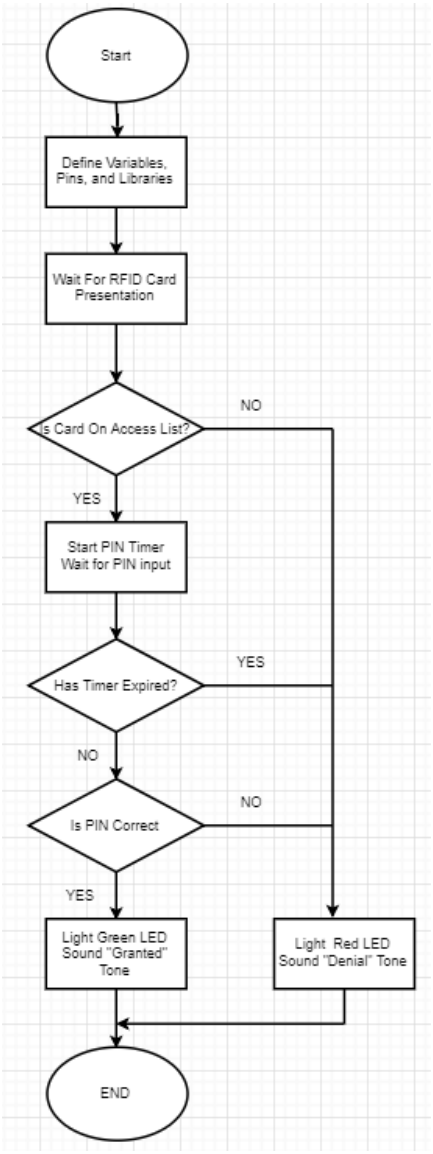

Fig.3: Programming Flow Chart

3. Conclusions

A fully functional version of an RFID access control system is designed and constructed. The system uses both an RFID reader and a keypad PIN to enhance the security. Since Arduino UNO microcontroller chip does not have enough pins to provide an integration of an RFID reader, LCD, and keypad into the system through their default wiring configuration, SPI bus is employed to minimize the number of pins used.

References

[1] J. P. Agrawal, C. Sekhar, and R. G. Davis, "RFID Based Permitted Entry System", in ASEE 2011 Annual Conference Proceedings, 12 pages. CD ROM publication.
[2] A. Khan, B. Cronin, M. Kumar, A. Mustafa, P. Patel, and J. Socorro, "Application of RFID Technology in a Senior Design Course", in ASEE 2007 Annual Conference Proceedings, 22 pages. CD ROM publication.
[3] G. T. Ibrahim, "Simple, Low-cost IOT/UHF RFID-based Lab Equipment Identification and Tracking System", in ASEE 2018 Annual Conference Proceedings, 16 pages, CD ROM publication.
[4] S. Sridharan and B. Zoghi, "Control System Project: RFID-based Access Human Transporter", in ASEE 2009 Annual Conference Proceedings, 10 pages, CD ROM publication.
[5] B. Zoghi, R. Beasely, and W. Zahn, "A Thorough Hands-On Process to Implement a RFID System", ASEE 2007 Annual Conference Proceedings, 9 pages, CD ROM publication.
[6] X. Fan, Radio-Frequency Identification (RFID): Emerging Technologies, Applications and Improvement Strategies, Hauppauge, NY: Nova Science Publishers, 2014