



A LOW-COST ENTRY DOOR USING DATABASE BASED ON RFID AND MICROCONTROLLER

Ferry Wahyu Wibowo and Muhammad Habib

Department of Informatics, Faculty of Computer Science, Universitas Amikom Yogyakarta, Yogyakarta, Indonesia

E-Mail: ferry.w@amikom.ac.id

ABSTRACT

The development of technology in the world is growing rapidly. In connection with the growth of these technologies, many houses or apartments implement the smart home system. The implementation of the smart home system is useful to the security of a home especially on the access of appliances and others that should implement smart environments. One of these systems is implementing radio frequency identification (RFID). This paper has used a method of identification implementing radio waves on the certain frequency combined with an Arduino microcontroller as the core to process input and output (I/O) components that are connected to the database through the interface application. The expected result of making this device can provide an additional security option in a real implementation to be able accessing a door to maximize a security by providing validation of the access rights using RFID tag that read by the RFID reader.

Keywords: database, door, microcontroller, RFID, technology.

INTRODUCTION

Security is a very important requirement in many areas of life. There are so many factors that require a security for a privacy factor. A technology development at this time also helped in the development of a safety system that is practical [1, 2]. An excess of a security system using a digital technology is currently applied compared with the conventional or manual system. Today the access of information can work continuously and automatically [3]. The interested field in the electronic engineering, especially a hardware-based and microcontroller can be competitive in the development of informatics technology industrial, electronics, and business [4].

Based on this, it is necessary to formulate a problem to be solved or resolved in the digital design [5]. This paper concerns on creating a system to restrict access rights in entering the room. The device to make the system utilizes radio frequency identification (RFID) as a validation of the access to be able to enter the room [6]. The implementation of the RFID and appliances can accommodate many RFID data such as username and password so that the data storage process of RFID isn't imposed on the microcontroller that in this term using an Arduino microcontroller [7, 8].

The boundaries of this paper focus on the device based on the microcontroller of Arduino Mega 2560. The principle system can control a movement of the door to open and close the door using RFID, keypad, and push button. Thus the serial communication interfaces on the personal computer (PC) as a liaison between both microcontroller and data storage, in this case using MySQL.

RELATED WORKS

A microcontroller is a mini-sized centralized controller that has a function as processing for both input and output that comes from the microprocessor. The microcontroller or sometimes called embedded controller is a system containing input/output (I/O), memory, and

processors, used in products such as washing machines, video players, automobiles, and telephones [9]. Another definition of the microcontroller is a system microprocessor in which there already exist central processing unit (CPU), read-only memory (ROM), random access memory (RAM), input/output (I/O), Clock, and other internal equipment already connected and well organized by the manufacturer and packaged in a single chip that is ready to use, so the programmer should program ROM contents in accordance with the rules of usage by the manufacturer.

Arduino board

Arduino is a series of electronics that use ATmega microcontroller released by ATMEL as a base Arduino that is an open source in which there is a chip that serves as a controller through the program using the Arduino IDE sketch so that it can set the input and output readings in the form of digital and analog signals [10].

There are many types of Arduino board i.e. Arduino Due, Arduino Leonardo, Arduino Severino, Arduino Lilypad, Arduino UNO, Arduino Nano, Arduino Micro, and Arduino Mega. The most commonly used in conducting experiments are Arduino UNO and Arduino Mega 2560. The most notable difference from both microcontrollers is a number of its ports, where the Arduino UNO ports are less than Arduino Mega 2560 microcontroller. The Arduino Mega 2560 has 54 digital pins and 16 analog pins, using an ATmega2560 microcontroller as the processing core paired into the header socket, there is also a universal serial bus (USB) connector which serves as a liaison to the personal computer (PC) and can also be a supplier of voltage.

Radio frequency identification

Radio frequency identification or known as RFID is a compact wireless scanning frequency for identification. The RFID can be used to perform labelling by capturing the transmitted data to identify and store information



stored in RFID tags. A RFID transponder/tag consists of a microchip-sized of $\pm 0.4\text{mm}$. Federal Communications Commission (FCC) in the United States sets the RFID frequency band allocation for commercial use. RFID uses a spectrum for short-range devices those are classified as medical knowledge of industrial equipment where equipment that operates on this bandwidth doesn't cause harmful interference. FCC also regulates bandwidth ranges as follows:

- The frequency of 125 kilohertz (kHz) up to 134 kHz included in the Low Frequency (LF) band, which is suitable for use over short range such as door locks and identification of objects,
- The frequency of 13.56 Megahertz (MHz) belongs to the High Frequency (HF) band, this frequency accuracy as far as three feet and over of it won't be detected. Application of RFID HF band is used for tracking goods in the luggage of air and warehouses,
- The frequency of 900 Megahertz (MHz) band including Ultra High Frequency (UHF) frequency has a further range than HF band, where the rate of readings ranged from 100 to 1,000 tags per second. Application of this band for scanning RFID in a container cargo,
- The frequency of 2.45 up to 5.8 Gigahertz (GHz) including the microwave bands which can cause surrounding interference in readings by the RFID reader with tag.

The RFID devices can communicate when working on the same frequency. A block diagram of the RFID reader shown in Figure-1.

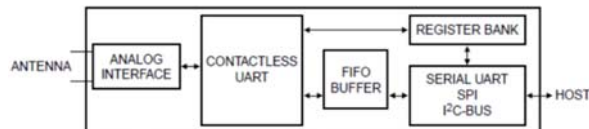


Figure-1. Block diagram of the RFID reader.

There are two kinds of RFID tag namely passive and active RFID tags, the comparison between both kinds is shown in Table-1.

Table-1. Kinds of the RFID tag.

No.	Passive tag	Active tag
1	Doesn't have a power supply source	Having a power supply source
2	Modulation will be activated when the tag receives electromagnetic waves from the reader	Modulation will be activated directly from the tag because it has a power supply
3	A reading range is about 10 centimetres to 10 meters	A reading range is up to 100 meters
4	Having 100,000 times to read/write	Influenced by the tag battery life
5		Encapsulation variation limited by the electricity resources or battery

Each RFID tag has 2 inlay components and inlay encapsulates, where inlay is a core part of a RFID tag which consists of a microchip for storing information and an antenna. An inlay is a small form so it is prone to damage, to anticipate such damage; the inlay is always encapsulated to secure information. The information contained two types, namely:

- The permanent information is information on the creation time of manufacture of an inlay contains the unique ID of the tag so that there is only one tag that can't be changed using applications or RFID reader.
- The non-permanent information is an information which can create read/write by users with an application or RFID reader that can be used to scan according to user needs.

While the inlay encapsulate is the outermost layer of a tag encapsulating inlay thus protected from the damage due to a human error. Various types of inlay shapes are shown in Figure-2.

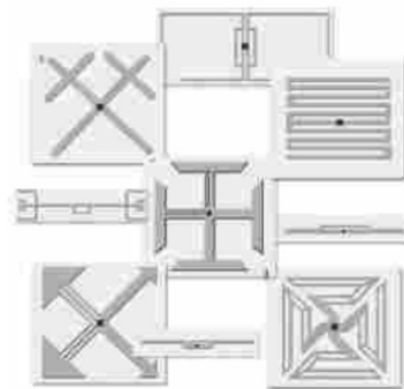


Figure-2. Inlay kinds of RFID tag.



Keypad

Membrane keypad or numeric keypad is a device used in a character input numbers and letters that can be used as input a password. Generally, keypad consists of rows and columns in which use is made first initialization pin between rows and columns, so that it can determine which rows and columns that represent a number or letter.

Prior to the application of the Arduino device keypad, keypad library was installed first in the sketch to be read by the system. The diagram of a 4x4 button keypad is shown in Figure-3.

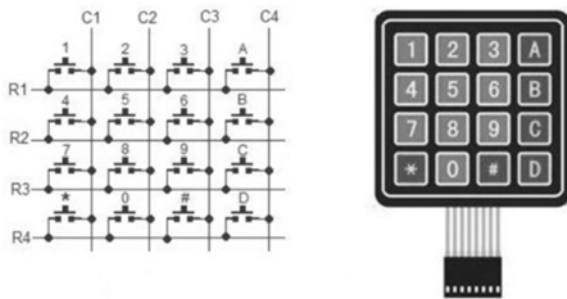


Figure-3. Keypad 4x4.

LCD Character display

Liquid crystal display (LCD) is a tool for displaying characters in processing information. Type of LCD is assortment sized i.e. 16x2, 20x4, and so forth. Letters or characters displayed are ASCII characters. The block diagram of the LCD is shown in Figure-4.

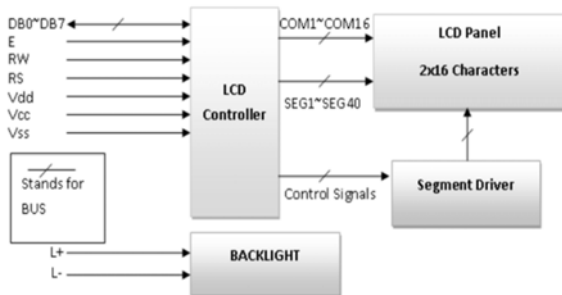


Figure-4. Block diagram of LCD.

On the LCD, there are 3 kinds of internal memory with the function and purpose of each, as for the type of memory on the LCD namely display data (DD) RAM, character display (CG) RAM, and character display (CG) ROM.

RESEARCH METHODOLOGY

Tools used in this implementation were in the form of hardware components and software. The hardware used includes the Board Arduino Mega 2560, RFID Reader MF522, DC motors and others, while the necessary softwares were needed to support in designing. Sketch Arduino IDE is a software editor to write source code before uploading to the microcontroller, the software

can be seen a writing source code whether in accordance with the rules of the programming language or not in accordance with the rules of the programming language. This program can be downloaded free of charge at the website of <http://www.arduino.cc/en/Main/Software/>.

For making an interface application using Delphi program. Delphi program, in this case, is used as an interface between the microcontroller interface features to a computer to communicate with each other using serial communication, the program serves to input matching intermediary sent by the microcontroller into a MySQL database. At Delphi's need to use the 4 program components as a liaison with Arduino microcontroller, namely:

- ComPort serves to direct the serial communication port and its baud rate which is connected to the microcontroller,
- MyQuery serves to steer the tables in the database that will be used so that the program can be connected with the contents of the table in the database used,
- MyConnection serves to connect between Delphi program with a database created through Xampp program where the Delphi program requires a username, password, server database, and the database used,
- DataSource serves as a direct data source pre-configured on myQuery.

For storing data in this implementation employed Xampp. Xampp serves to create a MySQL database with the purpose of storing the data Username and Password. In this database, there is 1 table with 2 fields namely Username and Password fields. The types for Username and Password are char (15) and char (8) respectively.

RESULT

In the design of the overall system is divided into an overview of basic concepts, Arduino component design, software design, and design prototypes. In the design and manufacture of the tool is expected to produce a system that can be used properly in order to provide more security at the door. In order to obtain a unitary system, the required components are complementary and can be connected to both the Arduino circuit board in this case using the Arduino Mega 2560 is the main circuit to regulate the work of all parts of the system. The block diagram of the basic concept of system tools work is shown in Figure-5.

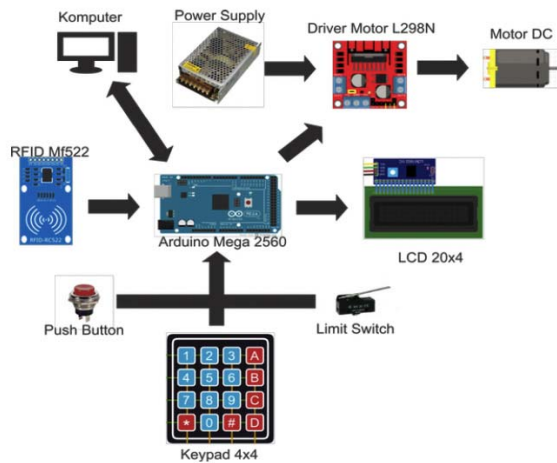


Figure-5. Block diagram of the system.

When the microcontroller gets input from the RFID, Keypad, Push Button, and Limit Switch, The microcontroller will be direct to process the inputs. Then especially for the input through the keypad and RFID by the microcontroller will be sent to the computer through a serial communication with the goal to match within MySQL database stored on the computer. If the input data is present, it will be reprocessed by the microcontroller as a command to open the door so that the user can enter the room.

In order to the system can work as its function, it needs to design components that are connected to each other. In Figure-6 shows a schematic design of the hardware connected to the microcontroller Arduino Mega 2560.

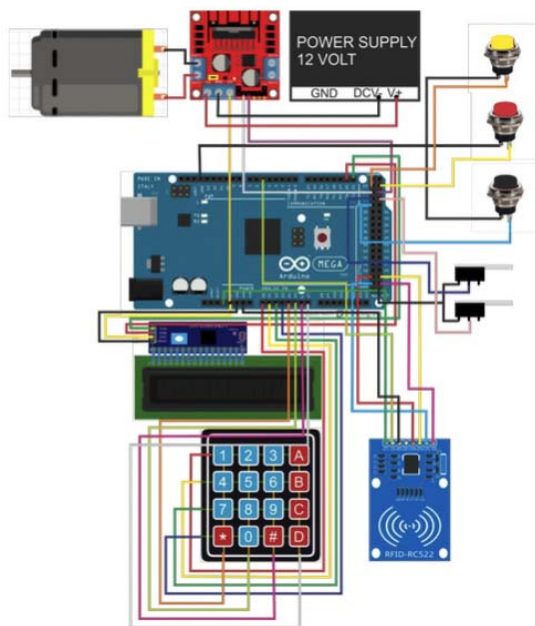


Figure-6. The system design.

Testing of the system was conducted to determine the function of each component tool to determine whether in accordance with the draft, so that can be known the shortcomings of the performance of the tool so do improvements that were found results in accordance with the design of both hardware and software. Testing of this system is shown in Figure-7.



Figure-7. System testing.

After the results of the input are complete, the microcontroller will send the data to the computer via serial communication and then processed by the Delphi program. Processing of the input of the tool on the Delphi program is shown in Figure-8.

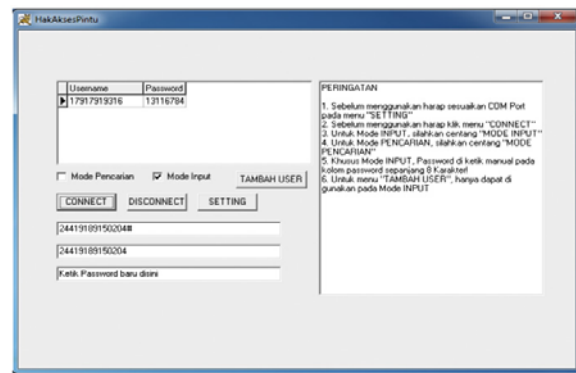


Figure-8. Interface application using Delphi.

CONCLUSIONS

A low-cost entry door using database based on RFID and microcontroller has been implemented in accordance with 2 validations namely Username and Password. The RFID reader could be implemented by using an Arduino Mega 2560 so that RFID tags could be read and processed by a user validation in entering a room. In order to use Radio Frequency Identification (RFID) in significant amounts and longer periods of time, the RFID data storage systems have been employed in the form of username and password in a database on a computer, not programmed onto a microcontroller.



REFERENCES

- [1] Neustupa Z., Danel R., Staša P., Beneš F. and Švub J. 2015. Ensuring the security of warehouse using automatic identification by RFID. In: Proceedings of the 2015 16th International Carpathian Control Conference (ICCC). pp. 338-342. DOI: 10.1109/CarpathianCC.2015.7145100.
- [2] U. Farooq, M. U. Hasan, M. Amar, A. Hanif and M. U. Asad. 2014. RFID Based Security and Access Control System. IACSIT International Journal of Engineering and Technology. 6(4): 309-314. DOI: 10.7763/IJET.2014.V6.718.
- [3] F.W. Wibowo and F. Hidayat. 2017. A low-cost home automation system based-on internet of things. Journal of Telecommunication, Electronic and Computer Engineering. 9(2-4): 155-159.
- [4] Sudarmawan, Wibowo F.W. and Kharisma R. S. 2014. How RFID Technology Supports E-Business Processes. In: Proceedings of 7th International Seminar on Industrial Engineering and Management (7th ISIEM). pp. DSS-7-DSS-12.
- [5] F.W. Wibowo. 2017. Implementation of strategic alignment framework for developing information technology of RFID in XYZ private university. Advanced Science Letters.
- [6] Konatham S., Chalasani B. S., Kulkarni N. and Taeib T. E. 2016. Attendance generating system using RFID and GSM, in: 2016 IEEE Long Island Systems, Applications and Technology. pp. 1-3. DOI: 10.1109/LISAT.2016.7494157.
- [7] Saravia M. W. D. 2015. Access control system using NFC and Arduino. In: 2015 IEEE Thirty Fifth Central American and Panama Convention (CONCAPAN XXXV). pp. 1-6. DOI: 10.1109/CONCAPAN.2015.7428472.
- [8] G. Kaushal, R. Mishra, N. Chaurasiya and P. Singh. 2015. RFID based security and access control system using arduino with GSM module. International Journal of Electrical & Electronics Engineering. 2(2): 5-8.
- [9] F.W. Wibowo. 2017. The detection of signal on digital audio synthesizer based-on propeller. Advanced Science Letters. 23(6): 5472-5475. DOI: 10.1166/asl.2017.7402.
- [10] M. A. Hidayatullah and F.W. Wibowo. 2016. Android and microcontroller based camtree controller system. Research Journal of Applied Sciences. 11(8): 687-691. DOI: 10.3923/rjas.2016.687.691.