

Garage Automation Door by Using Radio-Frequency Identification (RFID)

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Abstract: The purpose of this project is to develop an independent security system that able to open the garage door automatically with the help of Radio-Frequency Identification (RFID) and Arduino Uno. This requirement has become demanded as nowadays system are too dependent to the community. Different with an ordinary system, this project will be able to ensure the safety of the owner and to avoid the thief from enter the house through garage. This project entitled “Garage Automation Door by Using Radio-Frequency Identification (RFID)” with a simple design. The designation and implementation of automation controller for the garage door will be observed. The input in this project is RFID, Ultrasonic sensor, and Arduino Uno, meanwhile the output is the 12 V DC motor, buzzer, and Liquid-Crystal Display (LCD). The garage door will open when the owner scans the ID card using the RFID system and with the help of Ultrasonic sensor at certain range (below 100 cm). Then the 12 V DC motor is used to control the opening and closing movement of the garage door. As the result, the project is successfully conducted.

Keywords: RFID, Garage Automatic Door, Arduino Uno, DC Motor, Ultrasonic Sensor, LCD

1. Introduction

The development of industrial world in our country, Malaysia, goes very rapidly along with the expansion of types of industrial products. The complexity processing of raw materials which process both physically and chemically, has spurred humans to constantly upgrade and improve performance working systems that support the process to be more productive and efficiently. A big concern regarding to this case is the use of control systems industrial processes or also known as industrial control systems [1]. Arduino is a microcontroller board developed by Arduino.cc and based on Atmega328. Electronic devices are becoming compact, flexible, and cheap that can do more function as compared to cover more space, turned out expensive with the ability to perform fewer functions [2].

Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be direct line-of-sight of the reader to be tracked. Security systems play an important role to prevent unauthorized personnel entry into a secured environment, which may include physical and intellectual property [3]. RFID technology offers superior performance over the automatic identification systems and is used in many areas [4].

1.1 Problem statement

Nowadays, there are many technologies had been invented by human whether it is seen or unseen. Same goes to the garage system at home. Instead of using traditional way, where the person needs to get out of the car to open the garage door manually. But with the invention of garage automatic door by using Radio-Frequency Identification, it will help to ease human works. In additional, it also can be a safety or security system to avoid the unauthorized person from entering the premise.

1.2 Objectives

There are three objectives for this project:

- i. To design a security prototype that can use to open the garage door by using Radio-Frequency Identification (RFID) system.
- ii. To study how to open the garage door automatically without using physical contact by using Radio-Frequency Identification (RFID) system.
- iii. To apply the RFID into daily activities.

1.3 Project Scope

This project focuses on residential users provided by University Tun Hussein Onn Malaysia (UTHM) who are given the title of Bachelor Project in Electrical Engineering. The purpose of this project is to study how to open the garage door automatically by using Radio-Frequency Identification (RFID). It will focus on the security system of RFID, Arduino Uno, and motion detection sensor by using Ultrasonic sensor. The RFID reader will detect the card information to perform the opening and closing the garage door. By design a garage door will show how the system of automation door is working. RFID is chosen for the project due to it is cheap and affordable. With this automation system, it will have a big impact in the field of technology that is now looking for ways to invent something that can control any system from a distance. This is line with the development of technology and infrastructure developed through various research and several projects for the sustainability of life.

2. Methodology

In this project, the RFID reader reads the data from the tag and sends the card UID number to Arduino Uno microcontroller for comparison. If the card is valid the Liquid-Crystal Display (LCD) will display access granted on the screen. If invalid, it will show access denied on the screen.

2.1 Materials

The materials used to build the prototype of garage automatic door consisting of Radio-Frequency Identification (RFID), Arduino Uno, 12V DC motor, connecting wires, buzzer, Liquid-Crystal Display (LCD), IC register of motor shield, and Ultrasonic sensor.

- Arduino Uno Board – Arduino is a microcontroller board based on ATmega328 that consists of 14 digital input or output pins. 6 of the pins can be used as Pulse Width Modulation (PWM), 6 analog inputs, 15MHz ceramic resonator, a Universal Serial Box (USB), power jack, an In-Circuit Serial Programming (ICSP) header, and a reset button.
- Motor Driver L293D IC – L293D is a motor driver that allows DC motor to drive on either direction. It is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. Two

DC motors can be controlled with a single L293D IC. It can drive small and big motors as well and can also check the Voltage Specification.

- 12V DC Motor – A direct current (DC) motor is an electric motor that converts electrical energy into mechanical energy to produce torque, which causes it to turn. It requires two magnets of opposite polarity and an electric coil, which acts as an electromagnet. The DC motor speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of the current in its field windings.
- LCD Display – Liquid-Crystal Display is a screen-flat panel display or electronic visual that uses the light-modulating properties of liquid crystals. A 16x2 LCD display is very basic module and is very commonly used in various devices circuits.
- Radio-Frequency Identification (RFID) – It is a non-contact technology that is broadly used in the industries for many tasks. For example, access control, supply chain management, tollgate systems, personnel tracking, and so on. The RFID reader consists of a radio frequency module, a control unit, and an antenna coil which generates high frequency electromagnetic field.

2.2 Working Principle

Figure 1 shows the block diagram of access control system by using RFID and Arduino Uno. It has RFID card, RFID reader and microcontroller. Functions of RFID reader is to read the RFID tags and the data from the reader process that accept by microcontroller, used to either grant or deny the access to the user using the access controller. The LCD display also used in this project to display grant or denied access instead of using serial monitor.

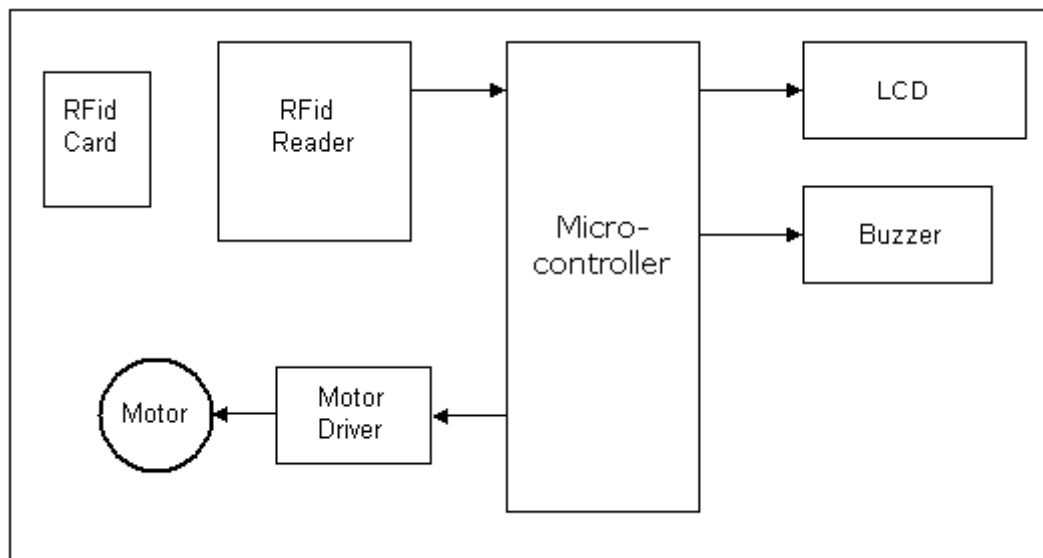


Figure 1: RFID Block Diagram

When the user scan the RFID tag into the RFID, the system will check whether the user is registered or not. If the user is registered, the tag information is matched with the user information stored in the system based on the Figure 2 below, the access is granted, and “WELCOME HOME” will show on the LCD display and back to its initial condition. If the incorrect tag is detected, “ACCESS DENIED” will show on the LCD display.

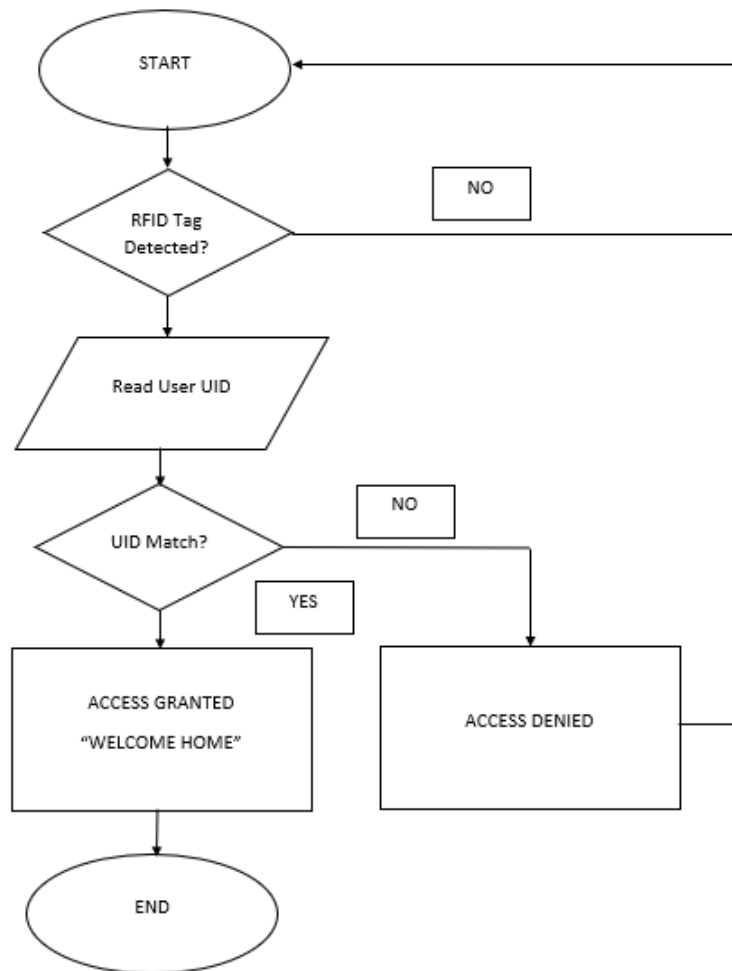



Figure 2: Flow diagram

3. Results and Discussion

This process will discuss the results in this project. Therefore, the result obtains in this project is the final design of Garage Automation Door by Using Radio-Frequency Identification (RFID).

3.1 Prototype Results

Diagram	Condition	Explanation
 <p>Figure 3: Initial condition</p>	Initial condition	Figure 3 shows the initial condition of the system before the gate opening. For the gate to open, the car must enter the line where the ultrasonic sensor can detect the car which is distance between the car and ultrasonic sensor must be less than 100cm. If the car did not reach the exact range, the gate will not open as it is one of the requirements needed for the gate to open. Currently, the gate is closed and the LCD on top of the garage shows "PLEASE SCAN".

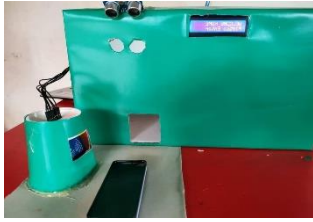


Figure 4: Gate opening

Gate opening

Figure 4 shows the condition of gate opening. Once the car is already entered the line of ultrasonic sensor, the user needs to scan the ID card on the RFID scanner. The RFID reader will detect the information of the ID card, and the gate will open if the information is correct. The buzzer sound will trigger for 5 milliseconds. The LCD will display “WELCOME HOME. PLEASE ENTER” But if the user uses the wrong ID card, the gate will not open as the RFID reader cannot read the information of the ID card. The buzzer is triggered for 3 seconds. The LCD will display “ACCESS DENIED. PLEASE SCAN”.



Figure 5: Gate closing

Gate closing

Figure 5 shows the condition of gate closing. Once the user already entered the garage. The gate will open for 15 seconds. After that, the gate will close. The LCD will display “GATE CLOSED”. The system is back to its initial condition.

3.2 Troubleshooting

No.	Components	Testing 1	Testing 2	Testing 3
1.	Arduino Uno	/	/	/
2.	Radio-Frequency Identification (RFID)	/	/	/
3.	12V DC Motor	x	/	/
4.	Liquid Crystal Display (LCD)	x	/	/
5.	Ultrasonic Sensor	x	/	/
6.	L293D Motor Shield Register IC	/	/	/

In this project, two testing had been conducted to ensure the working of the garage automatic door smoothly. The first one is testing 1. There were a few errors happened during this testing. Firstly, the 12V DC Motor. In the testing, the motor could not pull up the door since the door is heavy. The motor needs more power to pull up the motor. To overcome it, a 24 V battery is used and connected to the motor to ensure the motor can pull up the garage door.

Secondly, the Liquid Crystal Display (LCD), in the beginning the LCD is working normally. But after a few testing on the prototype, suddenly the LCD blank out. The screen does not show any words

or even functioning. To overcome the error, the connection of the LCD to the Arduino Uno had been checked to make sure the connection is tight. But the LCD does not display any words. The LCD then were replaced with a new one and some testing had been made. At last, the LCD work normally.

Finally, the ultrasonic sensor. As we know, the ultrasonic sensor is very sensitive component especially the pins of the component. Once it broken, the sensor cannot be used anymore. The sensor cannot detect the car during the testing and the gate is not opening. So, the range distance between the ultrasonic sensor and car had been changed manually in the coding. After a few try and error, final range distance had been decided which is less than 100 cm. As for testing 2 and testing 3, there is no error occurred.

4. Conclusion

In conclusion, the project entitled “Garage Automation Door by Using Radio-Frequency Identification (RFID)” is a simple design that serves main input function and Arduino Uno as a microcontroller board based on the ATmega328P is used. Two feedbacks to this project had been considered. The implementation of an effective system that a specific card can be used to open and close the garage door by using RFID scanner. Other than that, the uses of ultrasonic sensor are implemented to detect the car at specific range as requirements for the garage door opening system and having lots of advantages such as it can conserve energy, reduce human efforts or energy, and saves time.

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