Design and Implementation of a Smart Sensor and RFID Door Lock Security System with Email Notification

Enerst Edozie[1], Kambale Vilaka[2]

Department of Electrical, Telecommunication and Computer Engineering, Kampala International University, Uganda
Department of Information Technology, Kampala International University, Uganda

[1]enerst.edozie@kiu.ac.ug, [2]johnvilaka@gmail.com

Abstract: *Security has been a very significant concern in human society. Ensuring safety of people and their valuable things is very important for the prevention of illegal handling. Providing a security system for houses has become a vital research in which the latest technologies are being adopted to serve this purpose. Wireless network is one of the technologies that have been used to provide remote monitor and control for the home doors or gates, wireless security based applications have rapidly increased due to the dramatic improvement of modern technologies. Many access control systems were designed and/or implemented based on different types of wireless communication technologies by different people. The aim of this paper is to design and implement affordable, low power consumption, flexible, and fast monitoring home security system based on Raspberry Pi for intruder observation that reinforces smart sensor and RFID (Radio Frequency Identification) technology to provide essential security to home or office and associated control. The system is designed to access the door using RFID and to sense the current status of the door (That is when the door is open or closed) via proximity sensor. The status of the door is sensed by the proximity sensor and sends email notification to the user, stating the current status of the door.*

Keywords: Proximity Sensor, Raspberry Pi, RFID, Home Security, Email notification

1.0 Introduction

Over the years, various control systems have been designed to prevent access to unauthorized user. The main reason for providing locks for our buildings (home, office, church, school, etc) is for security of our life and property. It is therefore important to have a stress free and convenient means of achieving this purpose. Today security and safety is becoming more and more popular day by day and it is getting improved and used for the ease in our life. Nowadays, technology has become an integrated part of people's lives therefore the security of one's home must also not be left behind. The security system was basically divided into two types: used normal door lock key and used electronic automatic identification system. In general, locks are very simplistic device that are employed to address very a straightforward problem. The lock system was not real practical used in security system and easy explores to high risk enable thieves hack this system. In this research paper, proximity sensor is used as the door smart sensor notification, and RFID is used to access the door. RFID is a fundamental and inexpensive technology that enables wireless data transmission. This technology has not been very often used in industry due to lack of standardization among the manufacturing companies earlier. RFID technologies are efficient and secure compare to other network. With RFID, wireless automatic identification takes a very specific form: the object, location, or individual is marked with a unique identifier code contained with an RFID tag, which is in some way attached to or embedded in the target. Raspberry Pi control all the devices in this system. Raspberry pi platform is being used widely from the past few years as it provides easy use support and documentation. It is readily available to all the end users. From simple educational to smart application projects, Raspberry Pi has proved its significance in the development of applications spreading out in various fields.

1.1 Objectives:

The main objective of this research paper is to design and implement a low power consumption, affordable, flexible, and fast monitoring home security system that includes features such as emailing notification, door status sensor and RFID. The system is to be based on Raspberry Pi.

- ❖ To design and implement a security system with a smart sensor that notifies the user (via email) if an intruder entered in the restricted area.
- ❖ To design a security system that ease problems of unauthorized entry in the home or office.
- ❖ To develop RFID door lock security system using raspberry pi
- ❖ To validate the developed system

1.2 System Description

The system consists of a hardware module, an operating system for the raspberry pi and an application program called python. The operating system is called raspbian which is the main operating system for the raspberry pi and the application program is used for coding. The hardware module are RFID tag, and RFID reader, the display unit, the raspberry pi, servo motor, proximity sensor, relay switch, and the power supply unit. The RFID reader retrieve the information contains by tag as it come in the range of few millimeters from reader, after receiving the tag information, the system generates a control signal through parallel port which controls the opening and closing of door by means of

servo motor. Once the door is open, the door sensor will sense and trigger the relay switch to make open circuit just like magnetic switch, then the email will be sent immediately to the user stating that "The door is open at current time". After the door is closed, the door sensor will sense again and trigger the relay switch to make close circuit just like magnetic switch, then send email immediately to the user stating that "The door is closed at current time".

The power supply provides the voltage and current required for effective performance of the system. This supply is tapped from the 12V DC power source and then regulated before being fed to the system.

1.3 System Components

1.3.0 Hardware and Components used.

1.3.1 RFID Tag

IPC80 passive RFID tag operating at a frequency of 125 KHz is issued to the user. The tag transmits information to the reader in ASK format.

1.3.2 RFID Reader

IP10 proximity card reader with operating frequency of 125 KHz and reading distance up to 4 inches is used. The reader can be easily installed on metal doors, provides the tag information serially in RS232 format and is suitable for indoor as well as outdoor operations [11]. Three such readers are installed for hostel security: hostel entrance gate, hostel exit gate and mess entrance gate.

1.3.3 Servo motor

The **servo motor** is most commonly used for high technology devices in the industrial application like automation technology. It is a self-contained electrical device that rotate parts of a machine with high efficiency and great precision. The output shaft of this motor can be moved to a particular angle. Servo motors are mainly used in home electronics, toys, cars, airplanes, etc.

1.3.4 Raspberry Pi-3Model B

Raspberry Pi-3Model is the third generation Raspberry Pi. It replaced with Raspberry Pi 2 Model B in February 2016. As

of January 2017, Raspberry Pi-3 Model B is the newest version of Raspberry Pi.

1.3.5 Liquid crystal display

The microcontroller board's LCD port provides the signals needed for a standard character based LCD modules. The display has 8 pins which are connected directly into the microcontroller. It displays 16 characters by 2 lines; the characters are black against a green background.

Pin Summary of LCD 1602a
Pin 1: VSS.
Pin 2: To VDD 5V input.
Pin 3: VL to adjust LCD contrast with the help of 10K potentiometer. Low VL indicates light contrast and high VL indicates dark contrast.
Pin 4: RS for register select. Data registers used for high RS. Similarly, instruction register for low RS.
Pin 5: R/W signal stands for read/write. When R/W bit is high, it indicates a read operation. If R/W bit is low, it indicates write operation.
Pin 6: Clock Enable- Edge triggering.
Pin 7: to 14: Represents from Bit 0 to Bit 7.
Pin 15: back light Anode.
Pin 16: back light cathode.

1.3.6 Relay Switch

DC Relay Switch. Share. A Electromechanical switch is called as Relay. It reacts as Automatic switch to control (just ON/OFF) large voltage load by using low voltage signal. We use DC (Direct Current) supply to Energize electromagnetic coil placed inrelay so, it is referred as DC relay switch.

1.3.7 Proximity Sensor

Proximity Sensor are used to detect objects and obstacles in front of sensor. Sensor keeps transmitting infrared light and when any object comes near, it is detected by the sensor by monitoring the reflected light from the object. It can be used in robots for obstacle avoidance, for automatic doors, for parking aid devices or for security alarm systems, or contact

less tachometer by measuring RPM of rotation objects like fan blades.

- Obstacle Avoider or Obstacle Sensor
- Range Between 3cms to 7cms
- 2.54 mm with Breadboard compatibility
- Indicator LED & Power LED
- 3 pin easy interface connectors
- Can differentiate between dark and light colors
- Arduino, AVR, PIC, and other micro controllers Compatible
- Can Be Used For 3 - 5V DC Power Supply Modules

1.3.8 Power supply unit
The power supply circuit consist of the circuit for conversion of 220 volts, 50Hz AC into 12V, 5V and 3.3VDC. This is achieved by the use of a step down 12V-0-12V centre tapped transformer with a full wave rectifier. The AC ripples are eliminated using the capacitor and the LM78 and LM79 voltage regulator series used to regulate the output voltages. The 5V DC is used to power the Microcontroller (Raspberry Pi), the servo motor, the relay switch, and the LCD. The 12V DC is used to charge the battery and 3.3V is used to power the RFID leader.

Software Components used.

1.3.8 Raspbian
Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.

1.3.9 Python
Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.
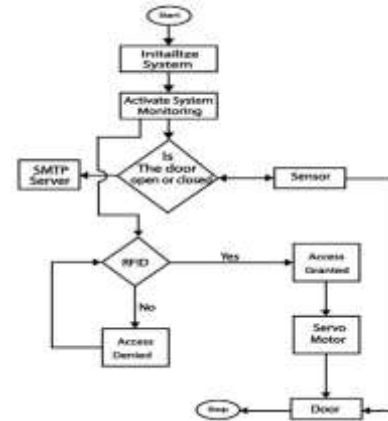
1.4 Flow Chart

Fig1. The flow chart of the system
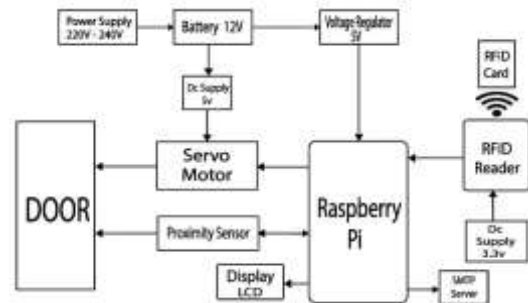
1.5 Block Diagram

Fig2. The block diagram of the system

1.6 Circuit Diagram

1.7 Result   Fig3. The circuit diagram of the system
The connections of the RFID reader, the LCD, the servo motor, the proximity sensor, the relay switch, and power supply to the raspberry pi PCB were done, and then checked for consistency. After running the python code successfully,

the instruction was displayed on the LCD screen, it means the system is prepared to read the RFID tag. After scanning the RFID master tag, some of the RFID tags were added. One of the tags was brought to about 5cm in front of the reader, a response 'Access Granted' was displayed on the LCD and the servo motor opened the door, and the door was closed after 8 seconds. The door sensor sense the status of the door and trigger the relay switch to make open or close circuit, then the email was sent immediately to the user stating that "The door is open at current time" or "The door is closed at current time". The other cards that were not added in the system was brought to about 5cm in front of the reader, a response 'Access Denied' and was also displayed on the LCD.

Fig4. The results of the system

1.8 Conclusion

The security level is increased due to the usage of Raspberry pi which sends the door status sensed by the proximity sensor to the user. Raspberry pi proves to be smart economic and efficient platform for implementing the home security system. The advantage provided by the system is that, Necessary action can be taken in short span of time in the case of emergency. A smart sensor and RFID door lock security system with email notification has been implemented and the results have been incorporated in this paper. It is concluded that this standalone security system provides a basic level of security. The advantage of the RFID system is contact-less and works without-line-of-sight.

References

[1] Lia Kamelia, Alfin Noorhassan S.R, Mada Sanjaya and W.S., Edi Mulyana , "Door-Automation System Using Bluetooth-Based Android For Mobile Phone" , ARPN Journal of Engineering and Applied Sciences , VOL. 9, NO. 10, OCTOBER 2014.

[2] M. R. Navya* and Prakash Ramachandran "Development Of Secured Home Automation Using Social Networking Sites" , Indian Journal of Science and TechnologyVol 8(20), IPL0116, August 2015.

[3] Ilkyu Ha, "Security And Usability Improvement On A Digital Door Lock System Based On Internet Of Things" International Journal of Security and Its Applications, Vol.9, No.8 (2015).

[4] S. Nazeem Basha, Dr. S.A.K. Jilani, Mr.S. Arun , "An Intelligent Door System Using Raspberry Pi And Amazon Web Services Iot" , International Journal of Engineering Trends and Technology (IJETT) , Volume 33 Number 2- March 2016.

[5] N. Ahmad, S. Butler, and U. Ramachandran, "GuardianAngel: An RFID based indoor guidance and monitoring system," 2010, pp. 546-551.

[6] Swetha.J, 2011, 'RFID Based Automated Bank Locker System', International Journal of Research in Engineering and Technology, Volume-1

[7] Joshua Bapu.J & Sirkazi Mohd Arif, 2013 'Locker security system using RFID technology' International Journal on Advances in Engineering and Technology, Volume 3

[8] G. Ostojic, S. Stankovski, and M. Lazarevic, "Implementation of RFID technology in parking lot access control system," in Proc. Annual RFID Eurasia Conference, 2007, pp. 1-5.