SMART HOME SECURITY USING RFID SYSTEM

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ABSTRACT

Radio Frequency Identification, (RFID) is an inexpensive technology that can be implemented for several applications such as security, asset tracking, people tracking, inventory detection, access control applications. RFID technology which is a matured technology that has been widely deployed by various organizations as part of their automation systems. The main objective of this project is to design and implement an RFID automatic access control system which resident need to use RFID card reader to access the door where only authentic person can be entered at their home. This system consists of two main parts which include: the hardware and the software. The hardware consists of the PIC 16F877A microcontroller, relay, magnetic lock, switch, LCD display, RFID reader and power supply circuit. Besides that, it also was implemented a security system containing door locking system using passive RFID which can activate, authenticate and validate the user and unlock the door in real time for secure access. The advantage of using passive RFID is that functions without a battery and passive tags are lighter and are less expensive than the active tags. The door locking system functions in real time as the door open quickly when user put their tag in contact of reader.

ABSTRAK

Radio Pengenalpastian Frekuensi (RFID) adalah satu teknologi yang murah yang boleh dilaksanakan untuk beberapa aplikasi seperti keselamatan, pengesanan aset, mengesan orang, pengesanan inventori, aplikasi kawalan akses. Teknologi RFID yang merupakan teknologi yang matang yang telah banyak digunakan oleh pelbagai organisasi sebagai sebahagian daripada sistem automasi mereka. Objektif utama projek ini adalah untuk mereka bentuk dan melaksanakan RFID automatik sistem kawalan akses yang pengguna perlu menggunakan pembaca kad RFID untuk mengakses pintu di mana -satunya orang yang sahih boleh dimasukkan di rumah mereka. Sistem ini terdiri daripada dua bahagian utama yang termasuk: perkakasan dan perisian. Perkakasan terdiri daripada pengawal mikro PIC 16F877A, relay, kunci magnetik, suis, paparan LCD, pembaca RFID dan litar bekalan kuasa. Selain itu, ia juga telah melaksanakan sistem keselamatan yang mengandungi sistem mengunci pintu menggunakan RFID pasif yang boleh mengaktifkan, mengesahkan dan mengesahkan pengguna dan membuka pintu dalam masa nyata untuk akses yang selamat. Kelebihan menggunakan RFID pasif adalah yang berfungsi tanpa bateri dan tag pasif adalah lebih ringan dan kurang mahal daripada tag aktif. Fungsi sistem mengunci pintu dalam masa nyata sebagai pintu terbuka dengan cepat apabila pengguna meletakkan tag mereka dalam hubungan pembaca.

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LIST OF ABBREVIATIONS

RFID	RADIO FREQUENCY IDENTIFICATION
PIC	PROGRAMMBLE INTERFACE CONTROLLER
ADC	ANALOG TO DIGITAL CONVERTER
LCD	LIQUID CRYSTAL DISPLAY
CPU	CONTROL PREIPHERALS UNIT

CHAPTER 1

INTRODUCTION

1.1 Background of the study

In our real life, security system plays an important role to prevent unknown user or robbery entry secured place without authorized from owner. 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. Basically, lock was easy be hacked by unwanted people allowing unauthorized people in. The lock system was not real practical used in security system and easy explores to high risk enable thieves hack this system.

Therefore, there was several automatic identification technologies including barcode, magnetic stripe and Radio-frequency identification (RFID) applied in security system. Radio-frequency identification (RFID) is an emerging technology

and one of most rapidly growing segments of today"s automatic identification data collection industry. RFID usage is steadily increasing and companies across many industries are 2 now looking at RFID to streamline operations, meet regulatory requirements and prevent the introduction of counterfeit product into the supply chain to protect both consumer safety and company profitability.

Industry experts view RFID not as competition with, but as a complement to barcode technology in many case such as tracking pallets, cartons and cases in a warehouse which both technology are used. RFID technology, in fact, overcomes certain limitations found in some barcode applications. Because it is not an optical technology like bar coding, no inherent line of sight is required between the reader and the tagged RFID objects. In addition, RFID transmits data wirelessly and is a read/write technology, so it can update or change the data encoded in the tag during the tracking cycle.

Since, the RFID technology used widely based on the business requirements of the organization for end users. This project will implement the RFID technology to replace the conventional lock system to tighten the security system in our homes. This RFID system monitor the incoming and outgoing people when they entry any door in house. All of the residents will use RFID tag which is their identification cards know as smart cards. The RFID reader transmits a signal that is received by an antenna intergraded and the chip is activate only when an RFID reader scans it. The doors will open about 2 second and if does not closed, the buzzer will sounded and LCD will display which doors or windows are opened.

1.2 Problem Statement

Smart home security using RFID systems were developed to reduce burglary cases and becoming popular in Malaysia today. In order to design smart home security system, the cost for RFID must be affordable so that ordinary people can own it. It is important to ensure that alert security system in high quality shape

although the price is not expensive as well as in markets. Besides that, most of the homes using conventional lock system and the thieves easily break down the doors or windows.

Another problem will be programming issue for the PIC16F877A. The complexity of the programming will need to have synchronization with the hardware so that the response is ideal. The programme itself is also very challenging and need to be debugged for errors before downloading it into the PIC. A study on the programming language is essential to complete the task.

1.3 Objectives

There are several objectives that have been recognized in this project and listed as below:

1. To introduce the use of RFID and its uses and functions in the Smart Home Security

2. To simulate the design circuit using Matlab and Proteus software

3. To improve the existing house system that used the key.

1.4 Scope of the Project

The applications cover aspects of personal, office, home and on the go. The purpose of this project for a home security system using RFID tags using the Tag Reader to open the security door, security door without a tag cannot be opened. These systems provide safety to the occupants of the house just using Tag to open the door. By introducing the uses of RFID systems that acts as a door opener to just use

a radio frequency signal. Meet the criteria of complete security. With this security system, users no longer need to fear their homes from theft and intrusion occurred.

There is some scope in implementing the "Smart Home Security System using RFID" that is:

• Searching for information in connection with a series of PIC microcontrollers, RFID, power circuit and control circuit.

• Designing electronic circuits and determined the components that will be used to produce a project.

• Understand how to write a program to be included in the PIC to execute the program instructions.

• Can be applied to homes, offices especially in places with the document or important things.

1.5 Project Outline

In brief, the report will contain 5 main chapters that will present the overall progress from the main idea to design and representing the results of the project. At the end, a conclusion will be made based on the findings after the completion of the project. Suggestions will be added along this chapter to provide ideas on how to make the design even better. Hence, the main contents of the report will be as the following:

The introduction is briefly discussed in chapter 1. In this chapter, the background of the research, objectives, problem statement, scope of the project and the outline are mentioned. Chapter 2 is about the background of the controller, switching circuit and the details about the component used for this project. For the circuit background, few types of circuit discussed. There are also included with the theory analysis about the smart home security system. Besides that, it also focused on the literature reviews of this project based on journals and other references. A detail

on the progress of the project then is explained in chapter 3. It is mainly focused on methodologies for the development of designing a circuit controller and switching for smart home security using RFID system. Chapter 4 discussed result and discussion for this project. This chapter explained detail about all information and the problem specification. The last chapter in this report is chapter 5. In this chapter the conclusion and recommendation of this project is discussed to ensure the main objectives of this project is achieved. All the obstacles faced and future researches are also discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The growing number of illegal entry cases over the years, require of many companies encouraged to design and production for automated door security systems. Door security systems are intended to look after houses, shops, offices and additional buildings from enforced entry and reduced the chances of theft. Door security systems can be install on dissimilar types of entries such as metal, wood, plastic, glass and fiberglass. They are existing in different conditions to outfit the security necessities of different types of buildings. Home security systems may contain of a PIN enabled electronic securing device, whereas top door security systems are regularly combine with invader alarms and security combination lock to offer greater security.

This chapter reviews some of the journal or studies which associated with this topic such as show effective use RFID technologies now generations in some application and reputation of a RFID system in security system .Besides, this chapter

analyses some principles for the important device used in this project. Therefore, some conventional door security system was explained here.

2.2 Radio Frequency Identification (RFID)

According to Harvey Lehpamer in studies of RFID design principles where Radio frequency identification (RFID) technology is interesting extensive attention as an accompaniment or even substitute for bar code because of the substantial range, speed and unattended reading advantages it affords. However, users should expect more than improved analysis before participating in an RFID system. RFID has read/write ability, and users can reveal the full worth and benefits of the expertise by taking advantage of the capability to add and change data on the tag in real time. Read/write RFID creates many new applications in the supply chain and helps accommodate changes in business processes, customer requirements or standards.[1]

RFID is expected to become persistent and universal, as it can be embedded into everyday items as smart labels. A typical RFID system comprises of a base radio transmitter/receiver, or reader, RF transponders or tags and the back-end database that associates records with tag data collected by readers. The RFID reader consists of an antenna, a radio interface, and a control unit that has an ability to interrogate and display electronic code held in a remote device, transponder and thus identify any item with which the transponder is associated. The reader control unit will execute the communication protocol with the tags and then interprets the data received from the tags. While the radio interface will perform detection, modulation and demodulation of the reader‟s signal and the tags replies. The readers communicate wirelessly with the tags to obtain the information stored on them. The data sent by the reader is modulated and backscattered from a number of tags.

RFID system is always made up of two components (Refer to Figure 2.1):

- The transponder, which is located on the object to be identified.
- The interrogator or reader, which depending upon the design and the technology used, may be a read or write/read device.

A reader typically contains a radio frequency module (transmitter and receiver), a control unit and a coupling element to the transponder. In addition, many readers are fitted with an additional interface (RS 232, RS 485, etc) to enable them to forward the data received to another system (PC, robot control system, etc).

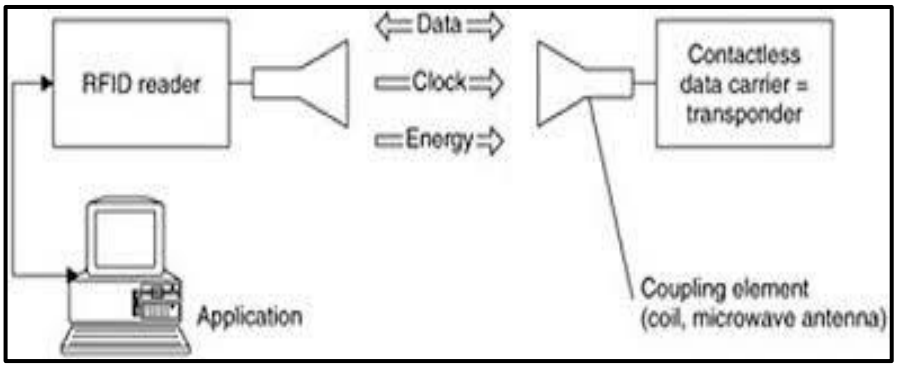

Figure 2.1: Transponder and Reader of RFID system

The transponder, which represents the actual data-carrying device of an RFID system, normally consists of a coupling element and an electronic microchip. When the transponder, which does not usually possess its own voltage supply (battery), is 5 not within the interrogation zone of a reader it is totally passive. The power required to activate the transponder is supplied to the transponder through the coupling unit (contactless), as are the timing pulse and data.

RFID system has better characteristic in identification system compared to others technology. Table 2.1 shows the advantages of RFID system according to system parameters given.

Table 2.1: Comparison between RFID systems with others technology systems

System parameters	Barcode	OCR	Voice Reorganization	Biometry	Smart card	RFID systems
Typical data quantity/byte	1-100	1-100	-	-	16-64k	**16-64k**
Data density	Low	Low	High	High	Very high	**Very high**
Machine readability	Good	Good	Expensive	Expensive	Good	**Good**
Influence of dirt/damp	Very high	Very high	-	-	Possible (contacts)	**No influence**
Influence of covering	Total failure	Total Failure	-	Possible	-	**No influence**
Influence of direction and position	Low	Low	-	-	Unidirectional	**No influence**
Degradation/wear	Limited	Limited	-	-	Contacts	**No influence**
Operating cost/Reading electronics	Very low	Medium	Very high	Very high	Low	**Medium**
Operating cost	Low	Low	None	None	Medium	**None**
Unauthorized copying/ Modification	Slight	Slight	Possible	Impossible	Impossible	**Impossible**
Reading Speed	Low – 4s	Low – 4s	Very low > 5s	Very low >5-10s	Low – 4s	**Very fast – 0.5s**
Maximum distance between data carrier and reader	0-50cm	<1cm	0-50cm	Direct contact	Direct contact	**0-5m microwave**

2.3 The Principle of RFID Technology

The RFID tag is essentially a memory device with a means of revealing and communicating its memory contents, when prompted (scanned) to do so. The memory consist of a plurality of binary (two state) digits, also known as bits, and the communication comprises RF reception and transmissions means. The binary data (bits) are formed into binary words comprising typically 8, 16 or 32 bits that can make up letters and numbers in the same manner as in computing, the Internet and texts on a mobile phone. The tag may comprise an electronic circuit (printed circuit board) with its own power supply – an active device; or be a very low power integrated circuit that is able to gain enough energy from the scanner/reader RF signal to actually power itself for long enough to transmit the contents of its memory–a so called passive device. In its passive embodiment RFID tag transmission power is very low and measured in millionths of a watt i.e. microwatts (μW). Figure 2.2 shows diagrammatically one of the latter style devices which may be found on products, particularly consumer durables.

Figure 2.2: Typical RFID Tag

The typical RFID tag portrayed in Figure 2.2, comprises a host substrate which is typically but not exclusively, a flexible (polymer), with an attached flexible etched aluminum alloy or conductive antenna, plus a small (few millimeters square) attached integrated circuit connected to the antenna. The whole assembly is typically 30 millimeters square, a fraction of a millimeter thick and is encapsulated so that it forms a flexible durable, attachable label. The data in the RFID tag memory may be pre-loaded (determine at time of manufacture) as Read Only Memory (ROM), or may be dynamically variable (Static Random Access Memory) and take up the status of the last write/read cycle. The data is always read out serially so that it can be correctly parsed. The information contained in the RFID tag memory is deliberately kept to a minimum and typically, dependent upon the data format (its syntax, numerical format – decimal, hexadecimal etc.) requires translating into a human readable form via host system.

2.4 RFID Reader

The RFID reader sends a pulse of radio energy to the tag and listens for the tags response. The tag detects this energy and sends back a response that contains the tags serial number and possibly other information as well. In simple RFID systems, the readers pulse of energy functioned as an on-off switch; in more sophisticated systems, the readers RF signal can contain commands to the tag, instructions to read or write memory that the tag contains, and even passwords. Historically, RFID reader were designed to read only a particular king of tag, but so-called multimode readers that can read many different kinds of tags are becoming increasingly popular.

RFID readers are usually on, continually transmitting radio energy and awaiting any tags that enter their field of operation. However, for some applications, this is unnecessary and could be undesirable in battery-powered devices that need to conserve energy. Thus, it is possible to configure an RFID reader so that it sends the radio pulse only in response to an external event. For example, most electronic toll collection systems have the reader constantly powered up so that every passing car will berecorded. On the other hand, RFID scanners used in veterinarians offices are

frequently equipped with triggers and power up the only when the trigger is pulled. Like the tag themselves, RFID readers come in many size. The largest readers might consist of a desktop personal computer with a special card through shielded cable. Such A reader would typically have a network connection as well so that it could report tags that it reads to other computers. The smallest readers are the size of a postage stamp and are designed to be embedded in mobile telephones.[2]

Nowadays lot of RFID reader sold with multiple brands such as Mifare, Hitachi, and Philip. Because of the major application used in worldwide, many systems require the simultaneous use of more than one operating frequency. Most systems available on the world market at present operate at one of the following frequencies or frequency ranges: below 135 kHz (125 kHz, 134.2kHz for example), 13.56MHz, UHF (860/960 MHz), 2.45GHz and 5.8GHz. The operating and control characteristics are different for each of these frequencies, and therefore each of them is more appropriate for certain types of application or certain countries.

2.5 RFID Tag

The tag, also known as the transponder (derived from the terms transmitter and responder), holds the data that is transmitted to the reader when the tag is interrogated by the reader. The most common tags today consist of an Integrated Circuit with memory, essentially a microprocessor chip. Other tags are chipless and have no onboard Integrated circuit. Chipless tags are more effective in applications where simpler range of functions is all that is required; although they can help achieve more accuracy and better detection range, at potentially lower cost than their Integrated Circuit-based counterparts. From here on out, we will use the term tag to mean Integrated Circuit15 based tag. We will refer to chipless tags explicitly, when needed. RFID tags come in two general varieties which are passive and active tag. Passive tags require no internal power source, thus being pure passive devices (they are only active when a reader is nearby to power them), whereas active tags require a power source, usually a small battery. [4]