A DEVELOPMENT OF SMART AUTOMATED HOME SECURITY SYSTEM

This report is submitted in accordance with the requirements of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Manufacturing Engineering (Robotics and Automation)(Hons.)

by

TEOH YEN TING

B051310072

930213-02-5174

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for Degree of Manufacturing Engineering (Robotics and Automation) (Hons.). The members of the supervisory committee are as follows:

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(Dr. Fairul Azni bin Jafar)

ABSTRAK

Laporan ini mendokumentasikan perjalanan projek bertajuk “A Development of Smart Automated Home Security System”. Demi menyelesaikan masalah sistem keselamatan rumah yang mahal dan tidak menyeluruh, sebuah sistem keselamatan rumah pintar berautomasi dicadangkan. Objektif demi mencapai matlamat tersebut adalah membangunkan sebuah sistem yang rendah kos-nya, menghasilkan sebuah prototaip yang berfungsi, serta menguji dan membandingkan prototaip yang telah siap dengan produk lain di pasaran. Di sistem ini, sebuah Arduino Mega digunakan sebagai pengawal sistem. Sistem tersebut dibahagikan kepada dua bahagian utama, iaitu perkakasan dan perisian. Bahagian perkakasan termasuk fabrikasi prototaip dan sambungan komponen elektronik. Pada bahagian perisian pula, Arduino serta komponen-komponen berkaitan diaturcarakan menggunakan kod berdasarkan C dalam Arduino IDE. Setelah siap membina prototaip, pengujian dijalankan demi memastikan prestasi dan kebolehpercayaan sistem. Fungsi kemasukan menggunakan kad dan kata laluan diuji dan keputusan ujian dianalisis. Daripada pengujian, kebolehpercayaan sistem dari segi memberikan keselamatan kepada rumah dibuktikan. Semasa pengujian, hanya kad RFID yang ditentukan dan kata laluan yang betul boleh mengaktifkan sistem supaya buka kunci pintu. Akhirnya, maklumat mengenai produk pesaing pada pasaran dikumpul dan dibandingkan dengan sistem yang telah siap. Berbanding produk yang hampir sama ciri-cirinya, sistem yang dihasilkan ditemui lebih berpatutan kerana boleh memberikan fungsi yang sama pada harga yang lebih rendah.

ABSTRACT

This report documents the progress of the project “A Development of Smart Automated Home Security System”. In order to solve the problem of home security systems that are expensive and not comprehensive, a smart automated home security system is proposed. The objectives in order to achieve this final goal are to develop an affordable system, fabricate a working prototype, and test the created prototype as well as compare it against other products on the market. In the system, an Arduino Mega is used as the system controller. The system is divided into two main parts, hardware and software. The hardware portion includes the fabrication of the prototype and the connection of electronic components. On the software side, the Arduino and its components are programmed in a C based code within Arduino IDE. After completion of the prototype, testing is done to verify the performance and reliability of the system. The card and password entry functions are tested and the results of the testing are analyzed. From the testing, it is found that the system is reliable in providing security to a home. During the testing, only the designated RFID cards and the correct password were able to unlock the door. Finally, information regarding competitor products on the market is collected and compared with that of the completed system. Against products of similar features, the completed system has a greater value as it is able to provide the same features at a lower cost.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATONS

CCTV	-	Closed Circuit Televison
GSM	-	Global System Mobile communication
HTTP	-	Hypertex Transfer Potocol
IoT	-	Internet of Things
LCD	-	Liquid Crystal Display
LPG	-	Liquid Petroleum Gas
PC	-	Personal Computer
PIN	-	Personal Identification Number
SMS	-	Short Messaging Service
SSH	-	Secured Smart Home
USB	-	Universal Serial Bus

CHAPTER 1
INTRODUCTION

In this chapter, the introduction of the home security system which includes the background of home security system is discussed. The motivation of this project is also discussed to describe the inspiration for the project. The problem statement, objectives, scopes and report structure are also discussed.

1.1 Background

Nowadays, people are living in this 21st century where crime rates are increasing and everybody wants to secure the safety and assets in their house. Security has become an important aspect of everyday life. Hence, various kinds of technology have been designed to provide security at all times to protect their assets and privacy.

The home automation and security system has been existed for some time and uses the concept of monitoring and controlling the home appliances or devices (Junoh and Mansor, 2012). According to Min (2013), there are a few terms that are fit with the Smart Home such as Home Automation and Home Networking. The Smart Home concept includes security, entertainment, communications convenience and transferring data systems. For home security systems, it is an essential means of protecting our home and to keep their welfare safe. Home security system is a facility that design to monitor the features of the house such as door, windows, closed-circuit television (CCTV) and alarm. Surveillance system is an important facility that should be installed in house area. With the application of security system, it can reduce the crime rate in society especially crime of theft at home. Due to the problem, making people requires a security technology in term of getting information easily and quickly so that alert to crime.

Security systems can range from a simple door lock to very complex systems depending on what the homeowner is willing to spend. With time, home security systems have become more sophisticated and advanced by implementing several technologies like sensors, camera/webcam, locking systems for door and window. However, this comes at an increased cost to the consumer. All of these cause problems for people who cannot afford the system in their house.

1.2 Motivation

There are many home security systems on the market which can improve the living condition. But, there are lacking of affordable home security systems which contain few specific systems. In order to achieve the project, an affordable system has to provide because there are already many options in the field of security system which were often absurdly expensive with having highly payment for every month. The issue nowadays are that home security systems that exist in the market have monthly fee, some are non-user friendly to many individuals

Hence, this project aims to implement a system that is both inexpensive and a one-time cost. There is a good amount of potential for a solution such as this in the current market. By creating a system which is user friendly, effective and low cost will help people with low income to improve their living standards and afford the same security as high income homes.

A majority of consumers are interested in new features and functionality that are enabled by connected home technology. Most of them would be interested in network-connected cameras as part of smart home-enable security service. It is because instead of using traditional lock, it can be implemented in several technologies like keyless lock, cameras, sensors and wireless technologies.

1.3 Problem Statement

Currently, one of the main issues of the home security systems that people face in the market, is that these systems can be expensive, unreliable and non-user friendly. It is because home security systems are often expensive. They are tend to be scattered, and usually for one specific system only. While traditional home security requires professional installation and often comes with a multi-year commitment and installation. Hence, they are not comprehensive. To solve this problem, this project is purposed to create the home security system which should be user-friendly, effective and low cost. In additional, the system should be simple enough to understand and manipulate. Therefore, the purpose to create the system is making homes more secure for an affordable price.

1.4 Objectives

The objectives of this project are:

i. To develop a smart automated home security system for an affordable price.
ii. To fabricate the prototype with complete home security system.
iii. To analyze the performance of smart automated home security system.

1.5 Scope

The scopes of this project are:

i. Understanding the concept of home security system especially in the concept of authentication system and surveillance system.

ii. The project will complete up until the prototype with the complete system. The scale drawing for the prototype is 1:10.

iii. The authentication system by implementing RFID based automatic door system.

iv. The controller for the home security system interfaces with the authentication system and locking system is Arduino because it is flexible and easy to interface with systems.

v. The every sub-system is going to analyze by conducting the experiments to achieve the expected result.

1.6 Summary

In this chapter, the background of smart homes and automated home security systems has been discussed. The problem the project aims to solve as well as the corresponding proposed solution has also been given. In the last two sections, the objectives of the project are stated and the scope is defined.

CHAPTER 2
LITERATURE REVIEW

The literature review undertaken as a part of development of an automated home security system. This chapter will discuss home security system in previous researches and journals. From this, the detail information and useful knowledge can be obtained so that can give the idea for this project. To clarify the idea for this project, understanding the every related research and journal papers and summarizing the information will be done in this chapter.

2.1 Home Automation and Security

Sabeel and Chandra (2013) stated that the home automation system can have different degrees of intelligence and complexity. Home automation is not only to give facilitate and convenience to the user but also can minimize the wasted energy and ensure home environment security. An ideal home automation has the functionality to sense its surroundings, technique and operate little to no supervision. The home automation is reliable, user-friendly and secure.

Vishy *et al*. (2005) defined that a home security system is a system which carries an advance automation technology to provide its inhabitants with the help of monitoring and controlling facilities. Within the past few decades, the market of home automation has increased due to high demand. The home security system may have automated facilities include following:

i. Controlling light
ii. Automated door
iii. Controlling fans or air conditioners
iv. Automated window or curtains

Gayathri and Paramathma (2014) defined that the automation is the usage of control systems and technology to manipulate device, industrial machineries and processes so that the need for human intervention is reduced. As population increases, there is furthermore an increase within the demand of standard of living and home automation plays an important technology for improving the quality and security of the house. Shepard (2005) stated that a smart home includes of three parts as following:

i. Internal home network
ii. Intelligent control and
iii. Home automation with wired/wireless access gateways

According to Greichen (1992), the idea of home automation has been during since the late 1970s. But by all of the advancement of technology and services, people's expectations on what their house should do or at which point the services should be provided and accessed at home has changed a lot around the branch of knowledge of anticipate, then has the concept of home automation systems. If review at the different home automation systems from one end to the other time, they always tried to provide useful, efficient, convenient and safe for home environment to secure their homes. Regardless of the change in expectations of users, advancement of technology, the performance of a home automation system has remained at the same.

Greichen (1992) discussed that some of the early challenges faced by home automation systems. These challenges are listed in following:

i. Valuable manufacturing costs
ii. High installation costs,
iii. High development costs
iv. Lack of home automation standards
v. Consumer unfamiliarity with technology
vi. Complex user interface

A lot of these factors contributed to addressing the challenges and worries of early domestic automation systems, which result in the recognition and wide acceptance of automatic homes. Shepard (2005) discussed the main obstacles in modern home automation systems are the high overall cost of the system, inflexibility due to integration of different devices into the system. Lack of reliable devices and reliance on consumer are one of the obstacles. These factors result in bad manageability by users and lack of convincing security. Nowadays, smart homes include excess of devices like multiple camera, different sensors, actuators, home database and device controller. These devices can be remotely accessed convenience for users.

According to Arun *et al*. (2009), the development of technology has contributed to the converting concept of safety in modern homes. It has modified from a simple lock and key protection concept to enforcing sophisticated security systems by using contact sensors, alarms, cameras, proximity sensors and so on. The users can get admission to and control their house remotely at anytime and anywhere by connecting modern house to the internet which is popular nowadays. The growth in processing energy of designed processors and the significant minimization in power consumption, length, and value of electronic gadgets allows people to recognize and manage every aspect in their home. By using live video and audio feeds from different parts of their home to keep their house safe. The users can be aware different environmental elements outside and inside their house, like light intensity, humidity and temperature.

Author Choudhury (2013) wrote that an important part of home security system is to allow various types of electrical devices and electronic gadgets to engage and communicate with each other.

Shepard (2005) gave an example for the home security system which can be installed, programmed and managed. However, different users would have different configurations for a theatre environment and consequently the system needs to be easy reconfigure and very flexible so that can be adapted for every consumer needs. The following are few examples of features that can be included in home automation system:

i. Security System: The system can be automated and integrated with other house gadgets. Systems can be responded to voice and biometric data while locks which might be opened with codes or swipes cards. Besides, even as the users are on vacation they are able to see images of cameras, get hold of messages from house and set the alarms.

ii. Intelligent Climate Control: Based on excluding parameters, the heating and air conditioning can be set to specific level which including expected and real occupancy, the inside temperature, weather forecast. This system also can be controlled remotely. This can help in financial savings mechanism, lowering the amount of power wasted on needless cooling and heating, but guarantees on the equal time that the residence is at the proper temperatures always.

iii. Lighting: Lighting fixtures systems can be programmed to switch off in certain lights conditions, reducing lighting wasted and cost. Lights may be set to interchange on routinely while one person enters a room, and decreasing electricity consumption.

Weinstein (2005) wrote that home automation system represents a great research opportunity to upgrade the security and the standard of house. From this system, the home devices or appliances may be controlled mechanically from anywhere and anytime. The link between each home appliance is shown as Figure 2.1.

Figure 2.1: Automated Control of home devices (Adriansyah and Dani, 2014).

Seo and Cho (2012) also explained that the sophisticated monitoring and control facilities over different type of functions. Normally the home equipment and gadgets internal home are linked to specific sensors. Hence, the human labour and physical effort will be reduced by sensing to their desires automatically. Nowadays, most systems use microcontrollers to centralize the whole system and act as a core for automation circuit layout. The most common microcontrollers are used on the system such as Arduino Mega and Rasberry Pi. The construction details is shown in Figure 2.2 block diagram, so that the input, output and microcontroller can be shown properly. The technology used by the authors is GSM which interface with arduino mega and send the notifications if any fire accident or LPG leakage happen.

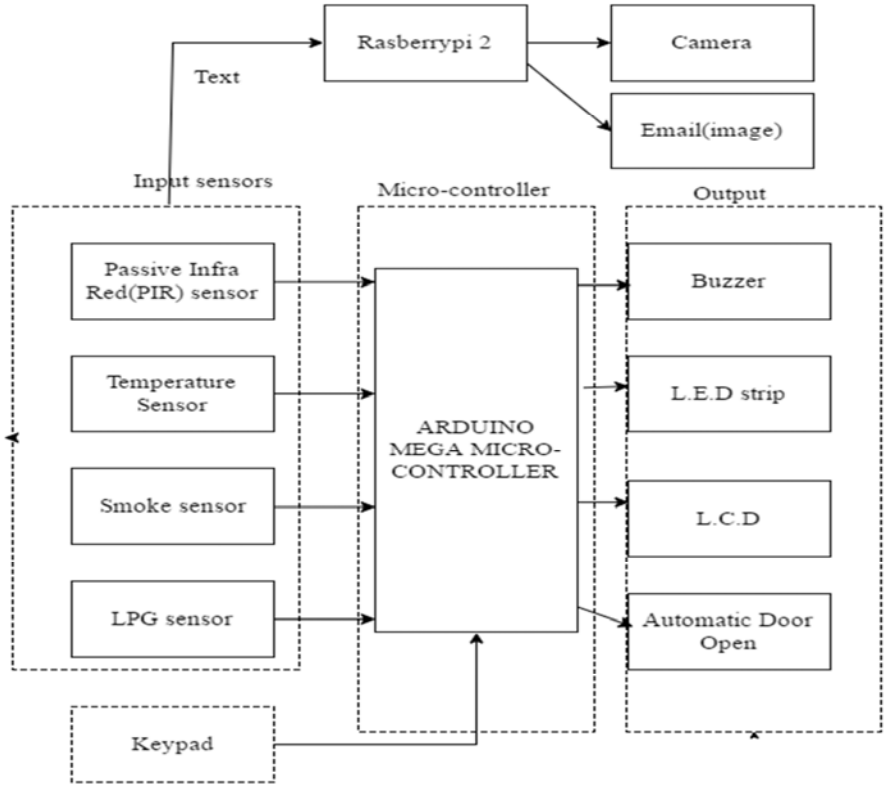

Figure 2.2: Block diagram of proposed home security system (Suhail,2016).

2.2 Authentication System

According to Finkenzeller (2003), with the speedy development in technology, there are several existed security and authentication mechanisms which can be planted in a smart home. There are include the use of codes like Personal Identification Number (PIN), passwords and security tokens like smart card and biometric authentication methods.

For authentication system, this project focused more on RFID authentication system. RFID, radio frequency identification is lower cost than biometric system. RFID can be applied for numerous application such as security, people tracking, access control applications, inventory detection, asset tracking. RFID enables wireless data transmission which is inexpensive technology (Verma, 2010).

RFID is a smart era technology which uses radio wave for identifying and tracking the object by sending data from an electronic tag, called RFID tag, and through a RFID reader. It provides a touch less facts hyperlink, without need for line-of-sight or worries approximately harsh or dirty environments that restriction different automobile identity technology inclusive of bar codes. RFID includes the use of electromagnetic or electrostatic coupling in the radio frequency component of electromagnetic spectrum which is to uniquely recognize an object or person (Nwaji, 2013).

According Weinstein (2005), RFID system consists of two parts which are RFID reader and transponders also knowns as tags. Generally, the familiar RFID systems as seen as following:

i. Access Control

   A person requires their proximity card to be read by RFID reader which placed at entrances so that the access can be made.

ii. Contact less Payment System

   Usually RFIDs are used in electronic Toll collection to carry payment information by using RFID tags. The tags carried by the driver and transmitted payment information to a fixed reader which attached at Toll station.

iii. Product Tracking and Inventory Control

   Tracking and recording the movement of items or products such as factory pallets, library books, and clothes are used the RFID systems too.