" I hereby declare that I have read through this report entitle "*Smartphone controlled Mobile Security Robot* " and found that it has comply the partial fulfilment for awarding the degree of *Bachelor of Mechatronics Engineering*".

Signature : .....

Supervisor's Name : .....

Date : .....

SMARTPHONE CONTROLLED MOBILE SECURITY ROBOT

DNASH KUMAR A/L MOHAN

A report submitted in partial fulfilment of the requirements for the degree

of Bachelor of Mechatronics Engineering

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

YEAR 2011/2012

I declare that this report entitle "*Smartphone Controlled Mobile Security Robot*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : .....

Date : .....

I dedicate this research work to my supervisor, Mr. Ma Tien Choon who teach and guide me, to my family who supports me in everything and to my friends who helped me finished this project.

ACKNOWLEDGEMENT

First of all, I would like to thank to God because I managed to complete the Final Year Project report on time, without face any difficult problem.

I want to thank to both of my parents, En.Mohan and Pn.Manimekala A/P Beeman and my entire family member who not stop encouraging me and always be there for me when I need them.

I will never forget all of their hard work in supporting me especially in financial aspect. Without them I will not be able to complete my FYP here. In order to complete this report, I had done a lot of researches from various types of source. I had to counter with journals, books, magazines and internet to understand and get the larger view of my project. I also had consulted with many people, researchers, and academician in order to make my project more success. They have played important role in contributed towards my understanding and thought.

In particular, I wish to express my sincere appreciation to my main project supervisor, En. Ma Tien Choon, for him help encouragement, guidance critics and friendship. Without him continuing support and interest, this project would not have been same as presented here.

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Thank you.

ABSTRACT

In this modern era, home security system is an importance issues to human daily life. Conventional security systems have various restrictions and shortcomings. For example the conventional security system like surveillance cameras is to install in each rooms of the house, which not practical due to the cost and privacy problem. Therefore, a robotic technology with security system is proposed. Thus the main aim of this project is to design and develop a Smart phone controlled – based mobile security robot. The mobile security robot has a PIR sensor system for intruder detection, infra-red sensor for autonomous movement and obstacle avoidances. Besides, user can also observe a real-time video and monitor the surrounding environment via a webcam built in net book. Thus, giving them a sense of relief whenever they are away. Furthermore, these project targeting to develop low cost mobile security robot because that everyone can buy this product and easily to use.

ABSTRAK

Di zaman moden ini, sistem keselamatan rumah merupakan satu isu penting dalam kehidupan harian manusia. Sistem keselamatan kovensional mempunyai pelbagai sekatan dan kelemahan. Misalnya sistem keselamatan kovensional seperti kamera pengawasan mempunyai “blind spot” kawasan. Bagi mengelakan masalah ini teknologi robot dengan sistem keselamatan diajukan. Tujuan utama projek ini mengawal robot dengan “smart phone”. Robot yang dicadangkan mempuyai “PIR sensor” untuk pengesanan penceroboh dan “infra-red sensor” untuk mengerakkan robot autonomi dan mengelakkan halangan.Selain itu, pengguna juga boleh mengawasi rumah mereka dengan menggunakan “webcam”. Projek ini mensasarkan membangunan kos rendah robot keselamatan kerana semua orang boleh membeli produck ini dengan mudah.

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LIST OF ABBREVIATIONS

IR – Infra red

PIR- Passive infrared

MSR-Mobile security robot

Led-Light emitting diode

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CHAPTER 1

INTRODUCTION

1.1 Chapter overview

Chapter 1 introduces the general view and background of this project with the title of "smart phone controlled mobile security robot". This is an individual project and is separated into two major tasks:-

i) To design a mobile security robot.

ii) To control the mobile security robot by using smart-phone via internet.

This chapter is divided into four sections. First section is a general preview of this chapter. The second section gives a simple explanation of the problem statement follow by section three which defines the objectives to achieve throughout the project. The last section described about the scope of the project.

1.2 Problem statement

Nowadays, people pay more attention on home security system in these modern days. This is because living in safe environment has becomes a critical issues for human. For examples, unexpected events like burglary, fire, medical attention and children's safety. Hence, to overcome this problem, many academic researchers and multinational companies has work together to design a variety of home security system. However, the cost upon purchase and to maintain is high and most of the mid-class community would consider unfavourable to have one installed in their household.

Based on the above situation, a robotic technology combine with security system is proposed and comparison diagram between the proposed and traditional security system is shown as figure1.1 and figure1.2.

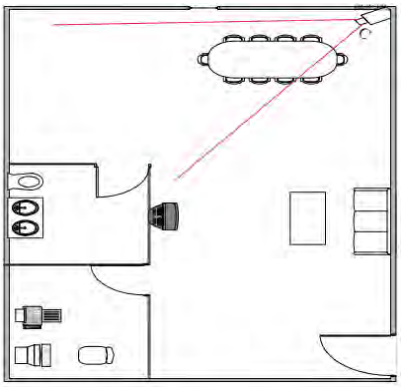

Figure 1.1: Traditional Security System

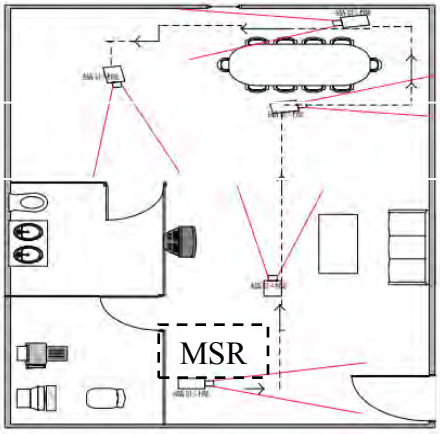

Figure 1.2 : Proposed Security System

A mobile security robot, act as a security patroller in the security system, which capable of recognizing prospective hazards to humans being in advance and can monitor those dead zones of the traditional fixed surveillance system. The mobile security robot can control through smart-phone by using “remote-desktop software” at anytime anywhere. However, the robot will patrol semi-autonomously around specific designed area, capable to detecting human movement and gives feedback to the users. Furthermore, this mobile security robot will give a sense of relief when the user leave their house as they will be able to see what is happening in their homes. However this mobile security robot is constructed economically so that everyone can buy this product and easily to used.

1.3 Objective

The main objectives of this project are:-

1. To design and establish basic mechanical structure of the robot.
2. To control mobile security robot through smart-phone via internet.
3. To implement communication between laptop and microcontroller.
4. To analyze the passive infrared sensor (PIR) in detection motion and infrared sensor in proximity detection.

1.4 Scope

The scope of this project covers the design, development and testing of the smart phone controlled-based mobile security robot. The scopes include:

1. Patrol Mobile security robot on flat surface, used indoor environment, avoid obstacle less than 30cm, detect human present within range of 6 meters and able to operate less than eight hours on a fully charged battery.
2. Testing of the performance of the mobile security robot.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, a review of several previous research projects which are related with this project's purpose and objective is discussed. Thus, a comparison will be made between the previous projects result be displayed in table. However in this chapter also we include a comparison table for sensor chosen for obstacle avoidances.

2.2 Review of previous project related with "Mobile security robot"

2.2.1 Overview

There are various type of mobile security robot has been developed with different features. Each developed of mobile robot has its own pro and cons. 3 papers related to my project were comparing in term of price, size, and intruder detection and user friendliness.

2.2.2 Security service system using Mobile Robot by Yoichi Shimosasa

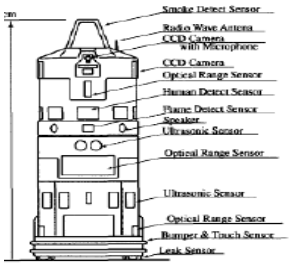

Figure 2.1: Robot Height

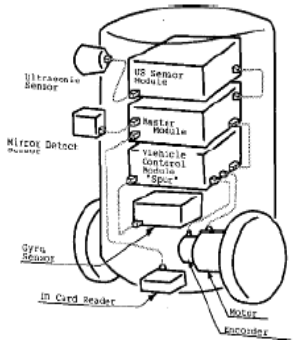

Figure 2.2 : Navigation Parts

Based on this project has been developed by Sogo Security Services Co in the year of 1999. The purpose of this system is to secure reduction of labor and guard's safety. This guard robot patrols through the given path in the building in every two hours automatically and at the same time as patrolling, the guard robot sends images and sensor data of each sensor to the monitoring equipment. A security guard, who is usually stayed at the center station, gets the information on monitor together with information from other robots or sensors. In case of anything unusual, the guard will cope with it, remotely from the station, or going to the place. This type of robot gives feedback to user by displaying the actual image. The robot is divided into top and bottom part. The top part is consisted with the guard function, and the bottom part is devoted to autonomous motion and navigation. The guard robot has two driving wheels at left and right of body center, and four casters at front and back to support the body. Encoders are mounted at driving wheels to realize odometer system [1]. The vehicle control module estimates the robot position based on the wheel rotation and optical fiber gyro sensor, and controls the driving wheels. The sensor of the guard is installed on top of the robot. It has smoke sensor, human body detection sensor, flame detection sensor, and leak sensor. The smoke sensor detects smoke by the reflection level of the light. The human body detection sensor detects infrared rays which come out from the human body. The flame detection sensor detects the ultraviolet rays which appear from the flame. The leak sensor detects conductive rate of water [1].Since it consists two parts which are autonomous and guard function part, it requires a lot of space to mount the entire sensor and other component. This result contributes in increasing the size of the robot. The robot become bulky and hard to move around if any obstacle is present in front of it. Furthermore, it become heavy thus makes it patrolling slowly in a certain area and needed longer time to do it task. Compared to the project which smaller in size is making it

less weight, stable, moving fast and easily avoid any obstacle whether it big or small so that it can easily move around in small space area.

2.2.3 Security Guard Robot by Ali Nasser Alshamma

Florida International University has been developed a product in 2009 called Autonomous Security Guard Robot which is a robot system that includes an autonomous mobile robot system. The robot monitors an area going through a predetermined path. The robot travels from predetermined spot to predetermined spot, in predetermined time intervals. Along the path the robot periodically takes photographs of its surroundings which are stored on the robot itself. When a user sends a request for taken photographs via cell phone, the pictures are sent to the user. The system comprises of a travel mechanism, camera, a storage section, and a control section which follows predetermined instructions for travel, photo capturing, storage and sending images. The receiving section will sends data to external locations and sends images from the storage section to requesting external device. This system also periodically collects sound which is stored on board of the robot. Any suspicious sounds will cause the system to send an alert to the user's external device, and ready to transmit to the user. It has a camera to photograph its surroundings, control section that determines where the robot will go and where the robot will take pictures which are predetermined, 16 storage sections that store the photographs and communication section that communicates with an external device which is ready to send photos to the user. This type of robot that uses a camera to snap a picture is very good in term of feedback. However, the price of the robot will become expensive due to the hardware. To have a better quality of the picture it needs a camera with high pixel. The higher the pixel the expensive the camera will be. Therefore, if this system uses a low quality of camera it will not effective due to the low quality of picture that has been taken.

2.2.4 Design and Development PIC- Based Robot by Gow Moh Kee

University Malaysia Pahang had done a project “Design and Development PIC-Based Autonomous Robot” that was developed in 2008. The robot is equipped with the obstacle-avoidance ability which uses the IR sensors and the robot can play pre-recorded messages. Those pre-recorded messages are stored in the Win bond ISD 2560 Chip order. Firstly the robot will sound "Autonomous robot on" and move forward when power is on. When it senses obstacle at right, it will sound "Obstacle at right, turning left" while when it senses obstacle at left, it will sound "Obstacle at left, turning right". The robot will continue to move forward if no obstacles. If the robot senses the obstacle in front of it, it will sound "Obstacle at front, reversing" and reverse for 2 seconds, then it will turn right before it continues to move forward. The autonomous robot controller board is designed around the PIC 16F877A, which contains 5 Input/output (1/0) ports with 33 I/0 pins. There are two IR sensors on this robot, right IR sensor and left IR sensor. Each IR sensor consist an infrared emitter and an infrared receiver. The infrared emitters are emitting at the frequency generated by the 555 Timer. The robot is designed two layered. The upper layer is the infrared sensor and the ISD 2560 Chip coder. Then the lower layer is the controller board which is attached to the chassis of the robot. In this project, the programming language used is Pic Basic. It used IR sensor to detect obstacle and give signal to microcontroller to instruct the robot to avoid it. It uses PIC16F877A to control all the movement of the robot. Figure 2.14 shows the hardware of the project.

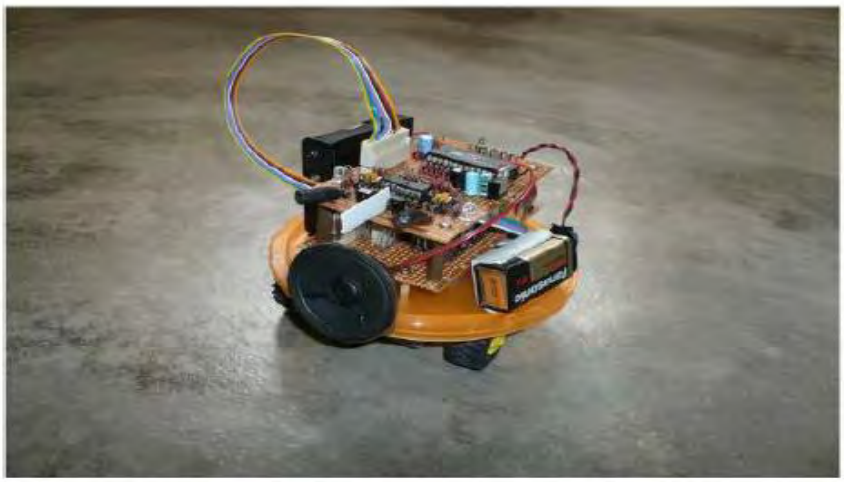

Figure 2.3: PIC Based Mobile security robot

2.3 Comparison Between previous projects

Table 2.1 below shows the conclusion of comparison between previous projects in different characteristics. These 3 projects are focusing on developing the robot that can autonomously move with/without human control. The robots are design to give users information when the sensors of the robots detect.

Title	Security Service System using Autonomous Mobile Robot	Autonomous Security Guard Robot	Design and Development PIC-Based Autonomous Robot
Author	Yoichi Shimisasa	Ali Nasser Alshamma	Gow Moh Kee
Company	Sogo Security Service Co.	Florida International University	University Malaysia Pahang
Functions	Guard robot makes the patrols runs through the given path in the building in every two hour automatically	Guard robot patrols autonomously in an area to detect intruder	Play pre-recorded messages
Feedback	Give feedback to user by sending image to the monitor at centre station	Give feedback to user by sending alarm.	Give feedback to user by playing pre-recorded messages
Robot design	The robot consists of two parts which are guard and navigation	The robot using dc motor to move around, sonar sensor to detect obstacle and 2 passive infrared sensor to detect motion	It consists of mechanical and electronics parts. For electronics it use PIC16F877A while mechanical it use Tamiya Twin-Motor Gearbox
Size	158cm height	-	Lessthan 30cmx30cmx30cm
Price	-	>RM1000	<RM400
Component	• Smoke sensor • Human body detection sensor • Flame detection sensor • Leak sensor	• Microphone • Ultrasonic sensor •Passive infrared sensor	• Infrared sensor •Winbond ISD 2560 Chipcorder to stored messeges
Controller	-	UseAT89C51 microcontroller	UsePIC16F877A microcontroller
Software	-	Keil C51 Compiler	PicBasicfor programming

Table 2.1: Comparison of Previous Project

2.4 Sensor selection for obstacle avoid

2.4.1 Infrared Distance Sensor

Figure 2.4: Infrared Distance Sensor

IR distance sensors are measuring sensor units, composed of an integrated combination of PSD (position sensitive detector), IRED (infrared emitting diode) and signal processing circuit. The variety of the reflectivity of the object, the environmental temperature and the operating duration are not influenced easily to the distance detection because of adopting the triangulation method. This device outputs the voltage corresponding to the detection distance. So this sensor can also be used as a proximity sensor.

Features

1. Less influence on the color of reflective objects
2. Line-up of distance output/distance judgment type
   Detecting distance: 10 cm to 80 cm
3. External control circuit is unnecessary
4. Low cost

Technical specifications

Table 2.2 : Technical Specifications of Infrared Distance Sensor

No	Specification	Value
1	Supply voltage	4.5 to 5.5 V
2	Average supply current	33 mA
3	Measuring distance range	20-80cm
4	Temperature	-10° to 60°C
5	Size	13mm x 29mm x 13.5 mm
6	Weight	5g