

SURVEILLANCE ROBOT

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"Dedicated to my parents, my siblings and also my colleagues and friends who have been supporting me all the time"

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ABSTRACT

Nowadays, surveillance system is used in order to observe specific activities or areas in purpose of managing, directing or protecting. By using the surveillance system, the users are able to monitor and identify if something abnormal happens and further action can be taken after that. However, since the typical surveillance system such as Closed-Circuit Television (CCTV) is using a static camera, the image captured is in single viewing angle and it is difficult to get effective image. The purpose of this project is to build a "Surveillance Robot" that can be used to visualize image captured on-site. This mobile robot that equipped with camera is controlled by human using a computer wirelessly via Zigbee wireless technology. The image visualize by this Surveillance Robot can be more efficient compared to other typical surveillance system since its multiple viewing angle can be varied.

ABSTRAK

Pada masa kini, sistem pengawasan digunakan untuk memerhati aktiviti atau kawasan tertentu bagi tujuan mengurus, mengarah atau melindungi. Dengan menggunakan sistem pengawasan, pengguna boleh memantau dan mengenalpasti jika sesuatu yang tidak normal berlaku justeru tindakan selanjutnya boleh diambil selepas itu. Walau bagaimanapun, oleh sebab sistem pengawasan yang biasa seperti televisyen litar tertutup (CCTV) menggunakan kamera statik, dimana imej yang dirakam adalah dari sudut paparan tunggal dan ia memberi kesukaran untuk mendapatkan imej yang berkesan. Tujuan projek ini adalah untuk menghasilkan "Robot Pengawasan" yang digunakan untuk menggambarkan imej yang dirakam di tapak kawasan. Robot mudah alih yang dilengkapi dengan kamera ini dikawal oleh manusia menggunakan komputer secara tanpa wayar melalui teknologi tanpa wayar, ZigBee. Imej yang dihasilkan oleh Robot Pengawasan ini lebih berkesan berbanding dengan sistem pengawasan biasa yang lain kerana pelbagai sudut paparan yang boleh diubah-ubah.

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LIST OF ABBREVIATIONS

PIC	-	Programmable Integrated Circuit
GUI	-	Graphical User Interface
MCU	-	Microcontroller Unit
DC	-	Direct Current
LED	-	Light Emitting Diode
CCTV	-	Closed-Circuit Television
RF	-	Radio Frequency
IP	-	Internet Protocol
RC	-	Remote Control
GPS	-	Global Positioning System
CMOS	-	Complementary Metal-Oxide-Semiconductor
CIF	-	Caltech Intermediate Form
PCB	-	Printed Circuit Board
PWM	-	Pulse Width Modulation
ADC	-	Analog-to-Digital Converter
RX	-	Receiver
TX	-	Transmitter
Li-Po	-	Lithium Polymer
GND	-	Ground

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CHAPTER 1

INTRODUCTION

1.1 Overview

Surveillance system is a type of system that been used to observe specific activities or areas in term of managing, directing or protecting purpose [1]. By monitoring the certain activities or areas every time using the surveillance system, the users are able to know if something abnormal happens and further action can be taken after that.

According to Tom Harris [2], robot is an electro-mechanical machine that is controlled by a computer program or electronic apparatus. It is being used to give convenience to human by doing specific task. Robots are able to execute the task that impossible or beyond capability of human. From this advantage, it can gives many advantages in term of safety, ease and efficiency.

Surveillance system and robots are two different systems that carry out their own task respectively. The main inspiration for this project is to combine these two systems to produce a mobile robot equipped with a camera as an intelligence surveillance system. By using this *Surveillance Robot*, the image visualize can be more efficient compared to other typical surveillance system since its multiple viewing angle can be varied. This robot can be used as a medium for a monitoring system wirelessly by remotely-controlled by human via computer.

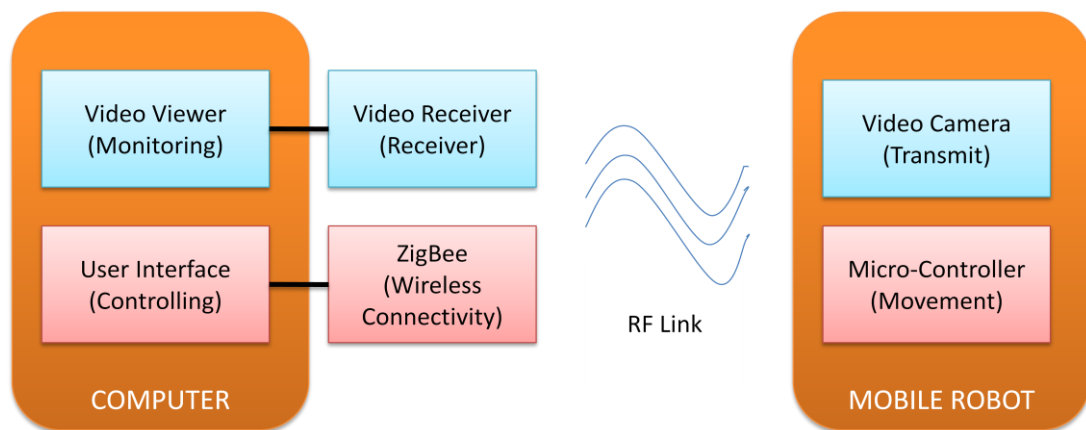


Figure 1.1: Overview of Project System

Figure 1.1 shows this project consists of both hardware and software modules where PIC microcontroller is used as a controller of the robot in term of movement and other control while Graphical User Interface (GUI) is created using Visual Basic as a navigation control and monitoring station for a user on a computer. Zigbee wireless technology is used in this project as a wireless communicating device between the mobile robot and the computer.

1.2 Project Objectives

The aim of this project is to develop a surveillance mobile robot that able to visualize image on-site and being control by a computer using Graphical User Interface (GUI). This is carried out by the following objectives:

- i. To develop a mobile robot equipped with camera for monitoring system using microcontroller unit (MCU).
- ii. To create a Graphical User Interface (GUI) as a console for navigation control.
- iii. To communicate the robot and computer using Zigbee wireless technology.

1.3 Scope of Project

In order to achieve the objectives of the project, the scopes of work are identified as:

- i. Remotely-controlled mobile robot by computer
- ii. Limitation of controlling range is between 50 to 100 meters indoor area
- iii. Working environment is flat surface
- iv. Two DC motors are used for mobile robot movement
- v. One wireless camera with 180° degree of panning rotation
- vi. Flash LED to light up dark area
- vii. Battery level indicator for mobile robot's battery level

1.4 Problem Statement

Currently, most of dangerous areas that should be monitored regularly often use the Closed-Circuit Television (CCTV) system as the medium of monitoring operation. However, this CCTV used a static camera where it is difficult to transmit the image on-site effectively because of single viewing angle for each CCTV installed. Due to this problem, manpower is used to give a direct view to get the desired image which is indirectly endanger to the safety of human being. Dangerous environment such as radiation, high temperature, flammable and etc will risk the human life. Their safety is not guaranteed if they are directly used to execute the monitoring task.

1.5 Outline of Report

This report consists of three chapters and organized as follows. In Chapter 1, the introduction section will be briefly explained about the background of the project generally. The problem statement, objective and scope of the project also being stated in this first chapter. In Chapter 2, literature review of the project is summarized where the background studies over the previous project developed by others is stated. Some critical review is discussed in this chapter. Methodology is briefly explained in Chapter 3 on how the project is approached and executed. Project planning is clearly stated here. Process flow of the project also included in this chapter. Chapter 4 discussed the result of the project. The final chapter concluded the overall performance of project achievement and some recommendations are being stated.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Literature review is a background studies that aims to review the critical points of recent information. All of information gained via internet, journals, conference papers and books is gathered to get a better idea and inspiration on this project.

In this chapter, the similar previous projects that developed by others is reviewed and discussed to give critical review and also to choose the suitable equipment and method before starting the project implementation.

2.2 Surveillance Mobile Robot

Presently, an intelligence surveillance system is in high demand where the traditional ways of monitoring system which using CCTV resulting an ineffective image due to its static position[3]. Several projects have been done to overcome the problem and one of the basic idea is developing a surveillance mobile robot. Several related project is reviewed as follows.

2.2.1 Autonomous Explorer Mobile Robot

The previous project by Csongor Márk Horváth and Róbert Tamás Fekete in their article "Development of Autonomous Explorer Mobile Robot for a Specific Environment" on 2011 [4] is using the same basic concept as the *Surveillance Robot* where a mobile robot is equipped with a camera but the robot is used for exploring purpose instead of monitoring. Figure 2.1 below shows the Autonomous Explorer Mobile Robot.

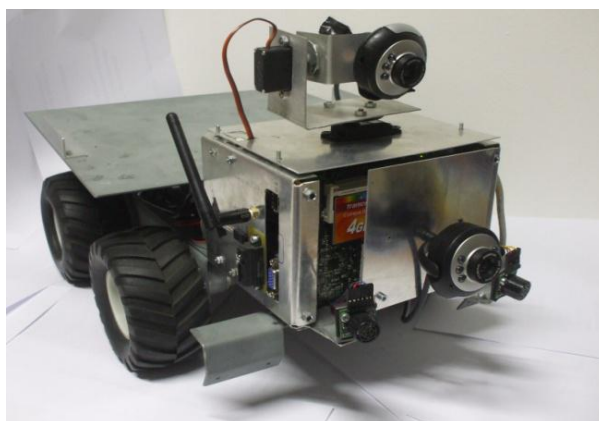


Figure 2.1: Autonomous Explorer Mobile Robot [4]

In this project, the robot is controlled by ATMEL ATmega128 microcontroller. It is a fully automated type of robot where it consists of sonar sensor for obstacle avoiding and infrared sensor for a wall following function [4]. The mobile robot used a wireless camera in order to transmit the image captured on-site to a monitoring station. This robot does not use a communicating device such as RF transceiver to manually control by a computer. It only used a Wi-Fi network to connect the robot and computer. This mobile robot is fully depends on the Wi-Fi access point that determine its covering area which gives some disadvantages where this robot only able to operate in a Wi-Fi network environment.

2.2.2 Remote Controlled Surveillance Mobile Robot with IP Camera

The *Remote Controlled Surveillance Mobile Robot with IP Camera* is developed by Gilbert, Martin and Janssen in 2011 [3]. This manually-operated mobile robot using PIC 16F877A microcontroller and equipped with wireless IP Camera. As shown in Figure 2.2, this surveillance mobile robot also being control by user using a GUI console created on a computer. As a connecting device, this robot used an RF Transceiver. Other additional function such as battery level indicator also included in this project.

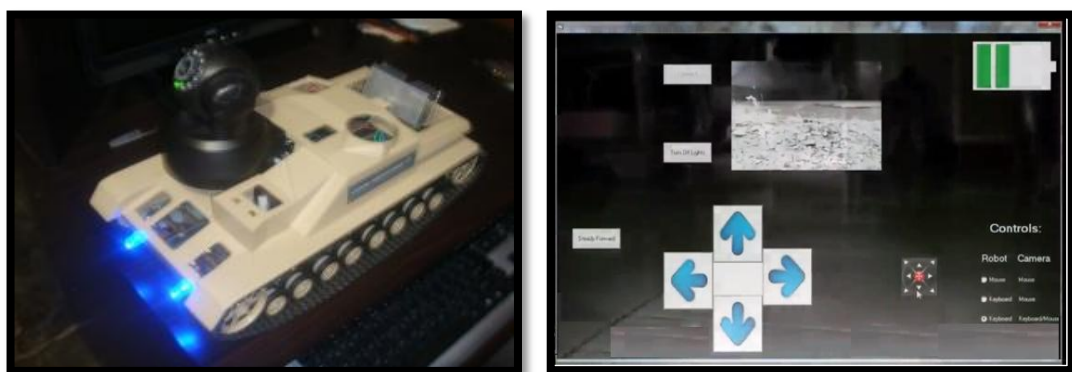


Figure 2.2: RC Surveillance Mobile Robot with GUI Console [3]