WIRELESS CAMERA CONTROLLER SYSTEM FOR MOBILE ROBOT USING RF

MOHD ZAKI B ABU BAKAR
B010510079

MAY 2009

WIRELESS CAMERA CONTROLLER SYSTEM FOR MOBILE ROBOT USING RF

MOHD ZAKI B ABU BAKAR

This Report is submitted in Partial of Requirements for the Degree of Bachelor in Electrical Engineering (Mechatronic)

Fakulti Kejuruteraan Elektrik
Universiti Teknikal Malaysia Melaka

May 2009

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)."

Signature : .....

Supervisor Name : Mohd Shahrieel Mohd Aras

Date : 21/04/09

MOHD SHAHRIEEL BIN MOHD ARAS
PENSYARAH
Fakulti Kejuruteraan Elektrik
Universiti Teknikal Malaysia Melaka

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : .....

Name : MOHD ZAFRI B. ABU BAKAR

Date : 21/04/09

DEDICATION

To my beloved father Abu Bakar B Abd Hamid and my beloved mother Supiyah Bt Lebai Awang, to my supervisor En Mohd Shahrieel B Mohd Aras and to all my friends for all their support throughout my studies. Last but not least to a special person in my life who encourage and motivate me to work harder into achieving my goals.

ACKNOWLEDGEMENTS

Alhamdulillah, thanks to the Almighty Allah with his permission, I finally have finished my Final Year Project within the time given.

I would like to take an opportunity to express my sincerest gratitude to my supervisor, En Mohd Shahrieel B Mohd Aras, for his engagement support, encouragement and patient guidance during the process of finishing my project. His knowledge of wireless controller was indispensable towards the successful completion of my project.

A big thank to everyone who has given me valuable advice especially friends and those who have offered their helping hands when I need.

Not forgetting to my beloved family for their moral and financial support. Thank you for believing in me and your undoubted love and encouragement had kept me going.

Thank you all.

ABSTRACT

This project is purposely to design Wireless Camera Controller for Mobile Robot using Radio Frequency. This project is combination of knowledge electrical and information technology. The goal of this project is to design the controller for control the position of Wireless Camera using Radio Frequency. To control the camera, forward and reverse motor circuit is most suitable to use in this project. This circuit will be given the instruction to the dc motor either to turn forward or turn reverse. That instruction comes from Radio Frequency Transmitter and Radio Frequency Receiver. In the controller also use the RF transmitter circuit and RF receiver circuit. The RF transmitter circuit is to transmit the signal from switch. In this circuit should have the HT-12E Ic as encoder to encode the signal from switch. The RF receiver circuit is to receive the signal from the RF transmitter circuit and this circuit used the HT-12D as decoder to decode back the original signal and in this circuit use the Regulator Circuit as step down voltage and battery charger as backup supply when common supply black out. For sending the signal needed the right and sharp frequency to transmit the signal from RF transmitter circuit to RF receiver circuit. For overall process, the wireless camera receiver and transmitter is use to transmit the signal from camera to monitor or display and the wireless camera will be control using the controller.

ABSTRAK

Projek adalah bertujuan untuk mereka bentuk satu Kawalan Kamera tanpa Wayar untuk Robot Bergerak dengan menggunakan Radio Frekuensi. Projek ini adalah gabungan antara pengetahuan elektrik dan pengetahuan teknologi maklumat. Matlamat projek ini adalah untuk mereka bentuk satu kawalan untuk mengawal pergerakkan kamera tanpa wayar dengan menggunakan radio frekuensi. Untuk mengawal kamera itu, litar motor pusing kehadapan dan pusing ke belakang adalah litar yang paling sesuai digunakan dalam projek ini. Litar ini akan memberi arahan kepada motor samada untuk pusing kehadapan atau pusing kebelakang. Arahan itu datang daripada penghantar radio frekuensi dan penerima radio frekunsi. Di dalam litar kawalan juga, terdapat menggunakan litar penghantar RF dan litar penerima RF. Litar penghantar RF adalah bertujuan untuk menghantar isyarat yang dikeluarkan oleh suis. Di dalam litar ini haruslah menggunakan HT-12E Ic sebagai encoder untuk mengencodekan isyarat daripada suis. Litar penerima RF adalah untuk menerima isyarat daripada litar penghantar RF dan litar penerima RF menggunakan HT-12D Ic sebagai pentafsir kod untuk mentafsir kembali kepada isyarat yang asal. Dalam penghantaran isyarat seharusnya memerlukan frekunsi yang tepat untuk menghantar isyarat daripada penghantar RF ke penerima RF. Untuk kesemua proses, penerima kamera tanpa wayar dan penghantarnya digunakan untuk menghantar isyarat daripada kamera ke paparan dan kamera ini dapat dikawal dengan menggunakan kawalan yang direka bentuk itu.

CONTENTS

CHAPTER	TOPIC		PAGE
	TITLE		**i**
	DECLARATION		**ii - iii**
	DEDICATION		**iv**
	ACKNOWLEDGEMEN		**v**
	ABSTRACT		**vi**
	ABSTRAK		**vii**
	CONTENTS		**viii**
	LIST OF FIGURE		**xii - xiii**
	LIST OF TABLE		**xiv**
1.0	**INTRODUCTION**		
	1.1	Introduction	1
	1.2	Project overview	2 - 3
	1.3	Objective	3
	1.4	Problem statement	3
	1.5	Scope	3
	1.6	Project methodology	4 - 6
	1.7	Summary	6
2.0	**LITERATURE REVIEW**		
	2.1	Introduction	7
	2.2	Digital Image Processing	7
		2.2.1 History	7 - 8
	2.3	Digital Image Uses	8 - 9
	2.4	Wireless Categories	9

	2.5	Communication System	9 - 10
		2.5.1 Source	10
		2.5.2 Transmitter	10
		2.5.3 Transmission System	11
		2.5.4 Receiver	11
		2.5.5 Antenna	11 - 12
	2.6	Summary	12
3.0	**PROJECT BACKGROUND**		
	3.1	Introduction	13
	3.2	Wireless system history	13 - 14
	3.3	Wireless communication	14 - 16
	3.4	Application of wireless technology	16
		3.4.1 Security system	16
		3.4.2 Television remote control	16
		3.4.3 Camera remote control	16 - 17
	3.5	Summary	17
4.0	**PROJECT DEVELOPMENT**		
	4.1	Introduction	18
	4.2	Transmitter circuit	18
		4.2.1 Encoder IC	18 - 20
		4.2.2 Approximate internal connections	20
		4.2.2a NMOS	20 - 21
		4.2.2b CMOS	21
		4.2.2c Oscillator	21
		4.2.3 Functional Description	22
		4.2.3a Operation	22
		4.2.3b Address or Data	22
		4.2.4 Operation of HT – 12E	23
		4.2.5 RF Transmitter Module	24

	4.2.6	RF Transmitter Circuit	25
		4.2.6a Operation	25 - 26
4.3	Receiver Circuit		26
	4.3.1	Decoder IC	26 - 27
	4.3.2	Function Description	28
		4.3.2a Operation	28 - 29
	4.3.3	RF Receiver Module	30
	4.3.4	RF Receiver Circuit	31
		4.3.4a Operation	31 - 32
	4.3.5	Voltage Regulator	32
		4.3.5a Internal Block Diagram	33
		4.3.5b Dc Parameter	33
		4.3.5c Operation	33- 34
4.4	Driver Motor Control Circuit		35
	4.4.1	ULN2003A	35 - 36
	4.4.2	Relay	36
	4.4.3	Operation of Dc motor circuit	37 - 39
4.5	Wireless Camera		39
4.6	Radio AV Receiver		40
4.7	Installation Process		40
	4.7.1	Circuit Installation	40 - 42
	4.7.2	Installation of Dc Motor Holder and Wireless Camera	43 - 45
4.8	Summary		45
5.0	**RESULT AND DISCUSSION**		
5.1	Introduction		46
5.2	Testing		46 - 47
5.3	Result		47 - 49
5.4	Recommendations		50
5.5	Summary		50

6.0	**CONCLUSION**	51
7.0	**REFERENCES**	52
	APPENDIXS	54

LIST OF FIGURE

No	Title	Page
1.1	Block diagram for display image	2
1.2	Block diagrams for control the position of wireless camera	3
1.3	Flow chart of the entire project	4 - 5
1.4	Flow chart for controller of the project	5 - 6
2.1	Block diagram of basic communication	10
4.1	HT-12E	19
4.2	NMOS Transmission Gate	21
4.3	CMOS IN Pull High	21
4.4	Oscillator	21
4.5	Transmission timing for HT-12E	22
4.6	Address or Data bit waveform for the HT12E	22
4.7	Flow chart of operation HT-12E	23
4.8	RF Transmitter Module	24
4.9	RF Transmitter Circuit	25
4.10	Fabricate process of the Transmitter	26
4.11	HT-12D	27
4.12	Flow chart of operation HT 12-D	28 - 29
4.13	RF Receiver Module	30
4.14	RF Receiver Circuit	31
4.15	Fabricate Process of Receiver Circuit	32
4.16	Voltage Regulator	32
4.17	Internal Block Diagram	33
4.18	Circuit of DC Parameter or Fixed Voltage Regulator	33
4.19	Regulator Circuit	34
4.20	Fabrication Process of Regulator Circuit	34
4.21	ULN 2003A	35

4.22	Internal Connection for ULN 2003A	36
4.23	Relay	36
4.24	Driver Motor Control Circuit	37
4.25	Dc motor turn forward	38
4.26	Dc motor turn reverse	38
4.27	Fabrication Process Driver Motor Control Circuit	39
4.28	Wireless Camera	39
4.29	Radio AV Receiver and Monitor	40
4.30	Block connection of receiver controller	41
4.31	Front view of receiver controller	42
4.32	The actual of installation process of receiver controller	42
4.33	Stand holder without Dc Motor	43
4.34	Stand holder with Dc Motor	44
4.35	Holder of Wireless Camera	44
4.36	Wireless Camera Controller Using Radio Frequency	45
5.1	Controller Testing	47
5.2	Operation of Wireless Camera Controller Using Radio Frequency	48
5.3	Rotation of wireless camera	49

LIST OF TABLE

No	Title	Page
4.1	Pin Description for HT-12E	20
4.2	Pin Description of RF Transmitter Module	24
4.3	Pin Description	27
4.4	Pin Description of RF Receiver Module	30

CHAPTER 1

INTRODUCTION

1.1 Introduction

The term of wireless is normally used to refer to any type of electrical or electronic operation which is accomplished without the use of a hard wired connection. The term of the wireless came into public use to refer to a radio receiver or transceiver (a dual purpose receiver and transmitter device). Wireless communication is the transfer of information over a distance without the use of electrical conductors or wires. The distances involved may be short such as a few meters in television remote control or very long thousands or even millions of kilometers for radio communications [11]. Now, the wireless is commonly used in the telecommunications industry to refer to telecommunications systems such as radio transmitters and receivers, remote controls, computer network and network terminal.

Wireless camera has many advantages and its high technologies applications. Wireless camera using computerized is more efficient and flexible than television [6]. We are able to control a wireless camera as a security whenever not at home and the wide angle of lenses is easier to focus an images.

1.2 Project Overview

This project consists of three main parts such as Wireless Controller, Image Acquisition Setup and Processor.

1. Wireless controller
   - Design the wireless camera controller using radio frequency (315 MHz) to control the position of wireless camera with distance 100 meters without obstacle.
2. Image acquisition setup
   - It consists of an analogue camera (wireless camera) with suitable interface for connecting it to processor.
3. Processor
   - It consists of either pc or laptop

The entire of this system can be represented as shown in Figure 1.1.

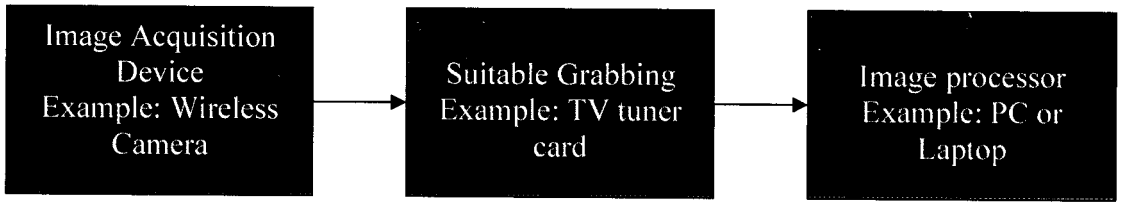


Figure 1.1: Block diagram for display image

Image capturing can be done using wireless camera available in various resolutions. There are two types of cameras generally available which is digital cameras (CCD charge coupled device and CMOS sensor based) and analogue cameras. Digital cameras generally have a direct interface with computer (USB port) but analogue cameras require suitable grabbing card or TV tuner card for interfacing with computer. Power requirement of Wireless cameras give high quality and low noise images. It generates an analog signal and uses analog to digital converter (ADC) and thus consumes high power [12]. In Figure 1.2 shown the blocks of operation for control the position of wireless camera. The frequency will be use in this project is 315 MHz for transmit and receiver. The rotation of wireless camera will be control by the motor driver circuit.

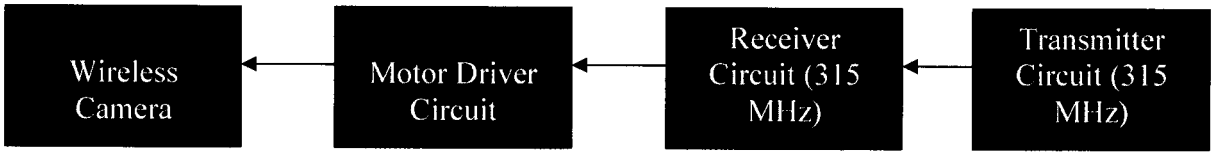


Figure 1.2: Block diagrams for control the position of wireless camera

1.3 Objective

The aim of this project is

- To design the Wireless Camera Controller System for control the position of Wireless Camera using Radio Frequency.

1.4 Problem Statement

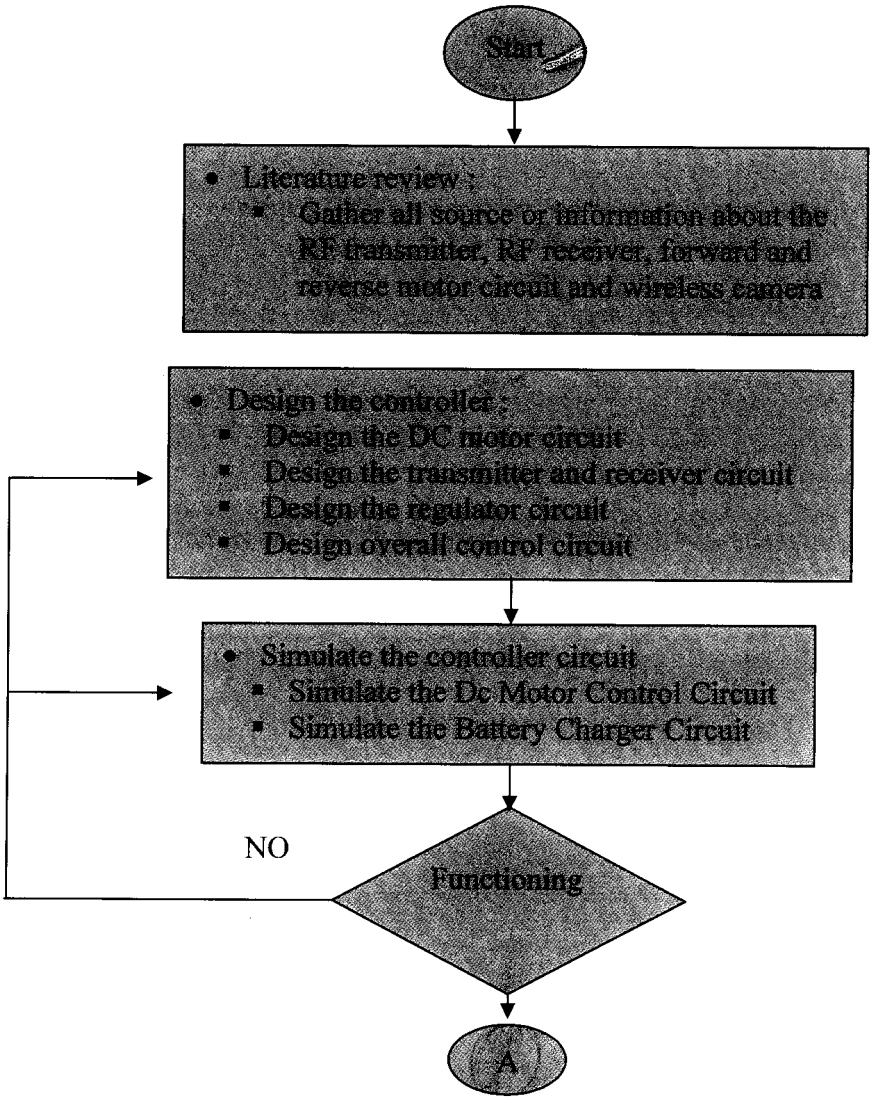
- Nowadays a hard wire is not relevant because the price of wire is very expensive and quiet difficultly to maintenance.
- Limited distance for wireless and radio frequency. In this project the distance should be 100 meters without obstacle. When the signal is transmit with obstacle, the distance must reduce below 100 meters.
- The market price is very expensive for component radio frequency

1.5 Scope

The target of this project is to design the wireless camera controller system for control the position of wireless camera using radio frequency. The wireless camera should be rotated 360 degrees. The distance involve for controller depends on the frequency will be used. In this project, the frequency will be used is 315 MHz with distance 100 meter without obstacle. The distance of wireless camera also 100 meters.

1.6 Project Methodology

This section will be explained about overall of the project and its controller process. This methodology must be done to make sure that a process to complete the 'Wireless Camera Controller system for Mobile Robot' using Radio Frequency is completely successfully. In designing process, step by step should be follow to reach the target. So in this project, firstly all the information about the RF Transmitter, RF Receiver, Forward and Reverse Motor Circuit, Regulator Circuit and Wireless Camera must be find out. After that, all the circuit should be design and simulate using the Proteus Design Suite software to make sure all the designing circuit in very well operation. Finally, the circuit must be fabricated when all the circuit already testing. Figure 1.3 shown the flow chart of entire of this project.



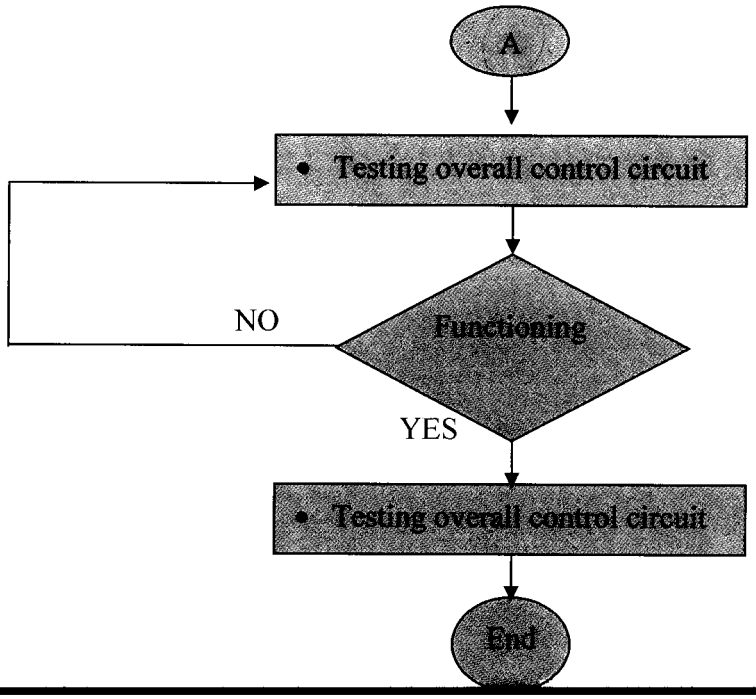
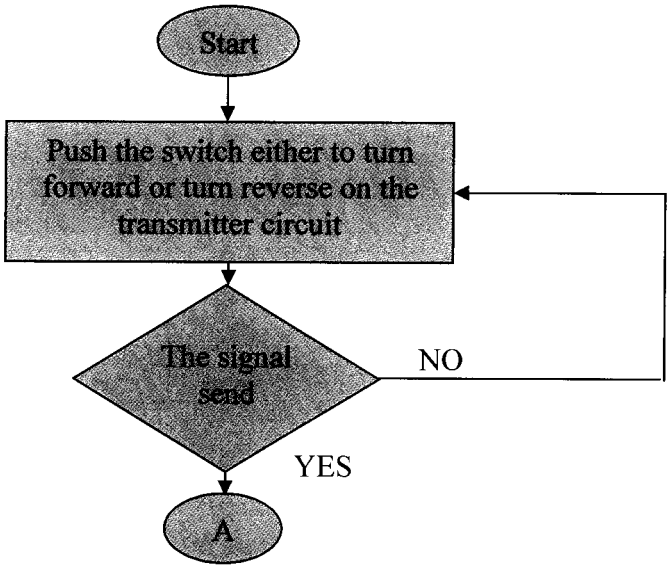


Figure 1.3: Flow Chart of the Entire Project

In Figure 1.4 shown the flow chart of controller for the wireless camera. When the push button on the transmitter is push either to turn forward or turn reverse, the encoder IC HT-12E will encode that signal from digital into analogue and transmitter modulation will send the signal to the receiver, carriers by the transmission system. The decoder IC HT-12D will decode back the signal into the original signal either the dc motor should be turn forward or turn reverse.



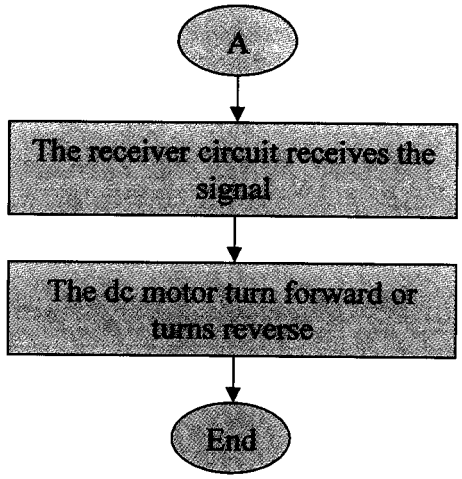


Figure 1.4: Flow chart for controller of the project

1.7 Summary

For this chapter, already finished explained about the project overview. This part is about the important things of the wireless camera controller which is how the process of the image will be capture and block diagram operation for control the position of wireless camera. The objective, problem statement and scope also already explained in this chapter and have been archive. The project methodology also done and has been explained in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter introduces an idea of the locations from where the bulk information was taken. The theory of the radio frequency also describe in this chapter. These references were used to gain an understanding of the ideas and concepts required to implement a working algorithm which would meet the requirements set out in the objectives.

2.2 Digital Image Processing

2.2.1 History

Many of the techniques of digital image processing or digital picture processing as it was often called, were developed in the 1960s at the Jet Propulsion Laboratory, MIT, Bell Labs, University of Maryland, and a few other places, with application to satellite imagery, wire photo standards conversion, medical imaging, videophone, character recognition, and photo enhancement. But the cost of processing was fairly high with the computing equipment of that era. In the 1970s, when cheaper computers and dedicated hardware became available, digital image processing proliferated. Then, images could be processed in real time, for some dedicated problems such as television standards conversion [10]. As general purpose computers became faster, they started to take over the role of dedicated hardware for all but the most specialized and compute operations.

With the fast computers and signal processors available in the 2000s, digital image processing has become the most common form of image processing, and is generally used because it is not only the most versatile method, but also the cheapest. Digital image processing is the use of computer algorithms to perform image processing on digital images [10]. Digital image processing has the same advantages over analog image processing as digital signal processing has over analog signal processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing.

2.3 Digital Image Uses

Digital cameras generally include dedicated digital image processing chips to convert the raw data from the image sensor into a color corrected image in a standard image file format. Images from digital cameras often receive further processing to improve their quality a distinct advantage digital cameras have over film cameras. The digital image processing is typically done by special software programs that can manipulate the images in many ways. Many digital cameras also enable viewing of histograms of images as an aid for the photographer to better understand the rendered brightness range of each shot.

A digital image is composed of pixels which can be thought of as small dots on the screen. A digital image is an instruction of how to color each pixel. A typical size of an image is 512-by-512 pixels. We will see that it is convenient to let the dimensions of the image to be a power of 2. For image, $2^9 = 512$. In the general case we say that an image is of size m-by-n if it is composed of m pixels in the vertical direction and n pixels in the horizontal direction. Let say that we have an image on the format 512-by-1024 pixels, this means that the data for the image must contain information about 524288 pixels, which requires a lot of memory. Hence, compressing images is essential for efficient image processing. Fourier analysis and Wavelet analysis can help us to

compress an image significantly. There are also a few computer scientific tricks (image: entropy coding) to reduce the amount of data required to store an image [10].

2.4 Wireless Categories

There are two major categories for wireless communications, that is:

a) Wireless LAN (also known as WLAN)

- A LAN is by definition a Local Area Network, example over short distances and normally indoors. Nowadays, the wireless LAN standards are well defined and devices from different vendors work well together [14].

b) Wireless bridges

- When it is necessary to connect buildings or sites with high speed links, a point to point data link capable of long distances and high speeds is required. Two commonly used technologies are microwave and laser [14].

2.5 Communication System

The basic of communication system is to communicate data or information from one point called source of generation to distant point called destination of end user. The communication channel or media connects source as well as destination over telephone lines, microwave links and optical fiber cable. The basic of communication block diagram as shown in Figure 2.1.