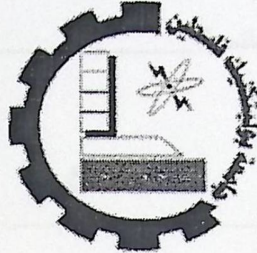# Palestine Polytechnic University

College of Engineering & Technology
Electrical & Computer Engineering Department

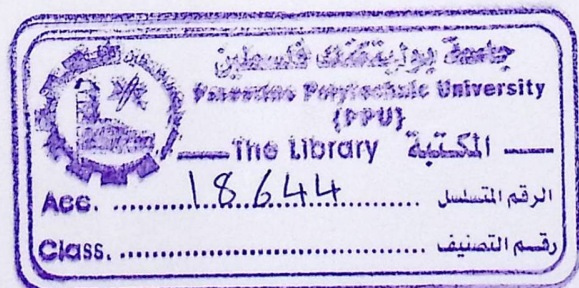**Graduation Project**

Wireless Communication System

Project Team
Ezdehar Jawaberh
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Project Supervisor
Dr. Daoud I. Zatari

Hebron-Palestine

July, 2005

I

DEDICATION

* To our supervisor Dr. Daoud Zatari……………..………………….…..…..

* To our colleagues and instructors……………………………………....

* To our dear parents, sisters and brothers and families………………………….

* To whom who have added anything to the   science and care for it……….......

* to our martyrs and prisoner……………………………………………

ACKNOWLEDGMENT

At the end of this stage, here we stop for a moment to thank everybody who has helped us to complete this work.

First, we want to thank our supervisor Dr. Daoud Zatari, who gave us a lot of his time and experience in order to complete the project.

We also thank Dr. Salman Talahmeh who helped us in this project. And we thank our teacher Mr. Rasmi Sayyed Ahmad and our families for supporting us.

Ezdehar

Reem

Rounza

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Chapter One

Introduction

Chapter One

Introduction

1.1 General Idea about the Project and its Importance

A wireless communication system is one that sends and receives data signals through the air without a physical connection, such as a metal wire or fiber optic cable. The system usually contains a transmitter, a modulator, a demodulator and a receiver.

The development in wireless communication technology is increasing very rapidly in different areas, and any project in this field should specify a lot of criteria. The aim of this project is to develop, design, build and test a wireless communication system between two buildings at the university (A and B building in Wad_Alharia).

The term "wireless" refers to telecommunication technology, in which radio waves, infrared waves and microwaves are used to carry a signal to connect communication devices. These devices include pagers, cell phones, portable PCs, computer networks, location devices, satellite systems and handheld digital assistants.

The project aims to transmit and receive data packets (voice, text, image) .This will be performed in three steps:

1- Within a building, a wireless card using 802.11b protocol will be used to transfer data wirelessly, from PC's to the main transceiver unit.

2- The transceiver unit will use the RF wireless technology to transmit data from site A to site B.

3- At site B, the transceiver will receive the data and second processing technologies will be applied. The processed data will be transformed from the transceiver to the PC's using 802.11b protocol wireless LAN (Local Area Network).

This system is supposed to be implemented if the wireless board transceivers XE900-500S came from United States. Due to occupation security accusations it was forbidden for these chips to enter the Palestinian region, and so it is decided to build transceiver units between the two sites with a total distance between of 10m.

The importance of this project comes from that wireless technology is being adopted for many new applications: to connect computers, to allow remote monitoring and data acquisition, to provide access control and security, and to provide a solution for environments where wires may not be the best solution. In addition, this project will be a good step for similar advanced projects in the university.

1.2 Literature Review

The first wireless transmitters went on the air in the early 20th century using radiotelegraphy (Morse code). Soon after, information was then added to the signal carriers, a process known as "modulation". This made it possible to transmit voices and music via wireless medium, the medium which came to be called "radio." With the advent of television, fax, data communication, and the effective use of a larger portion of the spectrum, the term "wireless" has been revived [1].

The implementation of wireless data transmission or wireless LAN was already found and there are many researches in this area .Indeed, many resources on the internet view complete system designs that implements this technology .Actually we can say that the world tends to be a wireless one within the few coming years.

From our studies we found two previous projects that discuss this technology:

1- Design and implementation of wireless LAN, this project describes the design and implementation of a WLAN(Wireless Local Area Network); two computers were connected to each other by means of wireless technique. It also describes how a WLAN can be connected to wire network through an access point [2].

2- WI-FI Project, the main goal of the project is to specify the exact locations for installing the APs in order to suggest the hotspots that will cover all Nablus city wirelessly using WI-FI technology [3].

1.3 Estimated Cost

The needed hardware chips for the system are shown in the following table, the prices in NIS (New Israel Shekel) for each one.

1	Quantity	Unit Price	Total Price
11 Cards	2	400	800
rocontroller 8051 Chip	1	2100	2100
C0804	1	20	20
C0801	1	20	20
Coupler(1N25)	18	46	828
fer(74LS245)	1	5	5
rophone	3	15	45
:473	1	8	8
stal	2	6	12
rter(47LS14)	1	4	4
(47LS257)	1	8	8
(DG508)	1	10	10
isistor (MPF102)	1	5	5
nter(47LS393)	1	5	5
(LM567)	1	5	5
iperature sensor(LM35)	1	20	20
plifier(TL081)	2	10	20
₹ sensor	1	4	8
acitor	10	6	60
istor	15	5	75
ictor	4	15	60
)s	2	4	8
		2991	4122

Table 1.1 Estimated Costs

1.4 Time Scheduling

The work in this project was divided into two semesters as shown in the following tables.

Task/week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Choosing a project	■	■														
Information Collection	■	■	■	■												
Studying project components					■	■	■	■	■	■						
Put suggested design circuit					■			■	■	■	■	■	■			
Documentation	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Fig 1.1 First Semester Scheduling

Task/Week	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Implementation	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Unit Testing			■	■	■	■	■	■	■	■	■	■	■	■		
System Testing										■	■	■	■	■	■	■
Documentation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Fig 1.2 Second Semester Scheduling

1.4 Time Scheduling

The work in this project was divided into two semesters as shown in the following tables.

Task/week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Choosing a project	■															
Information Collection	■	■	■	■												
Studying project components					■	■	■	■	■	■						
Put suggested design circuit								■	■	■	■	■	■	■		
Documentation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

Fig 1.1 First Semester Scheduling

Task/Week	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Implementation	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Unit Testing				■	■	■	■	■	■	■	■	■	■	■		
System Testing											■	■	■	■	■	■
Documentation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Fig 1.2 Second Semester Scheduling

1.5 Report Contents

This Report consists of seven chapters; this is the first chapter "introduction" and the other chapters as follows:

- **Chapter Two**: It presents a theoretical background related to the main concepts of wireless such as modulation, demodulation techniques, amplification, filtering and wireless local area network.

- **Chapter Three**: It discusses design concepts; it contains the project objectives, general block diagrams of the system and finally explains how system works.

- **Chapter four**: It talks about hardware system design, first it discusses the design options like protocol options, modulation options , antenna options and it justifies those chosen for the project, then it shows a detailed description of project parts.

- **Chapter Five**: It discusses the implementation and testing in details and how they are done in this project.

- **Chapter Six**: It includes the software system design that discusses algorithms and flowcharts.

- **Chapter Seven**: It contains future works for the project.

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2

Chapter Two

Theoretical Background

Chapter Two

Theoretical Background

2.1 Basic Communication System

The basic communications system should include the following modules:

1- Transmitter: It takes the information signal and processes it prior to transmission. The transmitter modulates the information onto a carrier signal, amplifies the signal and broadcasts it over the channel.

2) A Communication Channel: The medium which transports the modulated signal to the receiver. Air acts as the wireless channel for broadcasts like radio; it may also be a wiring system like cupper cables or the Internet.

3) A Receiver: It detects the transmitted signal from the channel and processes it to retrieve the data. The receiver must be able to discriminate the signal from other signals which may use the same channel (called tuning), amplify the signal for processing and demodulate (remove the carrier) to retrieve the information. It also then processes the information so it can be ready for the user at the receiving end.

2.2 Modulation

The process in which some characteristic of a wave (the carrier wave) is made to vary in accordance with an information-bearing signal wave (the modulating wave); demodulation is the process by which the original signal is recovered from the wave produced by modulation. The original, unmodulated wave may be of any kind, such as sound or, most often, electromagnetic radiation, including optical waves. The carrier wave can be a direct current, an alternating current, or a pulse chain. In modulation, it is processed in such a way that its amplitude, frequency, or some other property varies.

The two basic types of modulation are digital and analog; this section discusses some of these methods.

2.2.1 Frequency Modulation (FM)

In frequency modulation, the instantaneous frequency of the radio-frequency wave varies with the modulation signal, the amplitude is kept constant. The number of times per second that the instantaneous frequency varies from the average (carrier frequency) is controlled by the frequency of the modulating signal. The amount by which the frequency departs from the average is controlled by the amplitude of the modulating signal. This variation is referred to as the frequency deviation of the frequency-modulated wave. We can now establish two clear-cut rules for frequency deviation rate and amplitude in frequency modulation:

1- Amount of frequency shift is proportional to the amplitude of the modulating signal. (This rule simply means that if a 10-volt signal causes a frequency shift of 20 kilohertz, then a 20- volt signal will cause a frequency shift of 40 kilohertz.)

2-Rate of frequency shift is proportional to the frequency of the modulating signal. (This second rule means that if the carrier is modulated with a 1-kilohertz tone, then the carrier is changing frequency 1,000 times each second) [4].
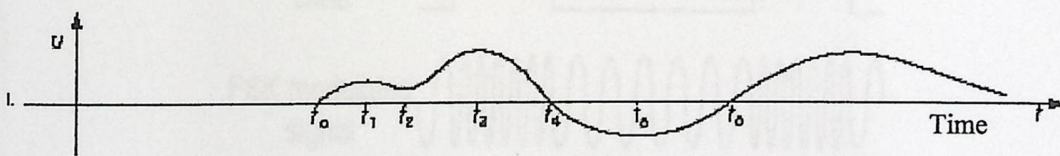
Fig2.1 Modulating Signal [4]
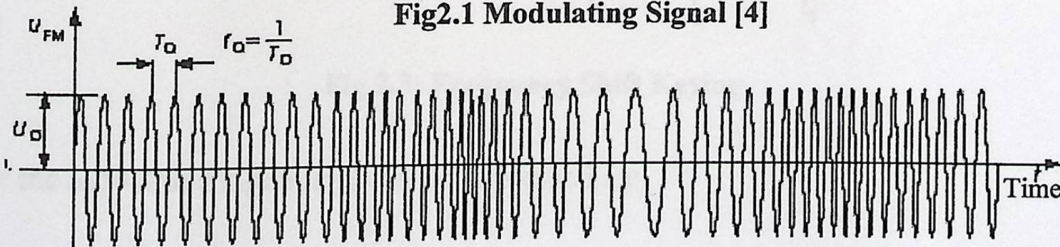
Fig 2.2 FM Modulated Signal [4]

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If the signal to be sent is

$$x_m(t)$$

and the sinusoidal carrier is

$$x_c(t) = A\cos(2\pi f_c t)$$

where f_c is the carrier's base frequency in hertz and A is an arbitrary amplitude, the carrier will be modulated by the signal as in

$$x_c(t) = A\cos(2\pi f(t)t) = A\cos(2\pi[f_c + f_\Delta x(t)]t)$$

In this equation, $f(t)$ is the instantaneous frequency of the oscillator and f_Δ is the frequency deviation, which represents the maximum shift away from f_c in one direction, assuming $x_m(t)$ is limited to the range ± 1.

2.2.2 Frequency Shift Keying (FSK)

In frequency shift keying, the carrier frequency is changed between discrete values. If only two frequencies are used then this will be called Binary Frequency Shift Keying (BFSK) as it shown in the figure (2.3).
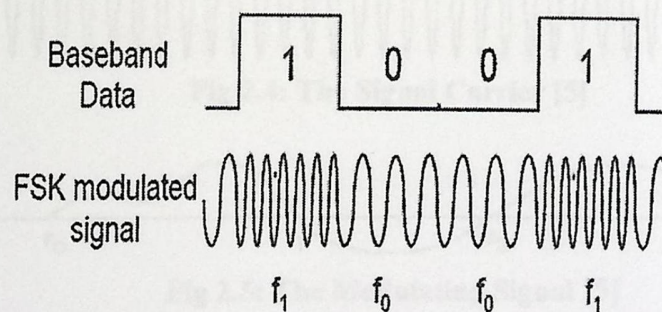
Fig 2.3: Frequency Shift Keying

Where the modulated signal s(t) can be expressed as:

$$s(t) = \begin{cases} A\cos(2\pi f_1 t) & \text{binary } 1 \\ A\cos(2\pi f_2 t) & \text{binary } 0 \end{cases}$$

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2.2.3 Amplitude Modulation (AM)

AM has been used since the first days of radio but really AM communication systems have several disadvantages that other methods of signal processing overcome, but, AM is commonly used in many types of systems because of the simple circuits, proven reliability, and low cost. Amplitude modulation is normally used to convey information from a source to a destination by electromagnetic waves using air as the transmission medium. By using amplitude modulation, a carrier signal that can propagate through the air is used. The carrier's amplitude is simply changed according to the amplitude of the information signal, hence the name amplitude modulation. When the information signal's amplitude is increased, the carrier signal's amplitude is increased.

When the information signal's amplitude is decreased, the carrier signal's amplitude is decreased. In other words, the "envelope" of the carrier signal's amplitude contains the information signal. Figure 2.6 illustrates the signals associated with amplitude modulation. [5]
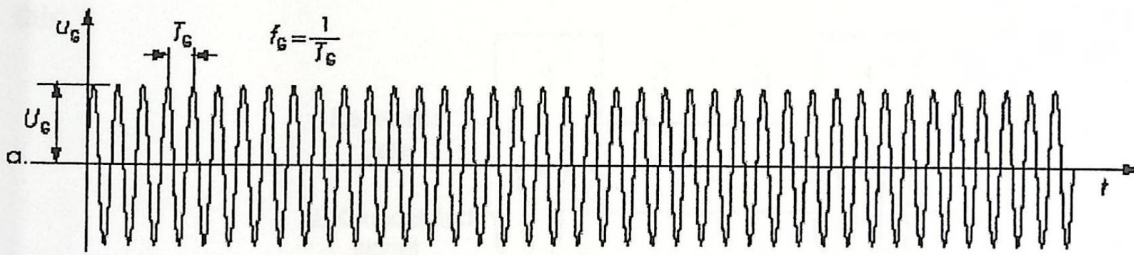
Fig 2.4: The Signal Carrier [5]
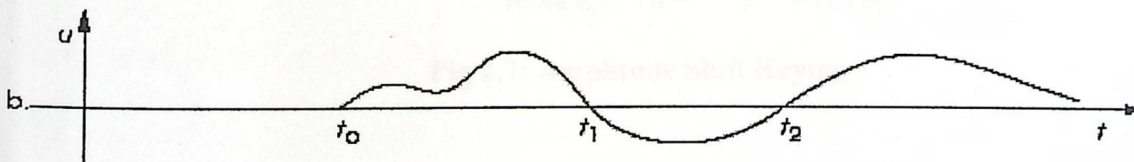
Fig 2.5: The Modulating Signal [5]
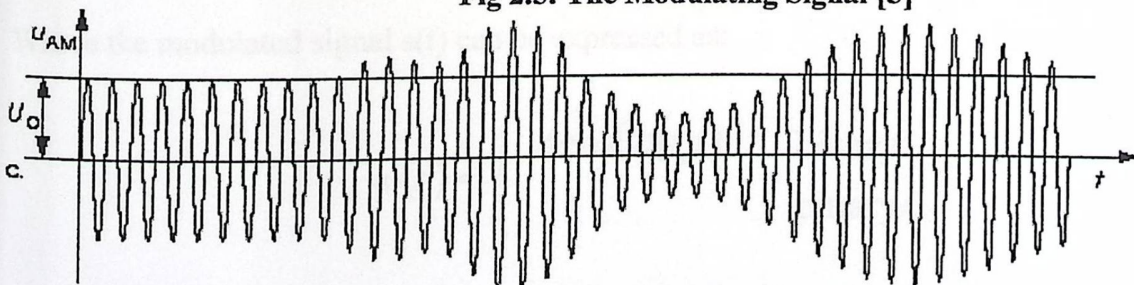
Fig 2.6: Amplitude Modulation Signal [5]

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Suppose we wish to modulate a simple sine wave on a carrier wave. The equation for the carrier wave of frequency ω_c, taking its phase to be a reference phase of zero, is

$$c(t) = C\sin(\omega_c t).$$

The equation for the simple sine wave of frequency ω_m (the signal we wish to broadcast) is

$$m(t) = M\sin(\omega_m t + \varphi),$$

With φ its phase offset relative to $c(t)$.

Amplitude modulation is performed simply by adding $m(t)$ to C. The amplitude-modulated signal is then

$$y(t) = (C + M\sin(\omega_m t + \varphi))\sin(\omega_c t)$$

2.2.4 Amplitude Shift Keying (ASK)

In amplitude shift keying, the carrier wave amplitude is changed between discrete levels (usually two) in accordance with the digital data. A typical ASK signal might look like this:
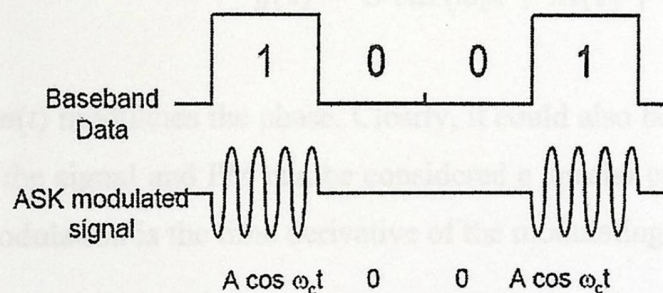
Fig 2.7: Amplitude Shift Keying

Where the modulated signal s(t) can be expressed as:

$$s(t) = \begin{cases} A\cos(2\pi f_c t) & \text{binary } 1 \\ 0 & \text{binary } 0 \end{cases}$$

2.2.5 Phase Modulation (PM)

Phase modulation (PM) is the encoding of information into a carrier wave by variation of its phase , it can be regarded as a special case of frequency modulation .The frequency modulation requires the oscillator frequency to deviate both above and below the carrier frequency. During the process of frequency modulation, the peaks of each successive cycle in the modulated waveform occur at times other than they would if the carrier were unmodulated. This is actually an incidental phase shift that takes place along with the frequency shift in fm. Just the opposite action takes place in phase modulation [6].

Suppose that the signal to be sent, the modulating signal with frequency ω_m and phase φ_m, is

$$m(t) = M \sin\left(\omega_m t + \phi_m\right)$$

and the single that will be broadcast, the carrier signal, is

$$c(t) = C \sin\left(\omega_c t + \phi_c\right).$$

Then the modulated signal,

$$y(t) = C \sin\left(\omega_c t + m(t) + \phi_c\right)$$

Which shows how $m(t)$ modulates the phase. Clearly, it could also be viewed as a change to the frequency of the signal and PM can be considered a special case of FM where the carrier frequency modulation is the time derivative of the modulating signal.

2.2.6 Phase Shift Keying (PSK)

The phase of the carrier wave at the beginning of the pulse is changed between discrete values.
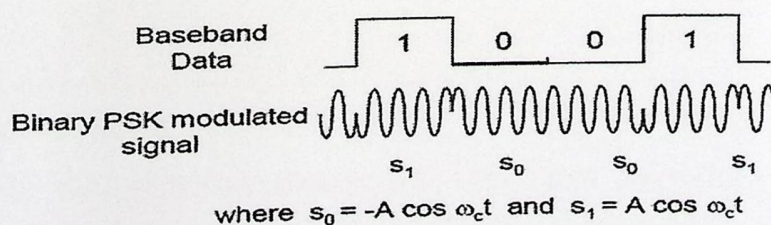
Fig 2.8: Phase Shift Keying

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Where the modulated signal s(t) can be expressed as:

$$s(t) = \begin{cases} A\cos(2\pi f_c t) & \text{binary } 1 \\ A\cos(2\pi f_c t + \pi) & \text{binary } 0 \end{cases}$$

$$= \begin{cases} A\cos(2\pi f_c t) & \text{binary } 1 \\ -A\cos(2\pi f_c t) & \text{binary } 0 \end{cases}$$

2.3 Demodulation

The process of re-creating original modulating frequencies from the RF carrier is referred to as demodulation or detection. Each type of modulation is different and requires different techniques to recover (demodulate) the signal.

The output of an ideal detector must be an exact reproduction of the modulation existing on the RF wave. Failure to accurately recover this intelligence will result in distortion and degradation of the demodulated signal and intelligence will be lost. The distortion may be in amplitude, frequency, or phase, depending on the nature of the demodulator.

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2.4 Signal Waveband

According to characteristics of their outspread, radio waves can be classified into several groups or ranges: long, mid, short and ultra-short. Limits between the wavebands are not precise; with the raise of their frequency the waves are gradually losing some features while gaining some others. This division is shown in Table 2.1.

Range	Frequency	Wavelength
Long waves (LF')	30 - 300 kHz	10 km - 1 km
Mid waves (MF')	300 - 3000 kHz	100 m - 100 m
Short waves (HF')	3 - 30 MHz	100 m - 10 m
Ultra short waves:		
a. Metre range (VHF')	30 - 300 MHz	10 m - 1 m
b. Decimetre range (UHF')	300 - 3000MHz	100 cm - 1 cm
c. Centimetre range (SHF')	3 - 30 GHz	10 cm - 1 cm
d. Millimetre range (EHF')	30 - 300 GHz	10 mm - 1 mm

Table 2.1 Range of Radio Waves

Radio diffusion is being performed in certain parts of the wavebands given in Table 2.1, their boundary frequencies are (rounded values):

* LW (long waves) 150 kHz (2km) 300 kHz (1 km)
* MW (mid waves) 500 kHz (600 m) 1500 kHz (200 m)
* SW (short waves) 6 MHz (50 m) 20 MHz (15 m)
* FM (ultra short waves) 88 MHz (3.4 m) 108 MHz (2.78 m)

In LW, MW and SW the amplitude modulation is used, while in FM range it is the frequency modulation. [7]

---

*LF: low frequencies, MF mid frequencies, HF high frequencies, VHF very high frequencies, UHF ultra high frequencies, SHF super high frequencies, EHF extra high frequencies, Waves with wavelength smaller than 30 cm are also called the microwaves.

2.5 Amplification

The term amplifier is very generic. In general, the purpose of an amplifier is to take an input signal and make it stronger (or in more technically correct terms, increase its amplitude). Amplifiers find application in all kinds of electronic devices designed to perform any number of functions.

There are many different types of amplifiers, each with a specific purpose in mind. For example, a radio transmitter uses an RF Amplifier; such an amplifier is designed to amplify a signal so that it may drive an antenna. Audio power amplifiers are those amplifiers which are designed to drive loudspeakers.

2.5.1 Amplifier Types

2.5.1.1 Power Amplifier

The purpose of a power amplifier, is to take a signal from a source device and make it suitable for driving a loudspeaker. Ideally, the only thing different between the input signal and the output signal is the strength of the signal. All power amplifiers have a power rating; the units of power are called watts.

The power rating of an amplifier may be stated for various load impedances; the units for load impedance are ohms. The most common load impedances are 8 ohms, 4 ohms, and 2 ohms .The power output of a modern amplifier is usually higher when lower impedance loads (speakers) are used.

2.5.1.2 Single-Ended Amplifier

A single-ended amplifier has only one input, and all voltages are measured in reference to signal common. In fact, single-ended is a misnomer, since the input voltage is measured relative to signal ground. With this amplifier, Vout is equal to Vin multiplied by the gain of the amplifier. This type of input is frequently used in devices such as oscilloscopes. A

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feature of single-ended amplifiers is that only one measurement point is needed. The following is a diagram for a single-ended amplifier:
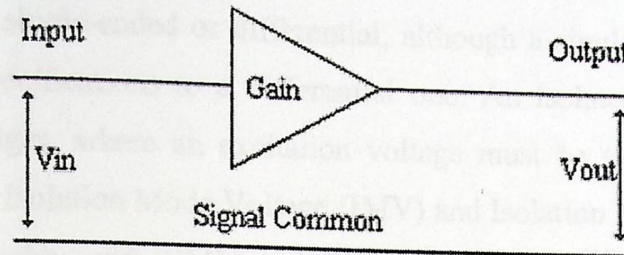
Fig 2.9: Single-Ended Amplifier

2.5.1.3Differential

a differential amplifier has two inputs, and amplifies the difference between them. The voltage at both inputs is measured with respect to signal common. The following is a diagram for a differential amplifier.
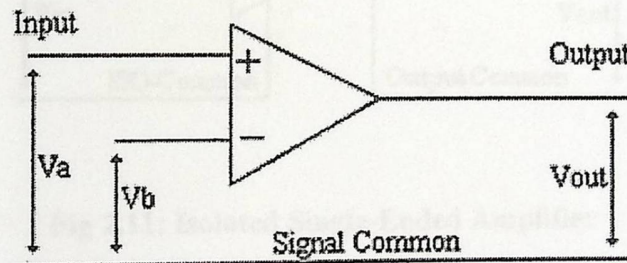
Fig2.10: Differential Amplifier

Calculating the gain for a differential is more complex than a single-ended one. Differential amplifiers are useful for "above ground" measurements, as long as the amplifier is not exceeded. They are also useful in environments where there is potential noise. One of the drawbacks of the standard differential amplifier is that in a multi-channel system, signal ground is often the same for all channels.

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2.5.1.4 Isolated Inputs

An isolated input has a signal common (ISO-common) that is isolated from the power supply for the analog circuitry. An additional feature is that in a multi-channel system, each channel's ISO-common is independent and isolated from other channels. Isolated inputs can be either single-ended or differential, although a single-ended isolated input will have similar specifications to a differential one. An isolated differential input is useful with DC bridges, where an excitation voltage must be supplied. With isolated amplifiers, the terms Isolation Mode Voltage (IMV) and Isolation Mode Rejection (IMR) are used interchangeably with CMV and CMR. Isolated single-ended amplifiers, for example, have the same noise reducing characteristics as a non-isolated differential amplifier. The following is a diagram for an isolated single-ended amplifier:
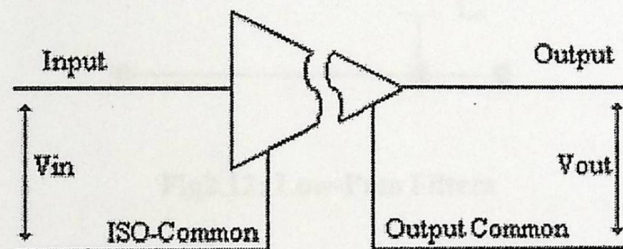
Fig 2.11: Isolated Single-Ended Amplifier

As the diagram illustrates, the isolated common on the input of the amplifier is not referenced to the output common of the analog circuitry. In fact, the iso-common can actually be used for "above ground" measurements, up to the limitation of the CMV. In this respect, an isolated single-ended amplifier is very much like a standard differential one. [8]

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2.6 Filter

2.6.1 Low-Pass Filter

A low-pass filter passes low frequencies fairly well, but attenuates 'high' frequencies. Therefore it is better called a high-cut filter or treble cut filter. Also the term hiss filter sometimes used. Low-pass filters are used to block unwanted high-frequency signals, whilst passing the lower frequencies. The low frequencies to be filtered out are relative to the unwanted higher frequencies and therefore do not have a definitive range. The frequencies that are cut vary from filter to filter. A low-pass filter is the opposite of a high-pass filter.
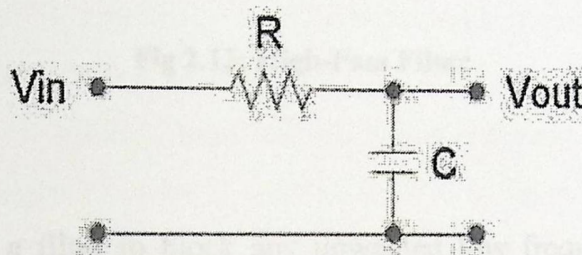
Fig2.12: Low-Pass Filters

Types of Low-Pass Filters

There are a great many different filter circuits, with different responses to changing frequency. The frequency response of a filter is generally represented using a Bode plot.

- A first-order filter, for example, will reduce the signal strength by half every time the frequency doubles. The magnitude Bode plot for a first-order filter looks like a horizontal line below the cutoff frequency, a straight line approaching zero.

- A second-order filter will reduce the signal strength by three-fourths every time the frequency doubles. The Bode plot for this type of filter resembles that of a first-order filter, except that it falls off quadratically instead of linearly. Third and higher order filters are defined similarly

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2.6.2 High-Pass Filter

A high-pass filter passes 'high' frequencies fairly well, but attenuates 'low' frequencies. Therefore it is better called a low-cut filter or bass-cut filter. The term rumble filter is sometimes used.
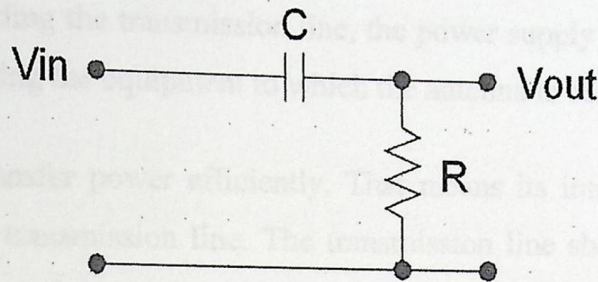
Fig 2.13: High-Pass Filter

Hence it is useful as a filter to block any unwanted low frequency components of a complex signal whilst passing the higher frequencies. Of course, the meanings of 'low' and 'high' frequencies are relative. A high-pass filter is the opposite of low-pass filter.

2.6.3 Band-Pass Filter

A band-pass filter is (usually) an electronic circuit that lets through frequencies between two other given frequencies. For example, an ideal bandpass filter would let through all signals above 30 hertz but below 100 Hz. All of the signal outside this range is attenuated or damped. It can be created by a combination of a low-pass filter and a high-pass filter. In practice, most band pass filters are not ideal and do not attenuate frequencies just outside the desired frequency range completely. There is generally a smooth and quick decrease in transmitted frequency outside the band. [9]

Finally, in our project the high pass filter will be used in the antenna receive circuits to obtain the original signal.

2.7 Antenna

An antenna can be any conductive structure that can carry an electrical current. If it carries a time varying electrical current, it will radiate an electromagnetic wave, maybe not efficiently or in a desirable manner but it will radiate. Usually one designs a structure to radiate efficiently with certain desired characteristics. If one is not careful, other things may radiate also including the transmission line, the power supply line, nearby structures or even a person touching the equipment to which the antenna is connected.

An antenna should transfer power efficiently. That means its impedance should match that of its connecting transmission line. The transmission line should transfer all of its power to the antenna and not radiate energy itself. This means that the mode of the transmission line should be matched to mode of the antenna. Often one wants the antenna to radiate in a specified direction or directions. This is accomplished by designing it to have the proper radiation pattern. Closely related to this is the antenna polarization. Many times antennas are arranged in arrays in order to achieve the desired pattern. These arrays may then be electronically steered. A passive antenna, that is one with no amplifiers attached, will have the same characteristics whether it is transmitting or receiving.

The antenna radiate the modulated signal through the air so that the destination can receive it, antenna has two types:

2.7.1 Omni Directional Antenna

Antenna transmits its power in all directions as shown in figure 2.14 the half wave dipole omni directional antenna will be used in this project.
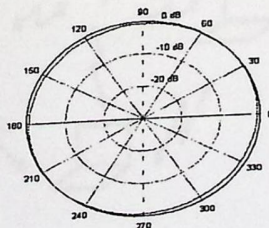
Fig 2.14 Omni Directional Antenna

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2.7.2 Directional Antenna

Antenna concentrates most of its power in one direction, as shown in Figure 2.15. [10]
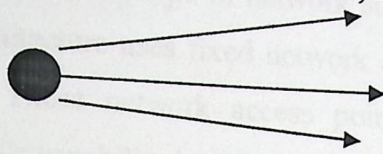
Fig 2.15 Directional Antenna

2.8 Access Point

Wireless access point plays the central role in a simple wireless LAN; it allow communication between computers equipped with wireless cards, the access point then bridges the traffic between the computers on the wireless networks it controls assuming the role played by a Ethernet hub in a basic star shaped wired network. Almost all access points also support an Ethernet port, to bridge its wireless network to an existing wired Ethernet network. [2]

2.9 IEEE 802.11 Standard

It is IEEE's proposed standard for wireless LANs (IEEE 802.11), there are two different ways to configure a network: ad-hoc and infrastructure. In the ad-hoc network, computers are brought together to form a network "on the fly." As shown in Figure 2.16, there is no structure to the network; there are no fixed points; and usually every node is able to communicate with every other node.
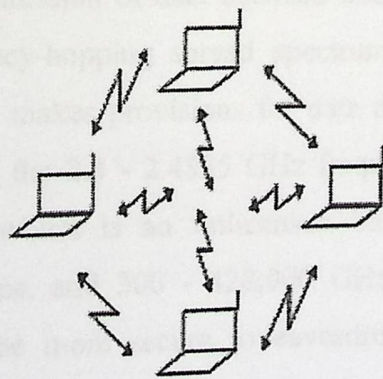
Fig 2.16: Ad-Hoc Network

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As shown in Figure 2.17, the second type of network structure used in wireless LANs is the infrastructure. This architecture uses fixed network access points with which mobile nodes can communicate. These network access points are sometime connected to landlines to widen the LAN's capability by bridging wireless nodes to other wired nodes. If service areas overlap, handoffs can occur. This structure is very similar to the present day cellular networks around the world.

To wired network

Wireless network
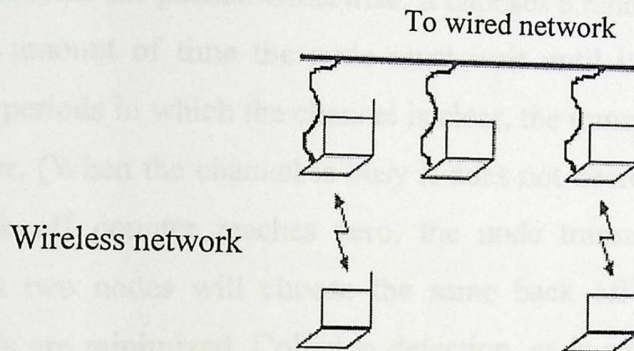
Fig 2.17 Infrastructure Network

2.9.1 IEEE 802.11 Layers

The IEEE 802.11 standard places specifications on the parameters of both the physical (PHY) and medium access control (MAC) layers of the network. The PHY layer, which actually handles the transmission of data between nodes, can use either direct sequence spread spectrum, frequency-hopping spread spectrum, or infrared (IR) pulse position modulation. IEEE 802.11 makes provisions for data rates of either 1 Mbps or 2 Mbps, and calls for operation in the 2.4 - 2.4835 GHz frequency band (in the case of spread-spectrum transmission), which is an unlicensed band for industrial, scientific, and medical (ISM) applications, and 300 - 428,000 GHz for IR transmission. Infrared is generally considered to be more secure to eavesdropping, because IR transmissions require absolute line-of-sight links (no transmission is possible outside any simply

connected space or around corners), as opposed to radio frequency transmissions, which can penetrate walls and be intercepted by third parties unknowingly. However, infrared transmissions can be adversely affected by sunlight, and the spread-spectrum protocol of 802.11 does provide some rudimentary security for typical data transfers.

The MAC layer is a set of protocols which is responsible for maintaining order in the use of a shared medium. The 802.11 standard specifies a carrier sense multiple access with collision avoidance (CSMA/CA) protocol. In this protocol, when a node receives a packet to be transmitted, it first listens to ensure no other node is transmitting. If the channel is clear, it then transmits the packet. Otherwise, it chooses a random "back off factor" which determines the amount of time the node must wait until it is allowed to transmit its packet. During periods in which the channel is clear, the transmitting node decrements its back off counter. (When the channel is busy it does not decrement its back off counter.) When the back off counter reaches zero, the node transmits the packet. Since the probability that two nodes will choose the same back off factor is small, collisions between packets are minimized. Collision detection, as is employed in Ethernet, cannot be used for the radio frequency transmissions of IEEE 802.11. The reason for this is that when a node is transmitting it cannot hear any other node in the system which may be transmitting, since its own signal will drown out any others arriving at the node. Whenever a packet is to be transmitted, the transmitting node first sends out a short ready-to-send (RTS) packet containing information on the length of the packet. If the receiving node hears the RTS, it responds with a short clear-to-send (CTS) packet. After this exchange, the transmitting node sends its packet.

When the packet is received successfully, as determined by a cyclic redundancy check (CRC), the receiving node transmits an acknowledgment (ACK) packet. This back-and-forth exchange is necessary to avoid the "hidden node" problem, illustrated in Figure 2.18. As shown, node A can communicate with node B, and node B can communicate with node C. However, node A cannot communicate node C. Thus, for instance, although node A may sense the channel to be clear, node C may in fact be transmitting to node B.

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The protocol described above alerts node A that node B is busy, and hence it must wait before transmitting its packet.
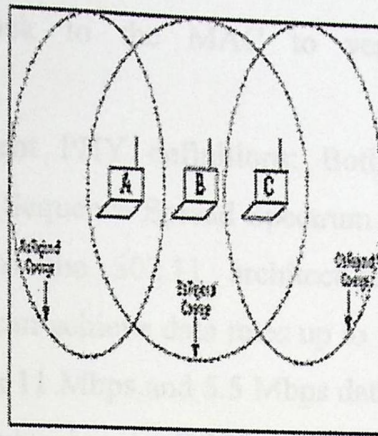
Fig 2.18: Hidden node problem

IEEE 802.11 is still in the process of being adopted as a standard by the IEEE standards body. Although 802.11 provides a reliable means of wireless data transfer.

2.9.1.1 802.11 Media Access Control

The 802.11 MAC layer provides functionality to allow reliable data delivery for the upper layers over the wireless PHY media. The data delivery itself is based on an asynchronous, best-effort, connectionless delivery of MAC layer data. There is no guarantee that the frames will be delivered successfully. The 802.11 MAC provides a controlled access method to the shared wireless media called Carrier-Sense Multiple Access with Collision Avoidance (CSMA/CA). CSMA/CA is similar to the collision detection access method deployed by 802.3 Ethernet Landsite third function of the 802.11 MAC is to protect the data being delivered by providing security and privacy services. Security is provided by the authentication services and by Wireless Equivalent Privacy (WEP), which is an encryption service for data delivered on the WLAN.

2.9.1.2 802.11 Physical Layer (PHY)

The 802.11 physical layers (PHY) is the interface between the MAC and the wireless media where frames are transmitted and received. The PHY provides three functions.

First, the PHY provides an interface to exchange frames with the upper MAC layer for transmission and reception of data. Secondly, the PHY uses signal carrier and spread spectrum modulation to transmit data frames over the media. Thirdly, the PHY provides a carrier sense indication back to the MAC to verify activity on the media.

802.11 provide three different PHY definitions: Both Frequency Hopping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS) support 1 and 2 Mbps data rates. An extension to the 802.11 architecture (802.11a) defines different multiplexing techniques that can achieve data rates up to 54 Mbps. Another extension to the standard (802.11b) defines 11 Mbps and 5.5 Mbps data rates (in addition to the 1 and 2Mbps rates) utilizing an extension to DSSS called High Rate DSSS (HR/DSSS). 802.11b also defines a rate shifting technique where 11 Mbps networks may fall back to 5.5 Mbps, 2 Mbps, or 1 Mps under noisy conditions or to inter-operate with legacy 802.11 PHY layers. [11]

Standard	Frequency Range	Throughput(Mbps)	Geographic Range
802.11b	2.4GHZ	11	175 feet
802.11a	5GHZ	54	80 feet
802.11g	2.4 GHZ	54	175feet

Table 2.2 Wireless Standards

2.10 Spread Spectrum

Spread spectrum is a technique trading bandwidth for reliability. The goal is to use more bandwidth than the system really needs for transmission to reduce the impact of localized interference on the media. Spread spectrum spreads the transmitted bandwidth of the resulting signal, reducing the peak power but keeping total power the same.

2.10.1 Frequency Hopping Spread Spectrum (FHSS)

Frequency Hopping utilizes a set of narrow channels and "hops" through all of them in a predetermined sequence. For example, the 2.4 GHz frequency band is divided into 70 channels of 1 MHz each. Every 20 to 400 msec the system "hops" to a new channel

following a predetermined cyclic pattern. The 802.11 Frequency Hopping Spread Spectrum (FHSS) PHY uses the 2.4 GHz radio frequency band, operating with at 1 or 2 Mbps data rate. [12]

2.10.2 Direct Sequence Spread Spectrum (DSSS)

The principle of Direct Sequence is to spread a signal on a larger frequency band by multiplexing it with a signature or code to minimize localized interference and background noise. To spread the signal, each bit is modulated by a code. In the receiver, the original signal is recovered by receiving the whole spread channel and demodulating with the same code used by the transmitter. The 802.11 Direct Sequence Spread Spectrum (DSSS) PHY also uses the 2.4 GHz radio frequency band. [12]

3

Chapter Three

Design Concepts

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Chapter Three

Design Concepts

3.1 Project Objectives

The main purpose of the project is to transfer data such as voice or text between two locations. Each location must be able to transmit and receive data at different times. We can summarize the project objectives in the following points:

1- To build a complete wireless communication system that is able to transmit and receive data (voice and text) between two locations.

2- To learn how to deal with RF signals in different types (digital and analog).

3- To study some of the modulation techniques and to implement them (e.g. AM, FM.).

4- To build a wireless channel between two locations using 802.11b technology and this channel to transmit different types of data (text, voice, image).

5- Replacing the wired communication system which already exits with a wireless channel.

3.2 General Block Diagram

The main goal of the system is to be able to send and receive data wirelessy between two PC's in two different locations (distance between them 10m nearly), the data on PC's could be text ,voice and image as shown in figure 3.1.
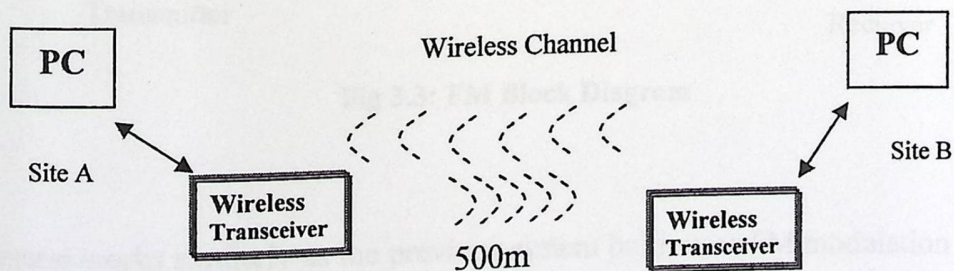
Fig 3.1: General Block Diagram for the System

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This trancivier may be designed using AM or FM techniques, a breief description as follows .

3.2.1 AM Block Diagram

Figure 3.2 is a block diagram for amplitude modulation technique that is used in the first stage of this work.

Transmitter   **Fig 3.2: AM Block Diagram**   Reciever
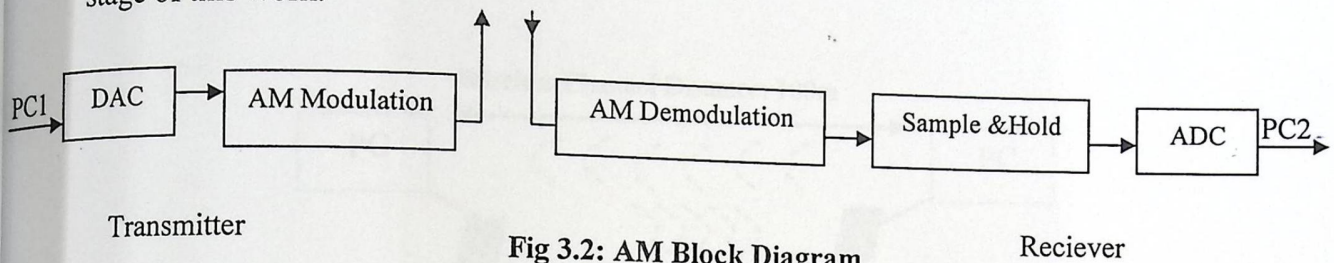
The AM system depends on taking data from the first PC in its digital form and converting it to analog signals by means of the DAC card, this data could be modulated by AM method and sent wirelessly to the other side; where it is demodulated and converted to its digital form to be read by the second PC.

3.2.2 FM block diagram

Transmitter   Reciever

Fig 3.3: FM Block Diagram
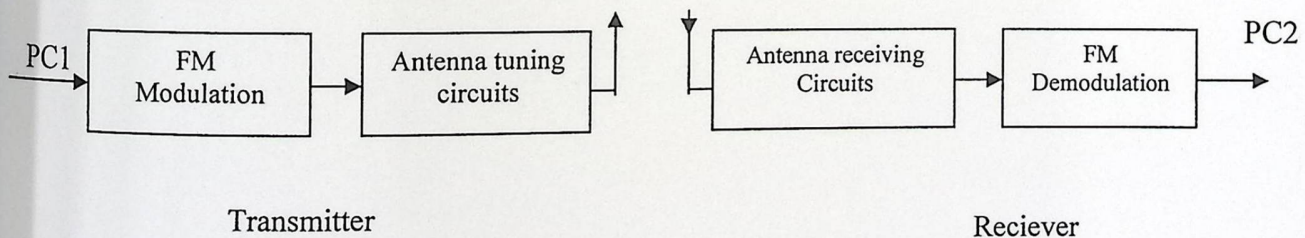
This system works similarly as the previous system but it uses FM modulation rather than the AM. In addition it contains the required antenna tuning and receiving circuits.

3.2.3 Wireless LAN Block Diagram

A WLAN is a cellular computer network that transmits and receives data through radio signals instead of wires. WLANs are used increasingly in both home and office environments. Innovative ways to utilize WLAN technology are helping people to work and communicate more efficiently. Increased mobility and the absence of cabling and other fixed infrastructure have proven to be beneficial for many users.

Wireless Channel Distance: 100m

PC

PC

Wireless Card   Wireless Card
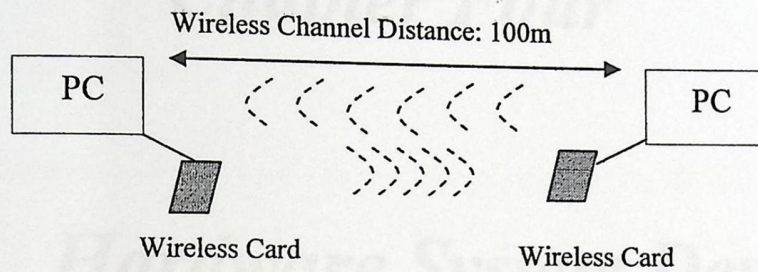
Fig 3.4: Wireless LAN Block Diagram

4

Chapter Four

Hardware System Design

Chapter Four

Hardware System Design

Radio frequencies are electronic waves used for wireless transmission, their range occurred between 10 kHz and 300 GHz. A RF system can be designed in different methods, in this project we discusses three options the AM , FM and the wireless cards (D-Link Air Plus) which uses spread spectrum technique.

4.1 AM Modulation System

Amplitude modulation results in three separate frequencies being transmitted: the original carrier frequency, a lower sideband (LSB) below the carrier frequency, and an upper sideband (USB) above the carrier frequency. The sidebands are "mirror images" of each other and contain the same intelligence. When an AM signal is received, these frequencies are combined to produce the sounds you hear. Each sideband occupies as much frequency space as the highest audio frequency being transmitted. If the highest audio frequency being transmitted is 5 kHz, then the total frequency space occupied by an AM signal will be 10 kHz (the carrier occupies negligible frequency space).

AM has the advantages of being easy to produce in a transmitter and AM receivers are simple in design. Its main disadvantage is its inefficiency. About two-thirds of an AM signal's power is concentrated in the carrier, which contains no intelligence. One-third of the power is in the sidebands, which contain the signal's intelligence. Since the sidebands contain the same intelligence, however, one is essentially "wasted." Of the total power output of an AM transmitter, only about one-sixth is actually productive, useful output!

Other disadvantages of AM include the relatively wide amount of frequency space an AM signal occupies and its susceptibility to static and other forms of electrical noise. Despite this, AM is simple to tune on ordinary receivers, and that is why it is used for almost all shortwave broadcasting. [15]

4.2 FM Modulation System

FM was promoted in 1936 over AM in order to provide radio transmissions less susceptible to noise. The following compare the AM and FM techniques:

1- Narrowband FM required the same bandwidth as AM, however for high quality of reception (HI-FI) a much higher bandwidth (75 kHz) is required for FM

2- FM requires less radiated power than AM to achieve the same signal to noise ratio.

3- Since FM reception is limited to line-of-sight, the area of reception for FM is much smaller than AM. This may be an advantage where cochannel allocations are concerned, but it represents a disadvantage from the point of view of FM mobile communication over wide area. This is due to frequencies employed for its transmission rather than the intrinsic properties of FM. A greater density of transmitter may be achieved in FM since the field intensity will reach a low value after a given distance (line of sight causing the threshold effect) which will not affect another system. An interfering audio signal creates objectionable interference if its level reaches 35-40dB below the wanted signal. The power ratio to FM interference is only 6dB compare to 35dB for AM interference because the information of the FM wave is in the zero crossing of the wave and not in its amplitude where the primary effect of the interference is manifested [16].

Parameter	AM	FM
Signal-to-Noise Ratio	Low-to-Moderate	Moderate-High
Performance vs. Attenuation	Sensitive	Tolerant
Transmitter Cost	Moderate-High	Moderate
Receiver Cost	Moderate	Moderate-High
Receiver Gain Adjustment	Often Required	Not Required
Installation	Adjustments Requires	No Adjustments Required
Multichannel Capabilities	Require High Linearity Optics	Fewer Channels
Performance Over Time	Moderate	Excellent
Environmental Factors	Moderate	Excellent

Table 4.1 AM/FM Comparison

4.3 802.11 Wireless LAN Design

In this project it is planned to use the wireless network adapter D-Link Airplus Dwl-120+ that implements the 802.11 protocol, the configuration of the card and its interface with the system illustrated below:
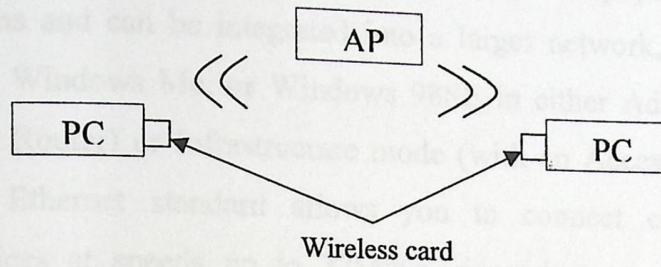

Fig 4.1 Internal Wireless LAN

Based on the IEEE 802.11b standard, the DWL-120+ is interoperable with existing compatible 2.4GHz wireless technology with data transfer speeds of up to 22Mbps when used with other D-Link AirPlus devices, it uses a frequency hopping spread spectrum (FHSS) modulation method.
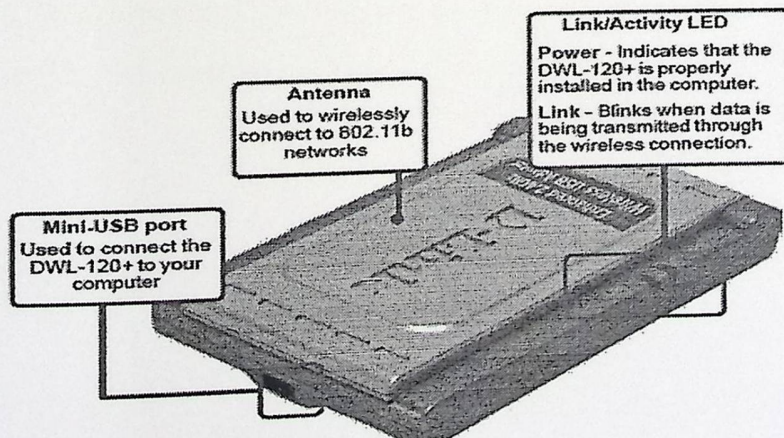
Fig 4.2: Wireless D-Link AirPlus DWL-120+ Card

The D-Link AirPlus DWL-120+ 2.4GHz Wireless USB Adapter is a convenient Plug & Play USB 1.1 solution that brings wireless networking to your laptop or desktop PC. It provides up to 256-bit level of WEP security to your wireless data transfers.

The DWL-120+ comes with software drivers for the most popular Microsoft Windows operating systems and can be integrated into a larger network, running Windows XP, Windows 2000, Windows Me, or Windows 98SE in either Ad Hoc mode (without an Access Point or Router) or Infrastructure mode (with an Access Point or Router). The IEEE 802.11b Ethernet standard allows you to connect computers and 802.11b compatible devices at speeds up to 22Mbps, dependent upon the distance between wireless adapters, the configuration of your working environment, or the capabilities or limitations of your computer systems [17].

5

Chapter Five

Implementation and Testing

Chapter Five

Implementation and Testing

A) Implementation

5.1 AM Modulation

This section illustrates the implementation of AM modulation in its general steps as the following.

a- Digital-to-Analog Converter (DAC)

An 8 bits value was entered from parallel port (2,3,4,5,6,7,8,9) to the DAC0801 and the output of the DAC measured between(2,4) as shown in Figure 5.1.

For example when you enter from parallel port (0Xff) the output from DAC is 5 volt and when you enter from parallel port (0X00) the output from DAC is 0 volt and so on.
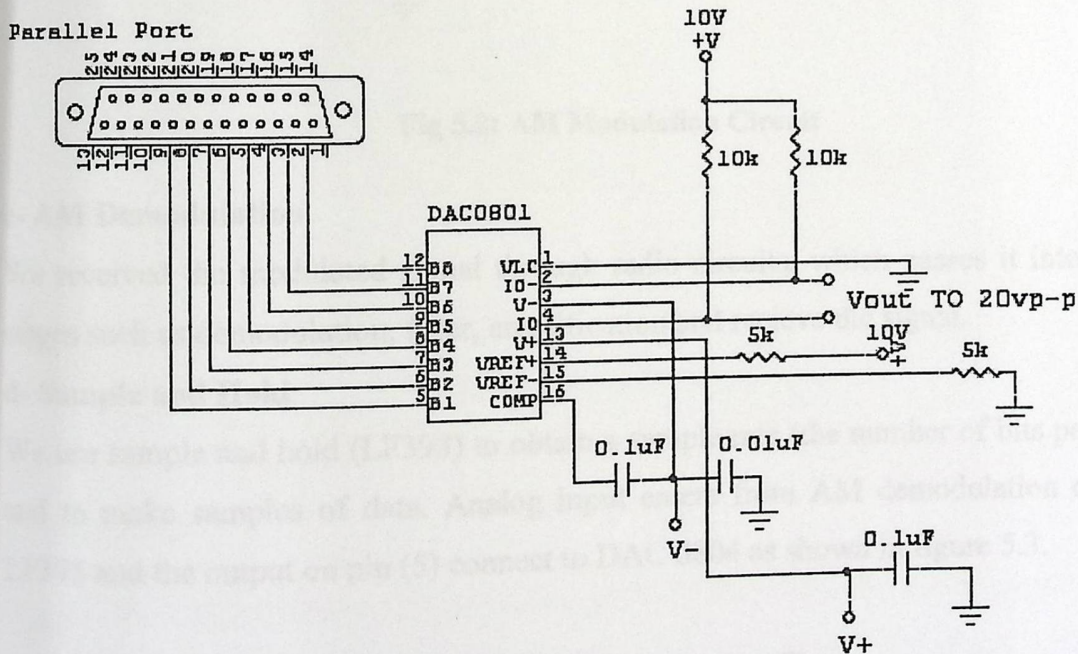
Fig 5.1: Digital-to-Analog Convert Circuit

b- AM Modulation

The oscillator has frequency range between 435KHz to 475KHz, the frequency is set by potentiometer P1 course tuning and P2 fine tuning , the output amplitude can be varied between 0 - 3 Vpp by potentiometer P3 , to tune the oscillator center potentiometer P1 and P2 and tune transformer T1 to obtain an output frequency of 455KHz , the modulator is composed of transistor Q1 and Q2 and network composed of capacitor and resistors.
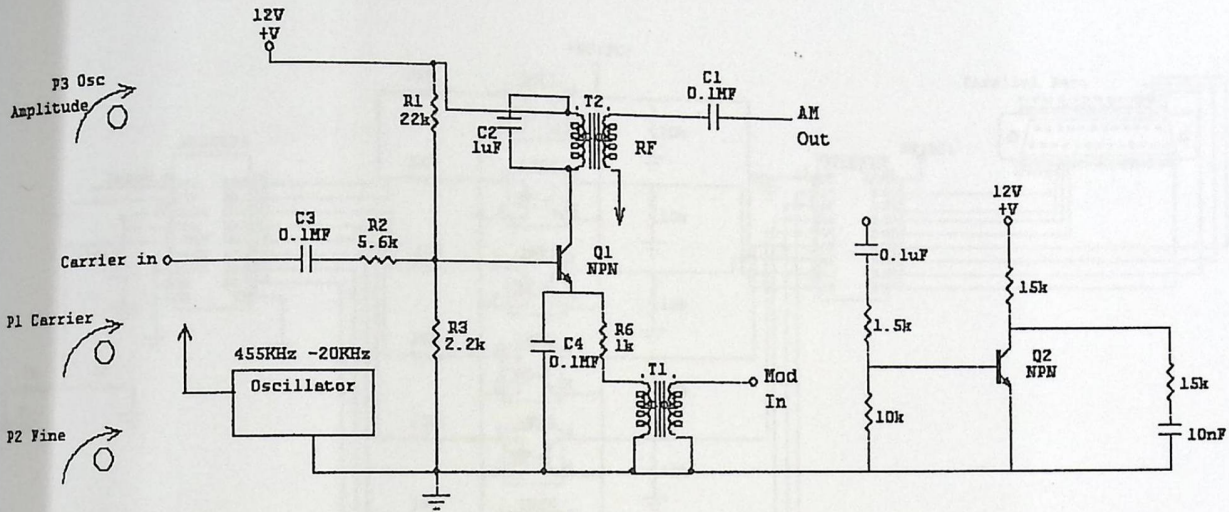
Fig 5.2: AM Modulation Circuit

c- AM Demodulation

We received the modulated signal through radio circuits, which passes it into different stages such as demodulation, filter, amplification and recieve the signal.

d- Sample and Hold

We use sample and hold (LF398) to obtain a sample rate (the number of bits per sample) and to make samples of data. Analog input enters from AM demodulation circuits to LF398 and the output on pin (5) connect to DAC 0804 as shown in figure 5.3.
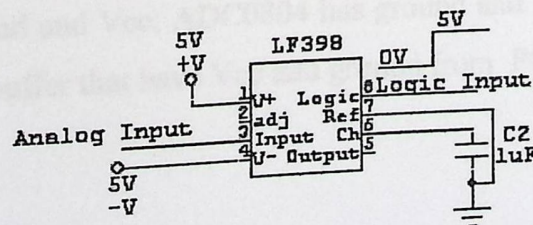
Fig 5.3: Sample and Hold Circuit

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e- Analog-to-Digital Converts (ADC)

An analog input enter to ADC0804 and the output of ADC is (11,12,13,14,15,16,17,18) that convert it to digital data then enter it to the Opto Coupler after that to the buffer and read it from parallel port (1,14,16,15,13,12,10,11) as shown in figure 5.4.

For example when enter to ADC 0 volt the input to the parallel port (0X00) and when enter to ADC 5 volt the input to the parallel port (0Xff).
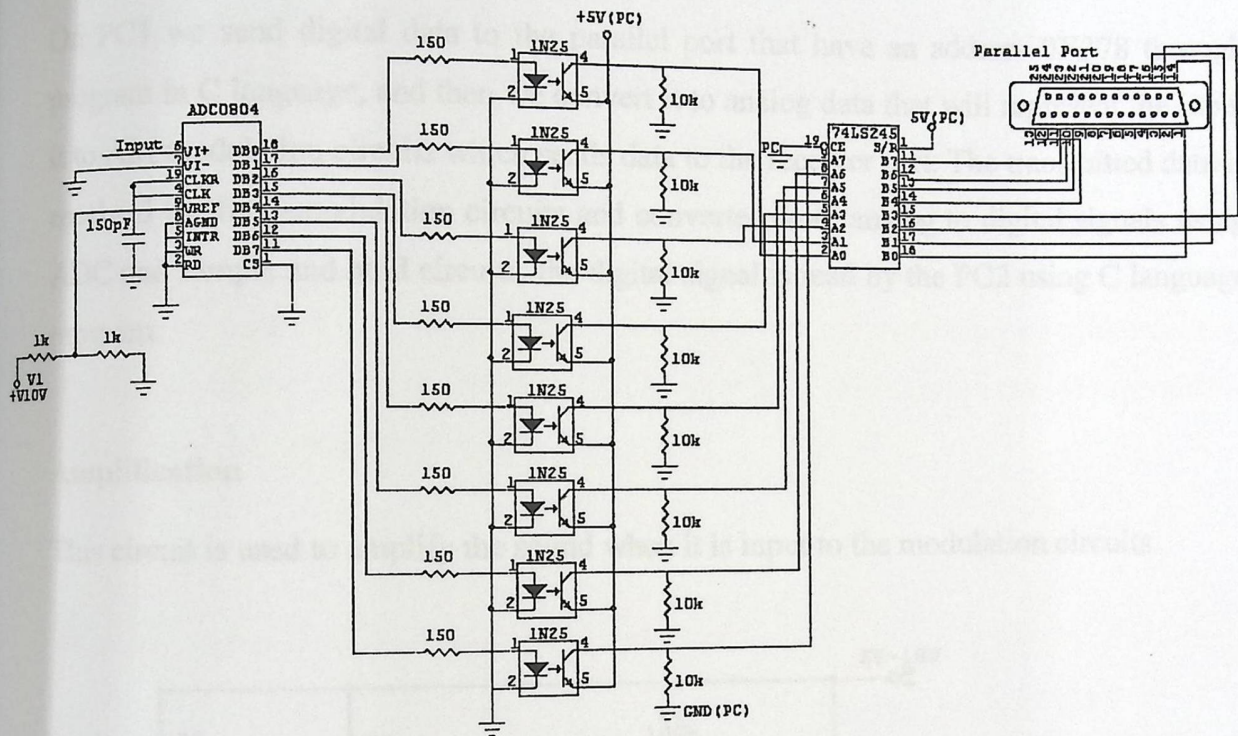
Fig 5.4: Analog to Digital Circuit

f-Opto Coupler

We use the Opto Coupler (1N25) to isolate ADC0804 from the buffer circuits, so each circuit has its own ground and Vcc; ADC0804 has ground and Vcc which different from ground and Vcc to the buffer that have Vcc and ground from PC.

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g-Buffer (74LS245)

We use the octal bus transceivers (74LS245) to asynchronous data between ADC and parallel port and to keep data from lost , the devices allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (OE) input can disable the device so that the buses are effectively isolated.

On PC1 we send digital data to the parallel port that have an address 0X378 through program in C language, and then we convert it to analog data that will represent the input it to AM modulation circuits which sends data to the receiver part. The transmitted data is received by the demodulation circuits and converted from analog to digital signals using ADC and sample and hold circuits, the digital signal is read by the PC2 using C language program.

Amplification

This circuit is used to amplify the sound when it is input to the modulation circuits.
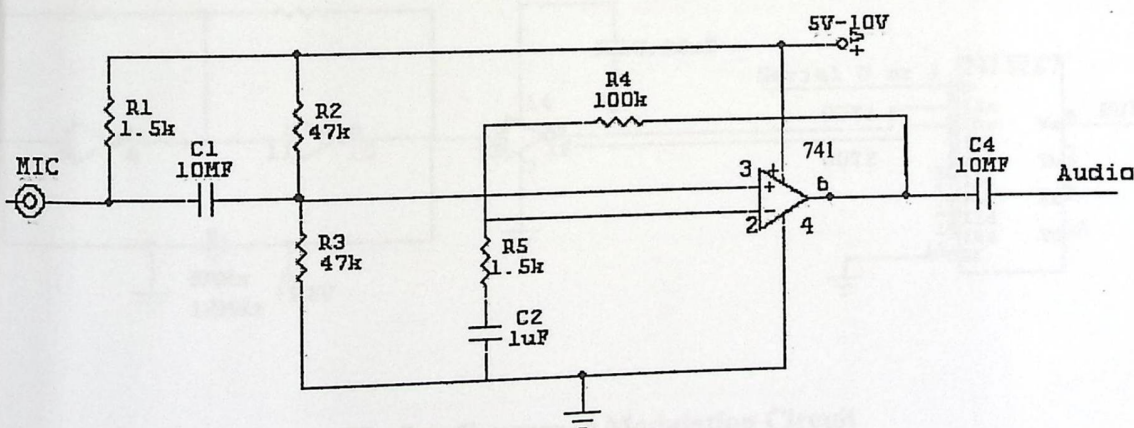
Fig 5.5: Amplification Circuit

5.2 FM Modulation

This technique depends on hiding digital data (1's and 0's) onto two different frequencies and sending them to the receiver part, the data sent from the PC using C programming language to the serial port interface.

5.2.1 Transmitting Part

5.2.1.1 Frequency Modulation:

The frequencies obtained from the crystal oscillator part which contains two crystals one provides a 12 MHz frequency and the other provides 6MHz frequency as shown in figure 5.6. These two frequencies represent the inputs to the second stage (Multiplexing).

The second step perform digital frequency modulation, it uses a multiplexer as a selector unit to choose one of the two frequencies produced from the oscillator part , the selection occurred according to the pin number 1 (see figure 5.6) which represents the digital data coming from the computer serial port.
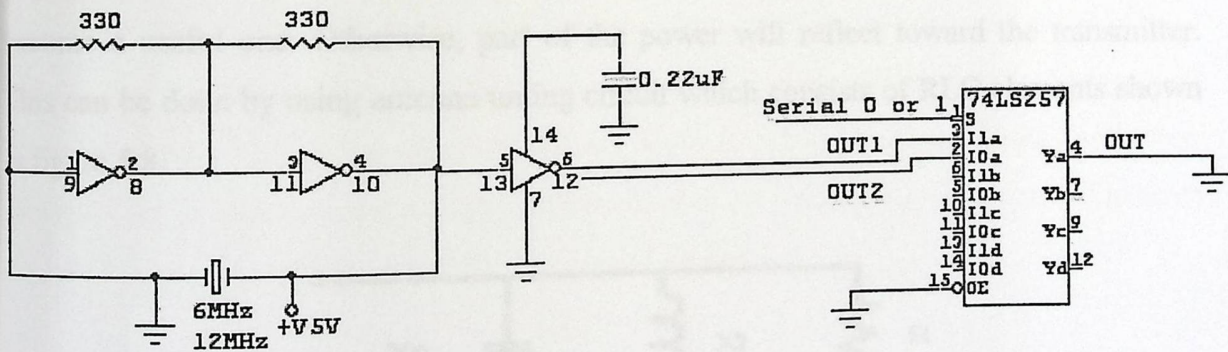
Fig 5.6: Frequency Modulation Circuit

5.2.1.2 Antenna Interface Circuits

In order to transmit the FM signal, an antenna and its interface circuits are needed. There are many types of antennas, in this system the half wave dipole antennas were selected at the beginning since they are easy to build and their cost is low, as shown in figure 5.7, the

half wave dipole antenna consists of a half wavelength radiator (B) that is cut into two sections (A) which are each a quarter – wavelength long.
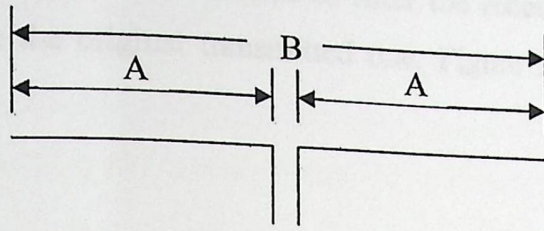
Fig 5.7: Half Wave Dipole Antenna

The following equations are used to calculate the lengths of A and B elements:

$\lambda = 300/F$

Where:

λ : the wavelength

F: frequency in MHz

$B = \lambda/2$

$A = \lambda/4$

5.2.1.3 Impedance Matching

Impedance matching is needed to radiate all the power from the transmitter and the signal become a useful one. Otherwise, part of the power will reflect toward the transmitter. This can be done by using antenna tuning circuit which consists of RLC elements shown in figure.5.8
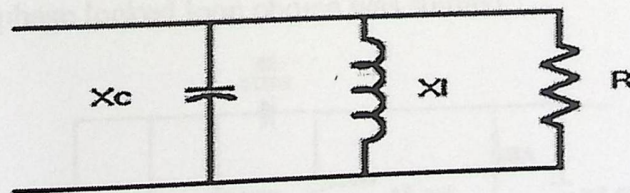
Fig 5.8: Matching Impedance Circuit

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5.2.2 Receiving Part

5.2.2.1 Antenna Receiving Circuit

The antenna receiving circuit is used to filter the received signal, then to amplify it in order to retrieve the original transmitted one. Figure 5.9 shows the antenna receiving circuit.
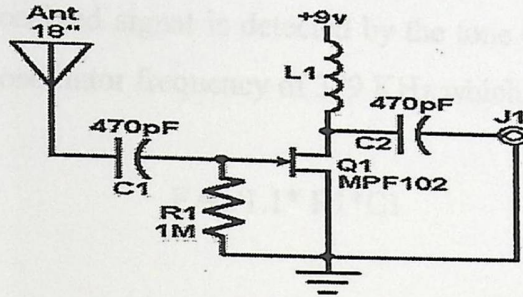
Fig 5.9: Antenna Receiving Circuit

5.2.2.2 Frequency Demodulation

Signal demodulation is used to retrieve the digital data 1's and 0's from the modulating signals. In order to demodulate signals, two options were studied:

1-Using Frequency Detector Circuits

Frequency detector circuits produce different voltage difference when the frequency of input signal is changed .By using this property, we can get two different voltages one will represents logic 1, and the other represents logic 0, when the input signal frequency changed, but in our case the voltage difference was not enough to differentiate between the two logics and so phase locked loop choice was studied.
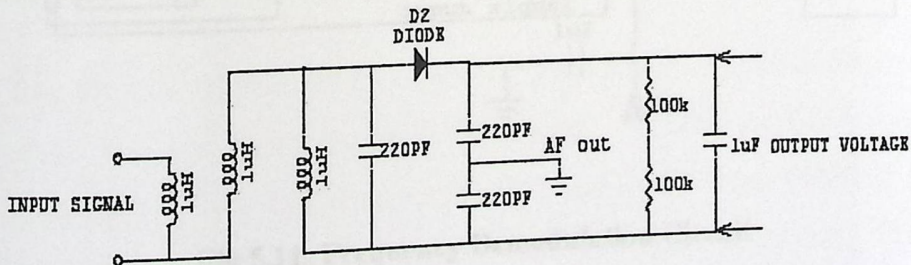
Fig 5.10 Frequency Detector Circuit

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2- Using Phase Locked Circuits

A phase-locked loop (PLL) is a closed loop frequency control system, its function is based on the phase sensitive detection of phase difference between the input and output signals of the controlled oscillator (CO).t is a feedback system combining a voltage controlled oscillator and a phase comparator so connected that the oscillator frequency (or phase) accurately tracks that of an applied frequency- or phase-modulated signal. [18]

The frequency of the received signal is detected by the tone decoder (PLL IC) LM567, which is adjusted to an oscillator frequency of 379 KHz which can be calculated from the following law:

$$F = 1/1.1 * R1 * C1$$

Where in our case:

R1=1.8k

C1=1.33nF (as in figure 5.11).

In order to obtain this frequency, the received signal is divided by using 74HC393 counter and so if the frequency is close enough to VCO then LM567 sends pin 8 to LOW (ground). Otherwise, the 10K Ω at the output will pull-up resistor holds it to 5 Volts.
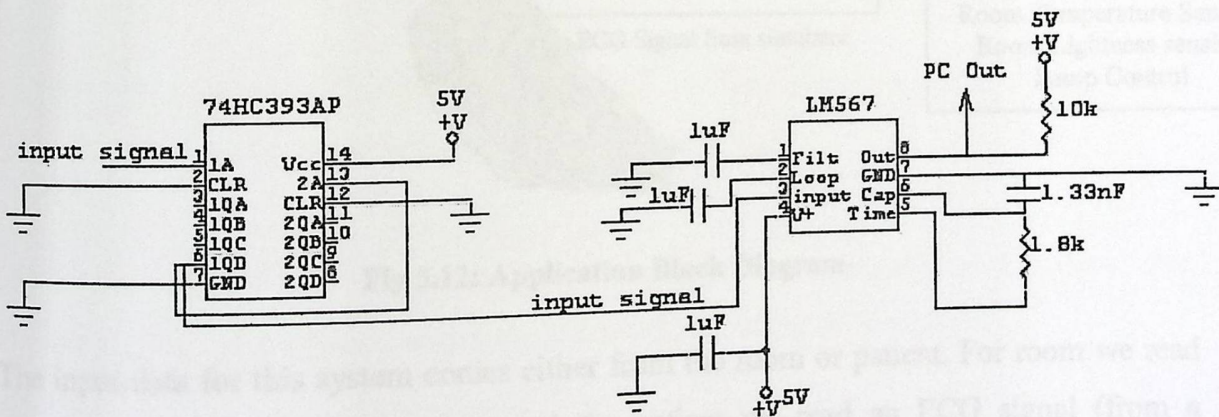
Fig 5.11: Frequency Demodulation Circuit

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5.3 Wireless Application System

In order to benefits from the wireless technology the project team decided to design an application system that applies and benefits from this technology in our real life. The application is based on sending medical data, images, and signals wirelessly from patient room to another far away place (max distance 100m). It could be useful for doctors in hospitals or any similar applications.

5.3.1 Application Block Diagram

The application depends on using microcontroller system, wireless cards, sensing and interfacing circuits and personal computers as it shown in the figure 5.13.
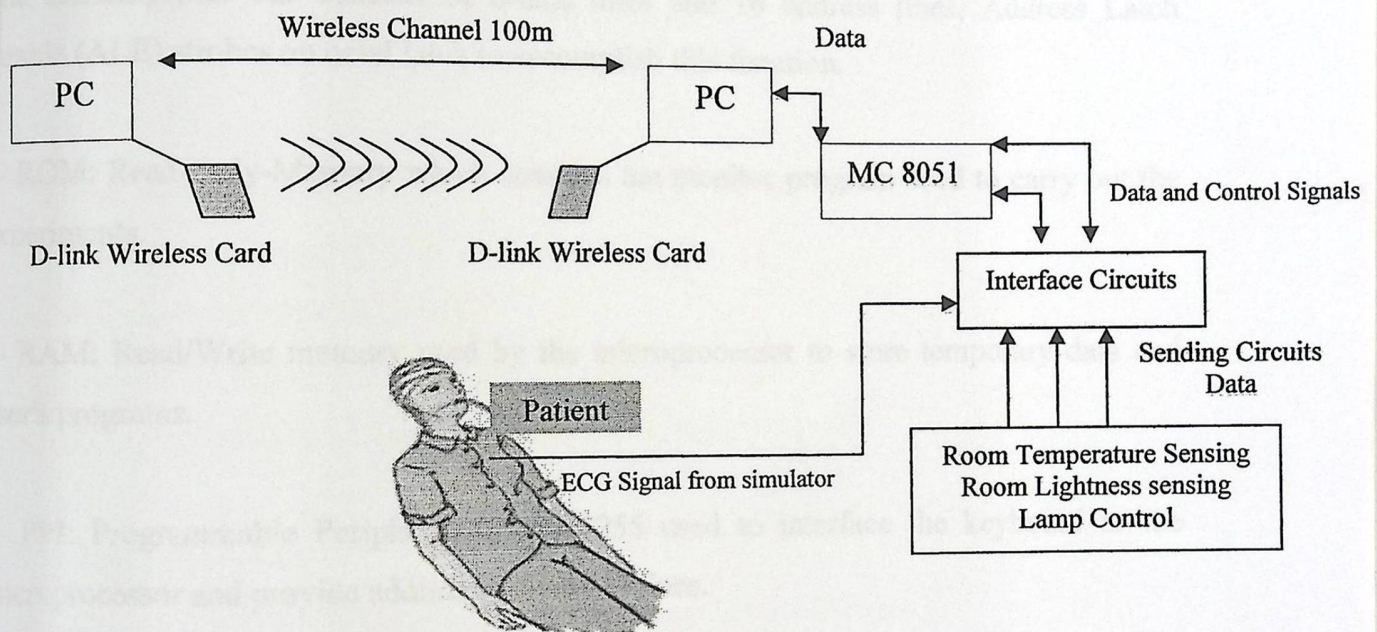
Fig 5.12: Application Block Diagram

The input data for this system comes either from the room or patient. For room we read the temperature and the lightness, and for patient we read an ECG signal (from a simulator instrument). Then by using a suitable interfacing circuit (Analog to Digital to converter and Multiplexers) the data sent to the 8051 microcontroller .The 8051 then processes the data and sends it to the first PC which reformulates the ECG signal and puts it along with the data (temperature/lightness) and an image (stored in the PC) in a

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file that will be transmitted wirelessly to the second PC. The following sections describe the system in more details.

5.3.1.1 The 8051 Microcontroller

The 8051 microcontroller process the data coming from the sensing and interfacing circuits and it provides the required handshaking signals between the PC and the circuits. The main components of the 8051 MC system include:

1- Microprocessor: 8 bit microprocessor which serves as the central processing unit.

2- Demultiplexer: Data/address demultiplexer used to separate address from data bus. The demultiplexer bus consists of 8-data lines and 16 address lines, Address Latch Enable (ALE) strobes on octal latch to accomplish this function.

3- ROM: Read-Only-Memory which contains the monitor program used to carry out the experiments.

4- RAM: Read/Write memory used by the microprocessor to store temporary data and user's programs.

5- PPI: Programmable Peripheral Interfac8255 used to interface the keyboard to the microprocessor and provide additional 8-bit I/O lines.

6- RS-232Circuits: Used to interface the microcomputer to standard serial devices, such as IBM PC/XT/AT personal computers or compatible, serial printers, etc.

7- Bus Interface: Provides a parallel expansion to the microcomputer .These 8 bit data lines, 4 bit address lines, one chip-select line and ground, are useful to expand the basic microcomputer to several hardware applications, such as relays, sensors, control units, etc.[19]

5.3.1.2 The D-Link Wireless Cards

The D-link wireless cards are used to send and receive data wirelessly between PC's.

Features and Benefits

- Convenience of plug and play installation.
- Fully 802.11 compatible.
- USB 1.1 standards.
- Stronger network security with 256-bit WEP encryption.
- Support infrastructure network via an access point or router and peer-to-peer communication in Ad-Hoc mode.
- User-friendly configuration and diagnostic utilities.
- Connects at up to 328 feet indoors.[17]

System Requirements

- A computer or laptop with available USB port.
- Windows XP/2000/Me/98SE.
- At least 32 MB of memory and a 300 MHz processor.
- Properly installed and working USB Controller.[17]

Contents of Packag

- D-Link AirPlus DWL-120+ 2.4 GHz Wireless USB Adapters.
- Manual on CD-ROM.
- Quick installation guide.
- USB cable.[17]

Types of networking

There are basically two modes of networking:

1-Infrastructure: using an access point or router, such as the DI-614+.

2-Ad-Hoc:directly connecting to another computer ,for peer-to-peer communication ,using wireless network adapters on each computer, such ass two or more DWL-120+ wireless USB adapters.[17]

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5.3.1.3 The Sensing Circuits

A- Temperature Circuit

This circuit reads the room temperature by using the LM35 sensor, the reading is then amplify using TL081 amplifier. The second amplifier is used to remove the negative signal .the output of this circuit is an analog one which needs an ADC to convert it to a digital signal so that it could be read by the MC board.
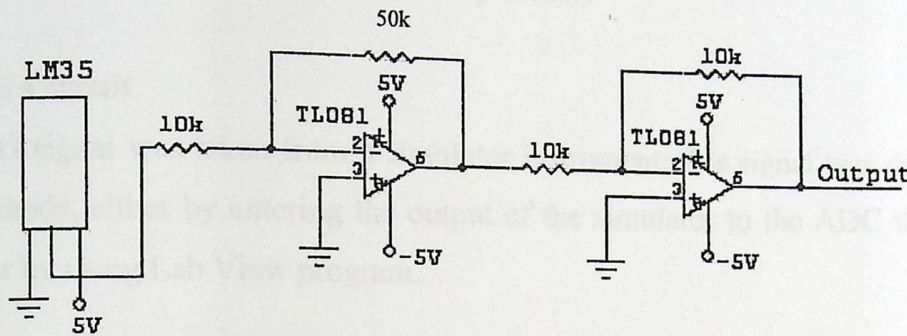
Fig 5.13 :Temperature Sensing Circuit

B- Lightness Circuit

This circuit use a LDR sensor to discover if there is a light in the room or not .The output of this circuit is a digital signal (1 or 0) that can seen on the LED, this data can be entered directly to MC board since it a digital one.
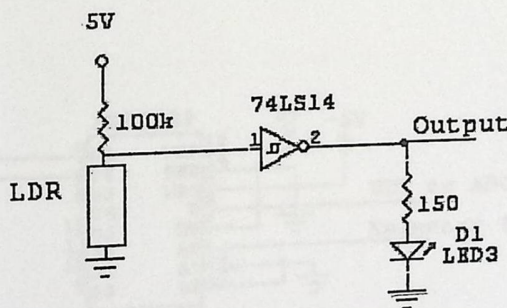
Fig 5.14: Lightness Circuit

C-Lamp Circuit

According to the output of the lightness circuit, a lamp will be turn on or off .This can be done wirelessly from the second PC. If the data sent to the second PC shows

49
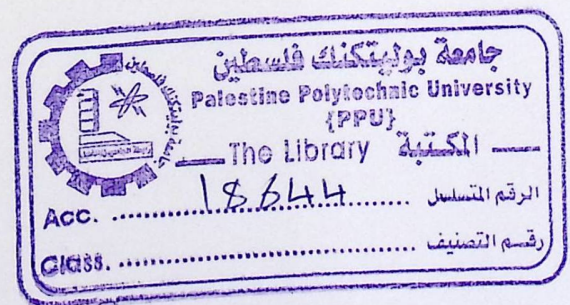
there is light in the room then PC2 will turn off the lamp. And if there is a darkness then it will turn on lamp.
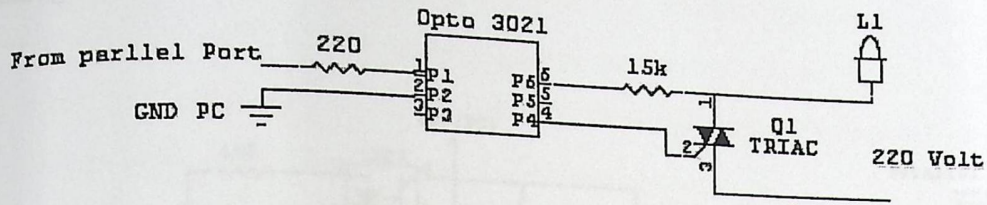
Fig 5.15: Lamp Circuit

D- ECG Circuit

The ECG signal was taken from a simulator instrument; this signal was drawn using two methods, either by entering the output of the simulator to the ADC then to MC board, or by using Lab View program.

5.3.1.4 The Interfacing between the Sensing Circuits and MC Board

The required interfacing circuits are the Analog to Digital Converter and the Multiplexer. The ADC circuit converts the analog inputs which come from the sensing circuits to digital ones, while the multiplexer where used to switch between different analog inputs (temperature or ECG).
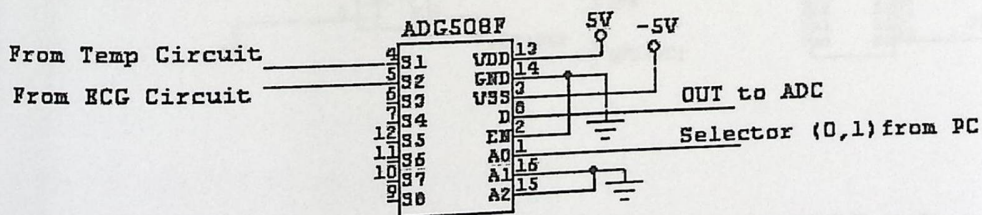
Fig 5.16: Analog Multiplexer circuit

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5.3.1.5 The Interfacing between PC and MC Board

In addition to that, we need an isolation circuit between the PC parallel port and the output from the MC board; this circuit protects the PC parallel port from being damaged.
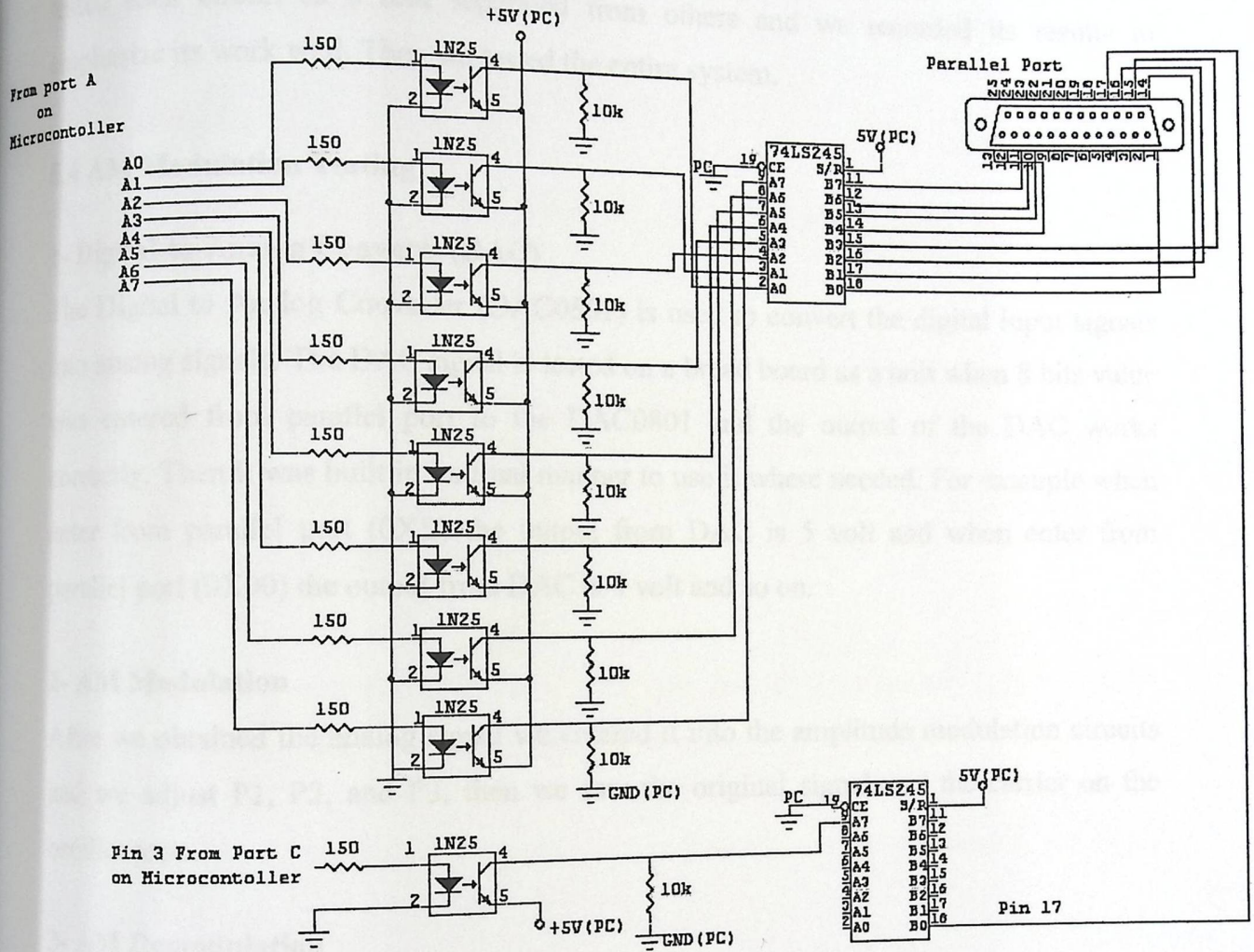
Fig 5.17: Isolation Circuit between PC and MC Board

B) Testing

This section describes the whole parts of the system that had been tested and implemented successfully. The testing passes in several stages. At the beginning we tested each circuit as a unit separated from others and we recorded its results to emphasize its work well. Then we tested the entire system.

5.4 AM Modulation Testing

1- Digital-to-Analog Converts (DAC)

The Digital to Analog Converter (DAC0801) is used to convert the digital input signals into analog signals. The DAC signal is tested on a bread board as a unit when 8 bits value was entered from parallel port to the DAC0801 and the output of the DAC works correctly. Then it was built in its final manner to use it where needed. For example when enter from parallel port (0Xff) the output from DAC is 5 volt and when enter from parallel port (0X00) the output from DAC is 0 volt and so on.

2- AM Modulation

After we obtained the analog signal we entered it into the amplitude modulation circuits and we adjust P1, P2, and P3, then we saw the original signal and the carrier on the oscilloscope.

3- AM Demodulation

We received the modulated signal through radio circuits, which passes it into different stages such as demodulation, filtration, and amplification. And at the end, we get the modulated signal.

4- Sample and Hold

An analog input enters from AM modulation circuits to sample and hold (LF398) that takes sample of data as input to ADC circuit and it works correctly.

5- Analog-to-Digital Converts (ADC)

The Analog to Digital Converter (ADC 0804) is used to convert the analog input signals into digital signals. The ADC signal is tested on a bread board as a unit for example when enters to ADC 0 volt the input to the parallel port (0X00) and when enter to ADC 5 volt the input to the parallel port (0Xff).

a- Opto Coupler

The Opto Coupler (4N25) is used to isolate the ADC0804 and the buffer circuits. We test it as a unit and it worked properly.

b- Buffer (74LS245)

The octal bus transceiver (74LS245) is used to asynchronous data between ADC and parallel port and to keep data from lost. We test it as units that allow data transmission from the A bus to the B bus correctly.

Finally when we operate the system as a whole, the data that sent from PC1 to PC2 didn't always receive correctly. After analyzing the entire system we found some reasons for that.

1-When the signal converted from analog to digital and from digital to analog, the signal may loss its power.

2- The sample and hold and ADC didn't work on the same time and speed.

Amplification Circuits

This circuit is used to amplify the sound when it is input to the modulation circuit then we received this signal through radio circuits.

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5.5 FM Modulation Testing
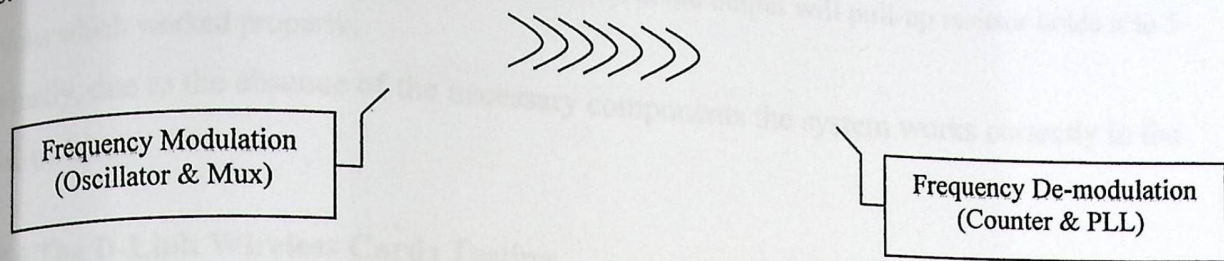
Fig 5.18: FM Modulation Testing

5.5.1 Transmission Part Testing

To test frequency demodulation circuits first we test oscillator part which contains two crystals one provides a 12 MHz frequency and the other provides 6MHz frequency which work correctly, after that we test multiplexer by sending from PC 0 or 1 to pin1 on multiplexer (47LS257) which use as a selector unit to choose one of the two frequencies (6 MHZ or 12 MHZ) produced from the oscillator part and the output of the multiplexer connect to the oscilloscope to observe the output, which works correctly.

5.5.2 Receiving Part Testing

In order to demodulate the signal, two options were tested:

1- Using Frequency detector circuits:

We tested the frequency detector circuits which produce different voltage difference when the frequency of input signal is changed, so we got two different voltages one represents logic 1 and the other represents logic 0 ,when the input signal frequency changed which means it worked properly .

2- Using Phase Locked Circuits (PLL):

We tested 74HC393 counter that is used to divide the received signal to an oscillator frequency of 379 KHz which worked correctly by observing it on oscilloscope, after that we tested phase-locked loop (LM567) the frequency of the received signal is detected using the tone decoder, which is adjusted to the output of counter frequency, then LM567

sends pin 8 to low (ground). Otherwise, the 10K Ω at the output will pull-up resistor holds it to 5 Volts which worked properly.

Finally, due to the absence of the necessary components the system works correctly in the wired level.

5.6 The D-Link Wireless Cards Testing

We installed D-Link wireless cards on PCs in different labs and we made the necessary configuration for them as shown in appendix B and it transmitted and received (voice, data and images) between two PC's correctly.

5.7 The sensing Circuits Testing

5.7.1 Temperature Circuit Testing

The temperature circuit was built to sense the temperature of the environment by using the LM35 sensor. We tested this sensor when the temperature of the environment was changed the output of the sensor was changed according to it which means it worked correctly. The reading was then amplified using TL081 amplifier, the second amplifier was used to remove the negative signal and we tested TL081 which means it worked correctly. The output of this circuit was an analog one which needs an ADC to convert it to a digital signal so that it could be read by the MC Board.

5.7.2 LDR Circuit Testing

The LDR (Light Dependent Resistance) sensor really was built in this system to test the area surrounded to the patient room either darkness or sunshine.

The LDR circuit was built on a bread board and tested successfully as a unit then used to interface the 8051 microcontroller. The output of the sensor was connected to input bit in port C of the MC Board, then to the parallel port of the PC, which can be read using VB.NET language.

Chapter Six

Software System Design

This chapter discusses the software part that has been implemented during working on different methods of wireless systems; indeed it contains illustrated flowcharts for each stage.

6.1 AM System

A-Sender Side

Fig 6.1: AM Sender Flowchart
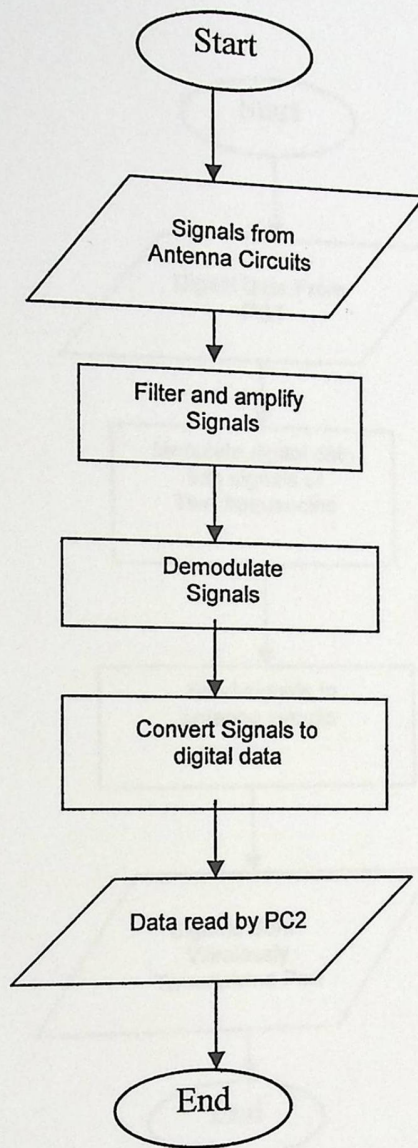
Fig 6.2: AM Receiver Flowchart

6.2 FM System

A-Sender Side


```
        ( Start )
           |
           v
    / Digital Data From /
    /       PC1        /
           |
           v
    +------------------+
    | Modulate digital |
    | data into        |
    | signals of       |
    | Two frequencies  |
    +------------------+
           |
           v
    +------------------+
    |  Send signals to |
    |  antenna circuits|
    +------------------+
           |
           v
    / Signals Sent     /
    / Wirelessly       /
    / To receiving Part/
           |
           v
        ( End )
```
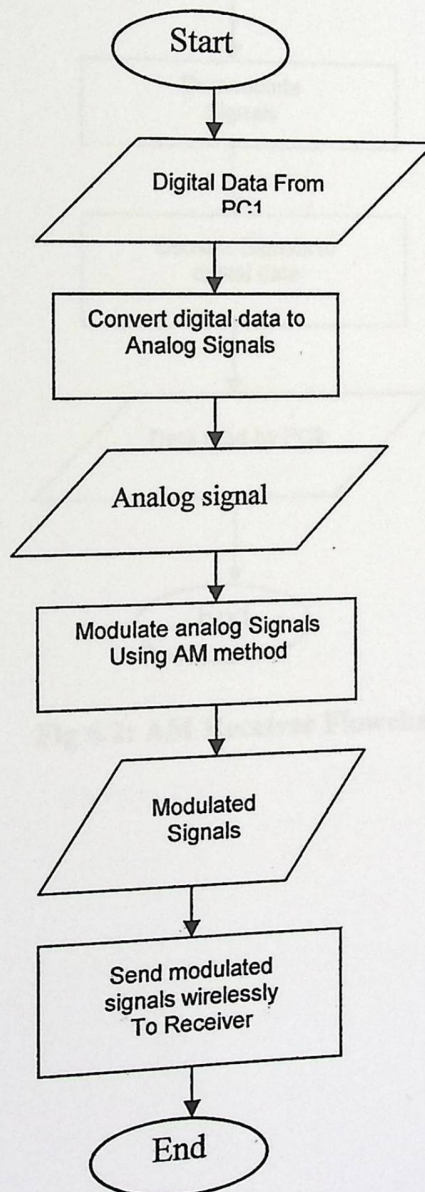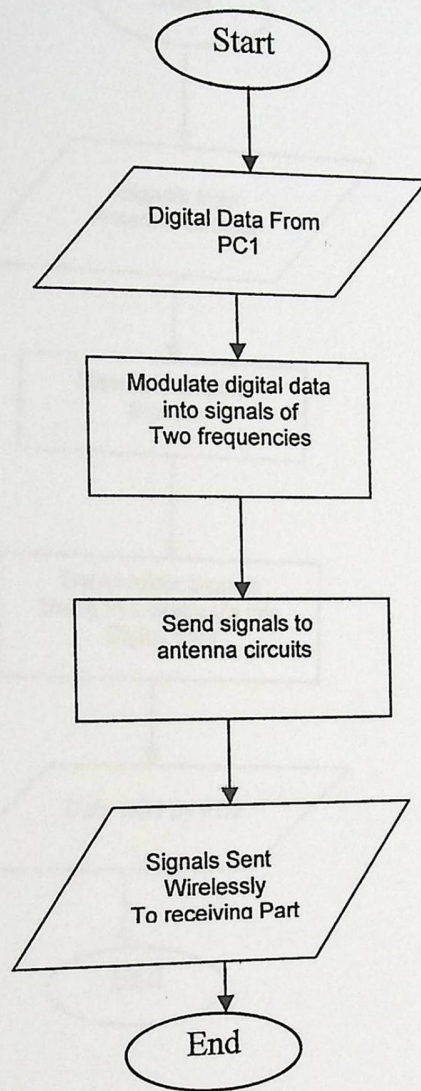
Fig 6.3: FM Sender Flowchart

Fig 6.4: FM Receiver Flowchart

```
                    ┌─────────────┐
                   (    Start      )
                    └──────┬──────┘
                           │
                           ▼
              ╱─────────────────────────╲
             ╱      Room Information       ╲
            ╱            and                ╲
            ╲      Patient information      ╱
             ╲───────────────────────────╱
                           │
                           ▼
                 ┌───────────────────┐
                 │   Data read by    │
                 │ Interface circuits│
                 └─────────┬─────────┘
                           │
                           ▼
                 ┌───────────────────┐
                 │     8051 MC        │
                 │   Process data     │
                 └─────────┬─────────┘
                           │
                           ▼
                 ┌───────────────────┐
                 │ PC1 accept data from│
                 │       MC           │
                 └─────────┬─────────┘
                           │
                           ▼
              ╱─────────────────────────╲
             ╱   Sent data wirelessly     ╲
            ╱    (by 802.11 method)        ╲
            ╲         To PC2               ╱
             ╲───────────────────────────╱
                           │
                           ▼
                    ┌─────────────┐
                   (     End       )
                    └─────────────┘
```
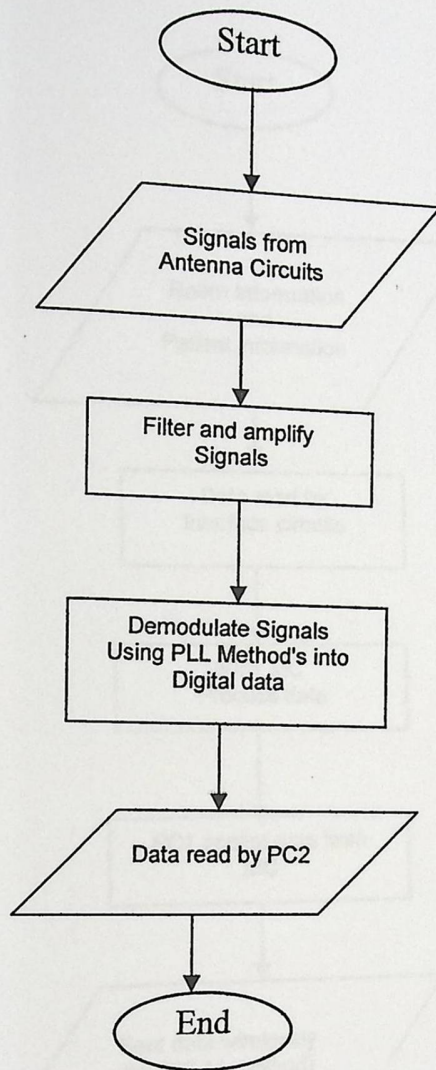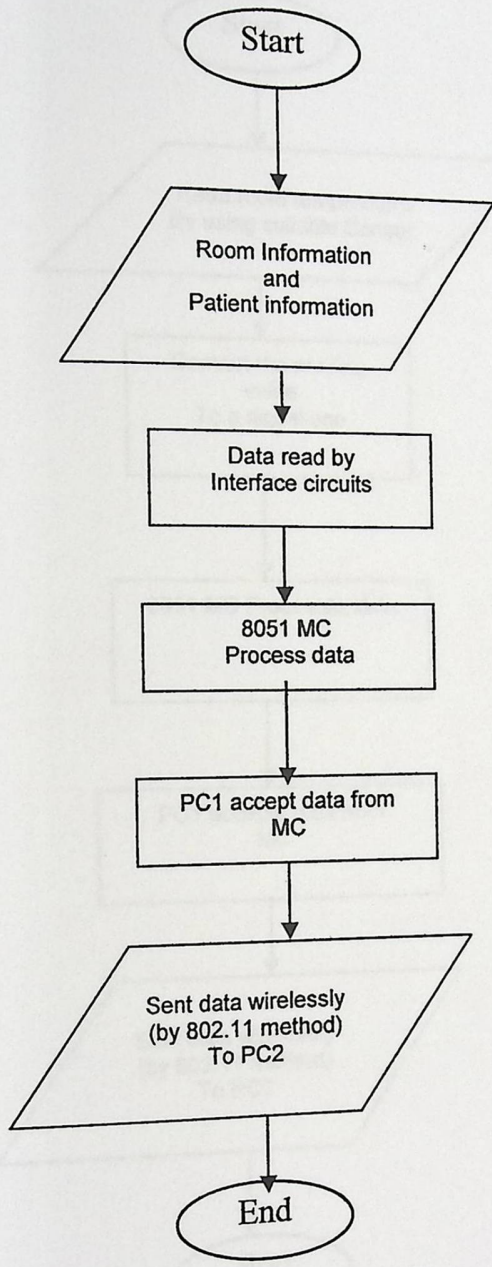
Fig 6.5: General Flowchart

6.3.1 Temperature Sensing

```
        ┌─────────────┐
        │    Start    │
        └──────┬──────┘
               │
               ▼
      ╱─────────────────╲
     ╱  Read room        ╲
     ╲  temperature      ╱
      ╲ By using suitable Sensor
       ╲─────────────────╱
               │
               ▼
      ┌─────────────────┐
      │ Convert the     │
      │ reading value   │
      │ To a digital one│
      └────────┬────────┘
               │
               ▼
      ┌─────────────────┐
      │ 8051 MC         │
      │ Processes data  │
      └────────┬────────┘
               │
               ▼
      ┌─────────────────┐
      │ PC1 accepts     │
      │ data from MC    │
      └────────┬────────┘
               │
               ▼
      ╱─────────────────╲
     ╱  Sent data        ╲
     ╲  wirelessly       ╱
      ╲ (by 802.11 method)
       ╲ To PC2 ────────╱
               │
               ▼
        ┌─────────────┐
        │     End     │
        └─────────────┘
```
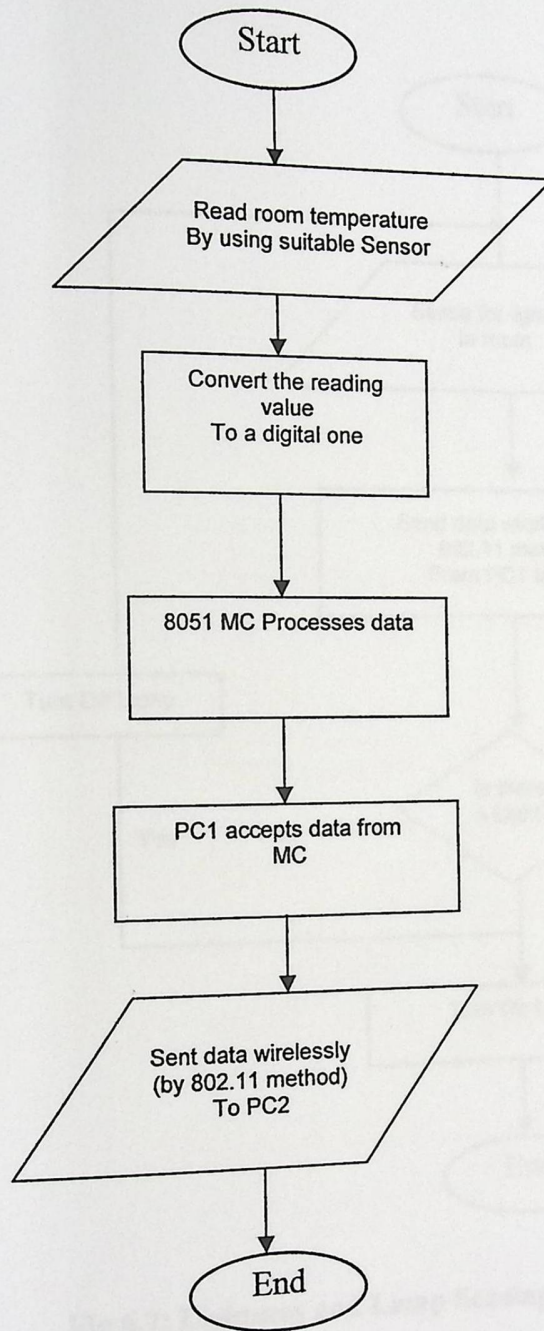
Fig 6.6: Temperature Sensing Flowchart

6.3.2 Lightness and Lamp Sensing
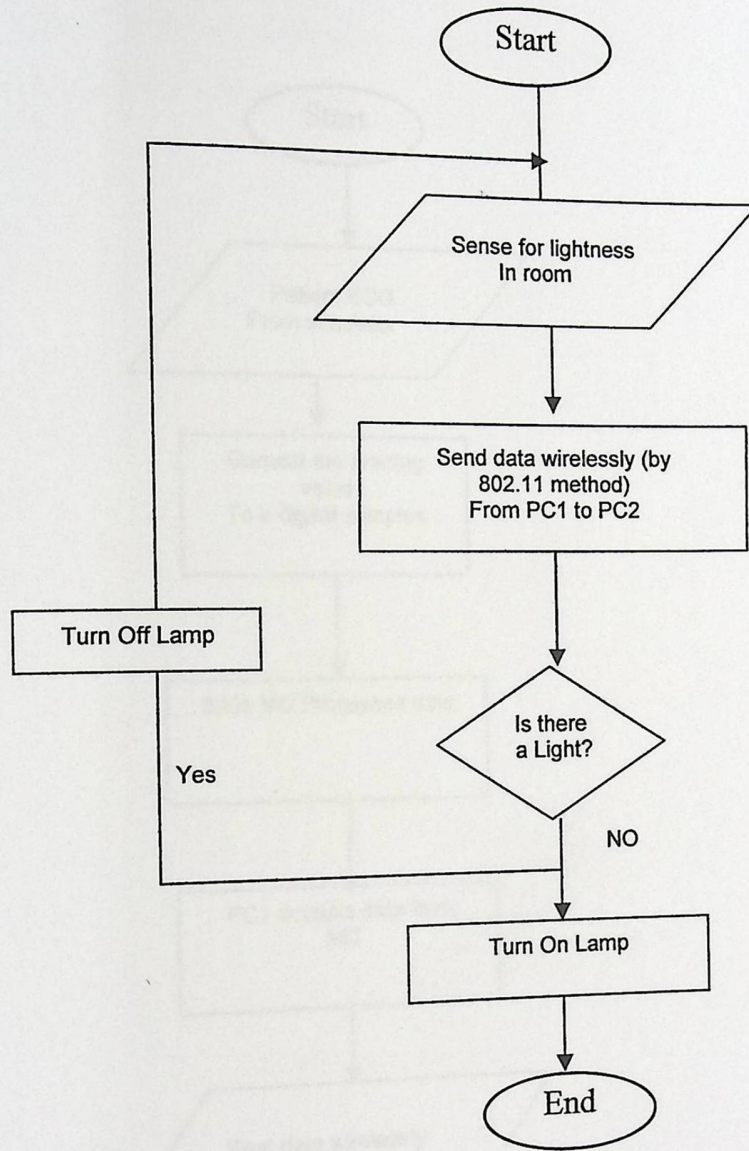
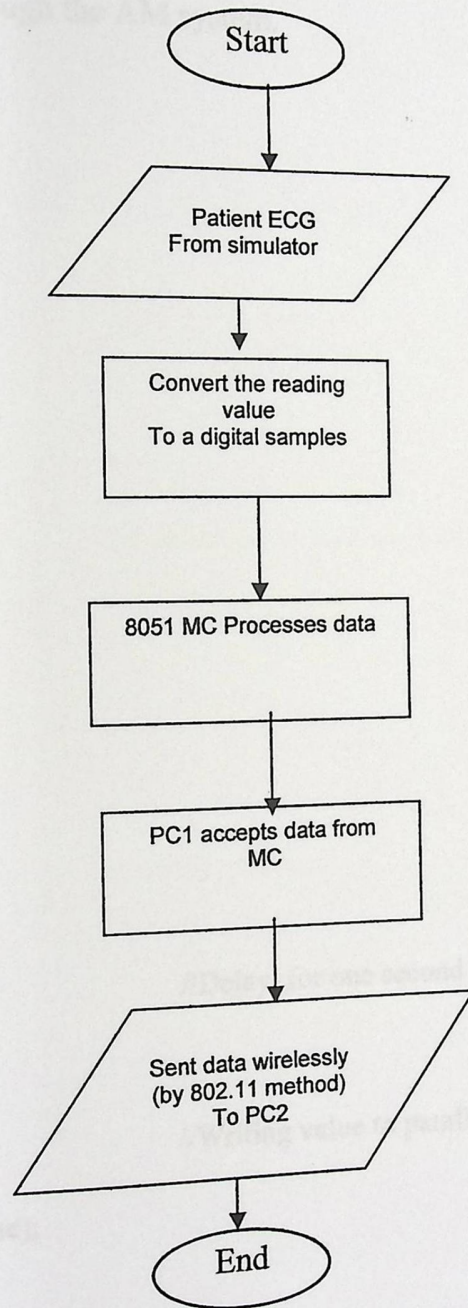Fig 6.7: Lightness and Lamp Sensing Flowchart

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6.3.3 ECG Reader

Fig 6.8: ECG Reader Flowchart

6.4 Software Programs

6.4.1 AM Software Program

This software written using C language to send and receive digital bits (1's and 0's) from PC1 to PC2 wirelessly through the AM system.

A- Sender Side

```c
#include <stdio.h>

#include <dos.h>

#include<math.h>

int main(void)

{

int i, j;

int port = 0x378;

int value ;

 for (j=0; j<100000; ++j)

{

sleep(1);                              //Delay  for one second

value =0x00;

outportb (port, value);                //Writing value to parallel port

printf ("Value= %x \n", value);

sleep (1);

value =0xff;

printf ("%d\n", value);}
```

```
return 0;}
```

B- Receiver Side:

```c
#include <stdio.h>
#include <dos.h>
#include<math.h>
int main(void)
{
int i,j;
int val, val1, val2;
int port1, port2;
char c;


port1=0x379;                        //Defining ports value
port2=0x37A;


val1=inportb(port1);                //Reading value from parallel port
val1=val1& 0xF8;


val2=inportb(port2);
val2=val2& 0x07;


val=val1+val2;                      // Adding values


printf("%d ", val);
scanf("%d",&c);


  return 0;
}
```

6.4.2 FM Software Program

This software written using C language to send and receive characters from PC1 to PC2 wirelessly through the FM system.

A-Sender Part

```c
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<math.h>
#include<dos.h>
void main()
{
char c;
int n,temp,i,value;
int bin[8],binf[8],dec=0;
clrscr();
scanf("%c",&c);        //Read Character from Keyboard
n=toascii(c);          //Convert to ASCII
printf("%d\n",n);
temp=n;
for (i=0;i<8;++i)      //Convert character to Binary
{
bin[i]=temp%2;
temp=temp/2;
}
for(i=7;i>=0;--i)
{
printf(" %d",bin[i])
}
```

6.4.2 FM Software Program

This software written using C language to send and receive characters from PC1 to PC2 wirelessly through the FM system.

A-Sender Part

```c
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<math.h>
#include<dos.h>
void main()
{
char c;
int n,temp,i,value;
int bin[8],binf[8],dec=0;
clrscr();
scanf("%c",&c);        //Read Character from Keyboard
n=toascii(c);          //Convert to ASCII
printf("%d\n",n);
temp=n;
for (i=0;i<8;++i)      //Convert character to Binary
{
bin[i]=temp%2;
temp=temp/2;
}
for(i=7;i>=0;--i)
{
printf(" %d",bin[i])
}
```

```c
printf("\n");
for(i=7;i>=0;--i)                    // Send character to Second port
                                     // Using Parallel port
{
if (bin[i]==0)
value=0x00;

else
value=0xff;

printf("%x ",value);

Outport(value,0x378)

}
}
```

B-Receiver Part

```c
#include<stdio.h>
#include<ctype.h>
#include<conio.h>
#include<math.h>
#include<dos.h>
void main()

{
int val, val1, val2;
int port1, port2;
int bin[8],binf[8],dec=0;

char c;
port1=0x379;
port2=0x37A;
for(i=0;i<8;++i)

{
val1=inportb(port1);          //Reading from parallel port
val1=val1& 0xF8;
val2=inportb(port2);
val2=val2& 0x07;
val=val1+val2;
bin[i]=val;
}
for(i=0;i<8;++i)
{
if (bin[i]=0xf8 )
binf[i]=0;
else
binf[i]=1;
}
for(i=0;i<8;++i)            //Convert from binary to ASCII
```

```c
if(bin[i]==1)
dec+=pow(2,i);

printf("\n%c",dec);                //Print Character To Screen
getchar();
}
```

6.4.3 8051 Microcontroller Software Program

This is an assembly program that reads from port A and writes into port B; in addition it reads from port C upper and writes into port C lower.

```
MOV DPTR, #7003H        //Control register address 7003H

MOV A, #8AH             //Control Word (PB input, PA output,PCL output ,PCU input)

MOVX @DPTR, A

MOV DPTR, #7002H        //Port C address (7002H)

MOVX A,@DPTR           //Reading from port C upper

ANL A, #F0H

RRC A

RRC A

RRC A

RRC A

MOVX @DPTR, A          //Output to C lower

MOV DPTR, #7001H       //Reading from Port B address (7001H)

MOVX A,@DPTR

MOV DPTR, #7000H       //Writing to Port A (7000H)

MOVX @DPTR, A

LJMP E006H
```

6.4.4 Wireless Cards (D-Link) Software Programs

This part of software has been written to input and output data from and to PC parallel port using VB.NET programming language. VB.NET was used to provide a user friendly interface programs.

A- Inp and Out declarations for port I/O using inpout32.dll

```
Option Strict Off
Option Explicit On
Module InpOut32_Declarations

Public Declare Function Inp Lib "inpout32.dll" Alias "Inp32"(ByVal PortAddress As Short) As Short

Public Declare Sub Out Lib "inpout32.dll"  Alias "Out32"(ByVal PortAddress As Short, ByVal Value As Short)

End Module
```

B- Writing data to parallel port commands:

```
Dim PortAddress1 as short = &H378S

val = 255

Out(PortAddress, val)                    //Writing to parallel port
```

C- Reading data from Parallel port commands

```
Dim PortAddress2 as short = &H379S

Dim PortAddress3 as short = &H37AS

Dim val1 as short

Dim val2 as short
                                         //Reading from parallel port
val1 = Inp(PortAddress2)

val2 = Inp(PortAddress3)
```

6.4.4.1 VB.NET Screen Interface (Sender PC)

A- Sender Screen
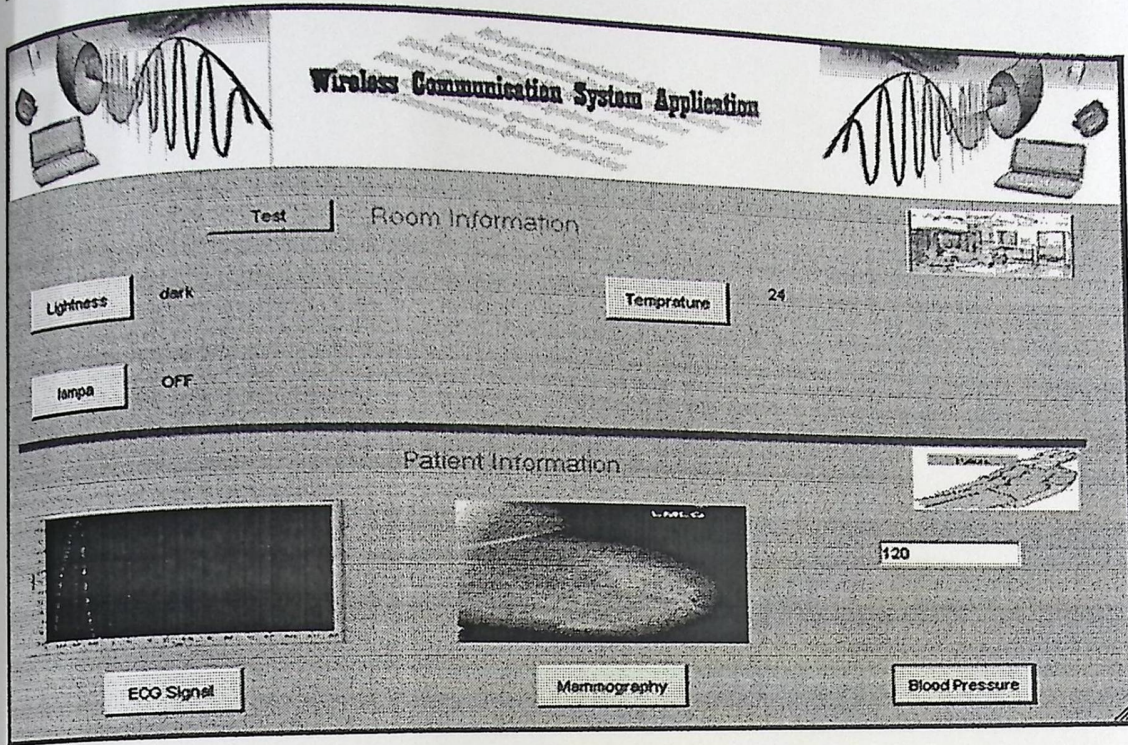
Fig 6.9: Sender Screen

B- Receiver Screen
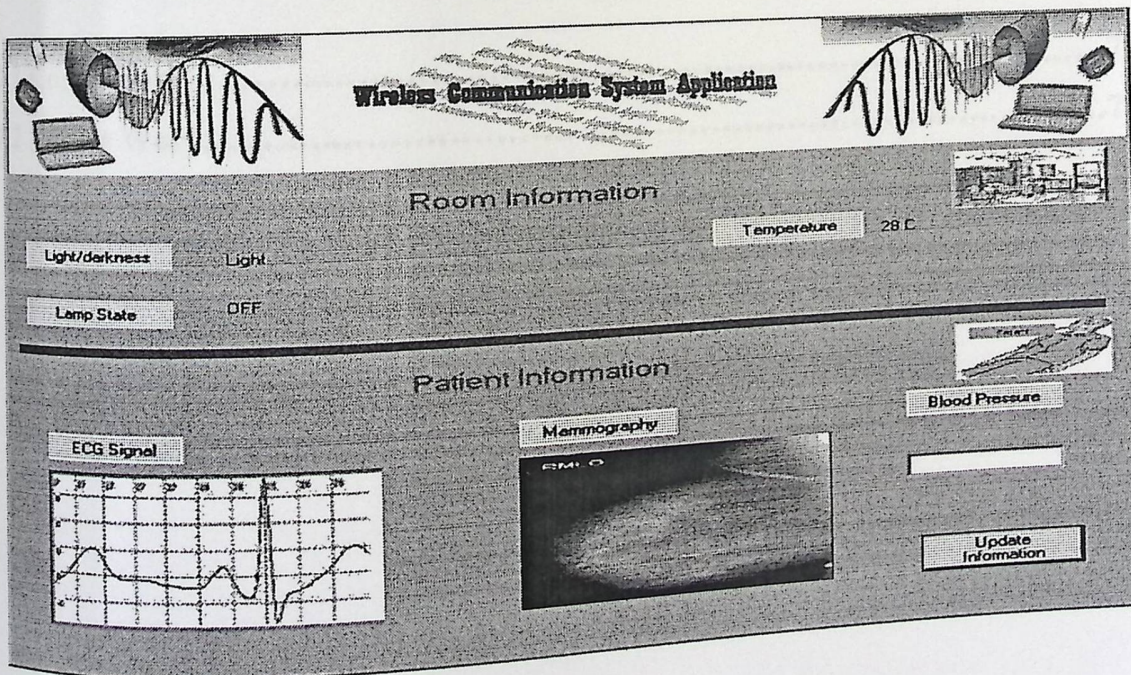
Fig 6.10: Receiver Screen

7

Chapter Seven
Conclusion and Future Work

Chapter Seven

7.1 Conclusions

As the wireless world is growing quicquly,it was important to use and implement this new tecnology.In this work,Amplitude Modulation(AM) and frequency Modulation(FM) circuits were designed,constructed and tested.

The outcome suggests that data can be transmitted and received between two nodes by means of a wired local area network.In our goal ,in this project was to umlement wireless technology.

A wireless Local Area Network(WLAN) was designed and implemented.Data in the form of text ,ECG, mamography image,control signal were transmitted between two nodes at two different location.The outcome of the experiment suggest that the WLAN system using 802.11b technology operate successfully inside laboratories(i.e in short distances less than 100 meters).

Further testing was performed to demonstrate the functionality of the WLAN system.A control parameters such as mamography images,control signal ,text and ECG signal ,temperature and switching lamp(On,Off)were transmitted between two locations to control remotly a medical room enviroment.the experiment was also successfull.

7.2 Future Work

Since the wireless technology is being adopted for many new applications, and the world tends to be a wireless one, there are many future works in this field that could be useful and interesting ones. In our project for the wireless application system, one of the future work is to remove the first PC in the patient room after making the suitable interface between the 8051 microcontroller and the wireless cards and so this system could be used in any unreachable place such as hot places or outside space…etc .Another future work is to control the air conditioning in the patient room according to the temperature, to sense the movement and then open or close a door or make an alarm.

Finally, we hope that the wireless communication system could be implemented in a larger range between the buildings at the university.

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Appendix A

Parallel Port

Interfacing to the IBM-PC Parallel Printer Port

The original IBM-PC's Parallel Printer Port had a total of 12 digital outputs and 5 digital inputs accessed via 3 consecutive 8-bit ports in the processor's I/O space.

- 8 output pins accessed via the DATA Port
- 5 input pins (one inverted) accessed via the STATUS Port
- 4 output pins (three inverted) accessed via the CONTROL Port
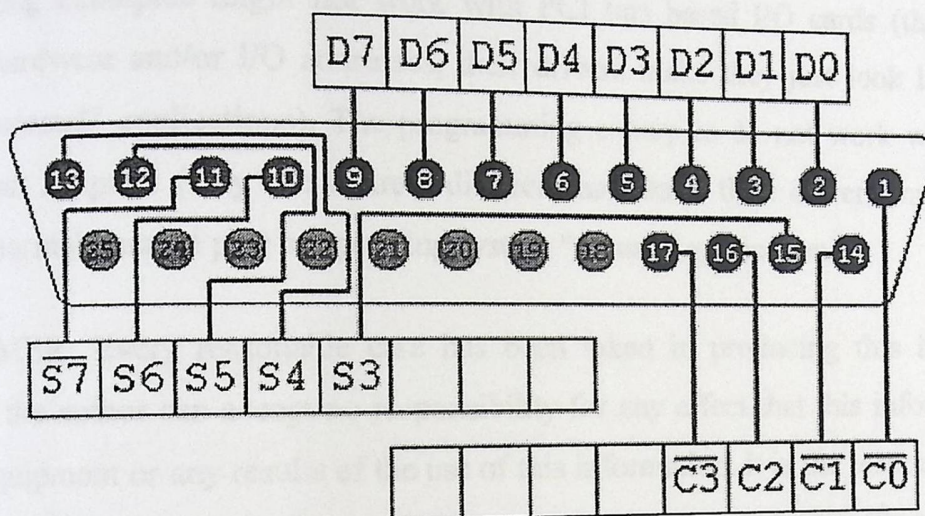- The remaining 8 pins are grounded

Fig A.1: 25-way Female D-Type Connector

Various enhanced versions of the original specification have been introduced over the years

- Bi-directional (PS/2)
- Enhanced Parallel Port (EPP)
- Extended Capability Port (ECP)

PC parallel port can be very useful I/O channel for connecting your own circuits to PC. The PC's parallel port can be used to perform some very amusing hardware interfacing experiments. The port is very easy to use when you first understand some basic tricks. This document tries to show those tricks in easy to understand way.

WARNING: PC parallel port can be damaged quite easily if you make mistakes in the circuits you connect to it. If the parallel port is integrated to the motherboard (like in many new computers) repairing damaged parallel port may be expensive (in many cases it is cheaper to replace the whole motherboard than repair that port). Safest bet is to buy an inexpensive I/O card which has an extra parallel port and use it for your experiment. If you manage to damage the parallel port on that card, replacing it is easy and inexpensive.

NOTE: The I/O port level controlling details here has proven to work well with parallel ports on the PC motherboard and expansion cards connected to ISA bus. The programming examples might not work with PCI bus based I/O cards (they can use different hardware and/or I/O addresses, their drivers make they just look like parallel ports to "normal" applications). The programming examples do not work with USB to parallel port adapters (they use entirely different hardware; their drivers make them to look like normal parallel port to operating system "normal" applications).

DISCLAIMER: Every reasonable care has been taken in producing this information. However, the author can accept no responsibility for any effect that this information has on your equipment or any results of the use of this information. It is the responsibly of the end user to determine fitness for use for any particular purpose. The circuits and software shown here are for non commercial use without consent from the author.

How to connect circuits to parallel port

PC parallel port is 25 pin D-shaped female connector in the back of the computer. It is normally used for connecting computer to printer, but many other types of hardware for that port is available today.

Not all 25 are needed always. Usually you can easily do with only 8 output pins (data lines) and signal ground. I have presented those pins in the table below. Those output pins are adequate for many purposes.

Pin	function
2	D0
3	D1
4	D2

```
5   D3
6   D4
7   D5
8   D6
9   D7
```
Pins 18,19,20,21,22,23,24 and 25 are all ground pins.

Those data pins are TTL level output pins. This means that they put out ideally 0V when they are in low logic level (0) and +5V when they are in high logic level (1). In real world the voltages can be something different from ideal when the circuit is loaded. The output current capacity of the parallel port is limited to only few mill amperes.

```
Dn Out ------+
             |+
Sourcing     Load (up to 2.6 mA @ 2.4 v)
             |-
Ground ------+
```
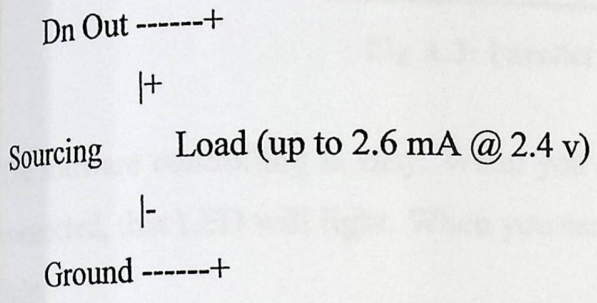
Simple LED driving circuits

You can make simple circuit for driving a small led through PC parallel port. The only components needed are one LED and one 470 ohm resistors. You simply connect the diode and resistor in series. The resistors is needed to limit the current taken from parallel port to a value which light up acceptably normal LEDs and is still safe value (not overloading the parallel port chip). In practical case the output current will be few milliamps for the LED, which will cause a typical LED to somewhat light up visibly, but not get the full brigtness.

Fig A.2: Simple Test Circuit

Then you connect the circuit to the parallel port so that one end of the circuit goes to one data pin (that one you with to use for controlling that LED) and another one goes to any of the ground pins. Be sure to fit the circuit so that the LED positive lead (the longer one) goes to the data pin. If you put the led in the wrong way, it will not light in any condition.

You can connect one circuit to each of the parallel port data pins. In this way you get eight software controllable LEDs.
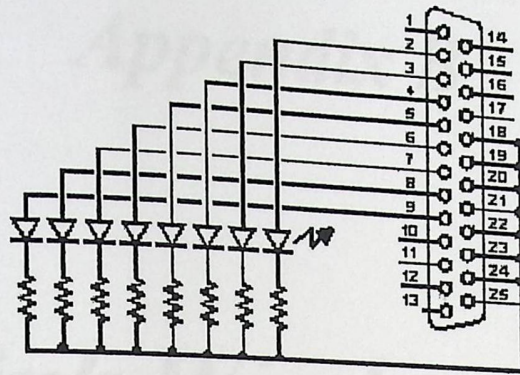

Fig A.3: Parallel Port Test Circuit

The software controlling is easy. When you send out 1 to the data pin where the LED is connected, that LED will light. When you send 0 to that same pin, the LED will no longer light.

D-Link Wireless Card

Contents of Package

- D-Link AirPlus DWL-120+ 2.4 GHz Wireless USB Adapters.
- Manual on CD-ROM.
- Quick installation guide.
- USB cable.

System Requirements

- A computer or laptop with available USB port.
- Windows XP/2000/Me/98SE.
- At least 32 MB of memory and a 300 MHz processor.
- Properly installed and working USB Controller.

Introduction

The D-Link AirPlus DWL-120+2.4GHz Wireless USB adapters is a convenient plug & play USB 1.1 solution that brings wireless networking to your laptop or desktop PC.

After completing the steps outlined in the quick installation guide (included in your package) you will have the ability to share information and resources, such as files, printers, and internet connection and enjoy the freedom that wireless networking delivers.

The DWL -120+ comes with software drivers for the most popular Microsoft Windows operating systems and can be integrated into a larger network, running Windows XP,Windows 2000,Windows Me or Windows 98SE in either Ad Hoc (without an access point or router)or infrastructure mode(with an access point or router).The IEEE 802.11 Ethernet standards allows you to connect computers and 802.11b compatible devices at speeds up to 22 Mbps dependent upon the distance between wireless adapters ,the configuration of your working environment, or the capabilities or limitations of your computer system.

Features and Benefits

- Convenience of plug and play installation.
- Fully 802.11 compatible.

- USB 1.1 standards.
- Stronger network security with 256-bit WEP encryption.
- Support infrastructure network via an access point or router and peer-to-peer communication in Ad-Hoc mode.
- User-friendly configuration and diagnostic utilities.
- Connects at up to 328 feet indoors.

Features

Antenna
Used to wirelessly connect to 802.11b networks

Link/Activity LED
Power - Indicates that the DWL-120+ is properly installed in the computer.
Link - Blinks when data is being transmitted through the wireless connection.

Mini-USB port
Used to connect the DWL-120+ to your computer
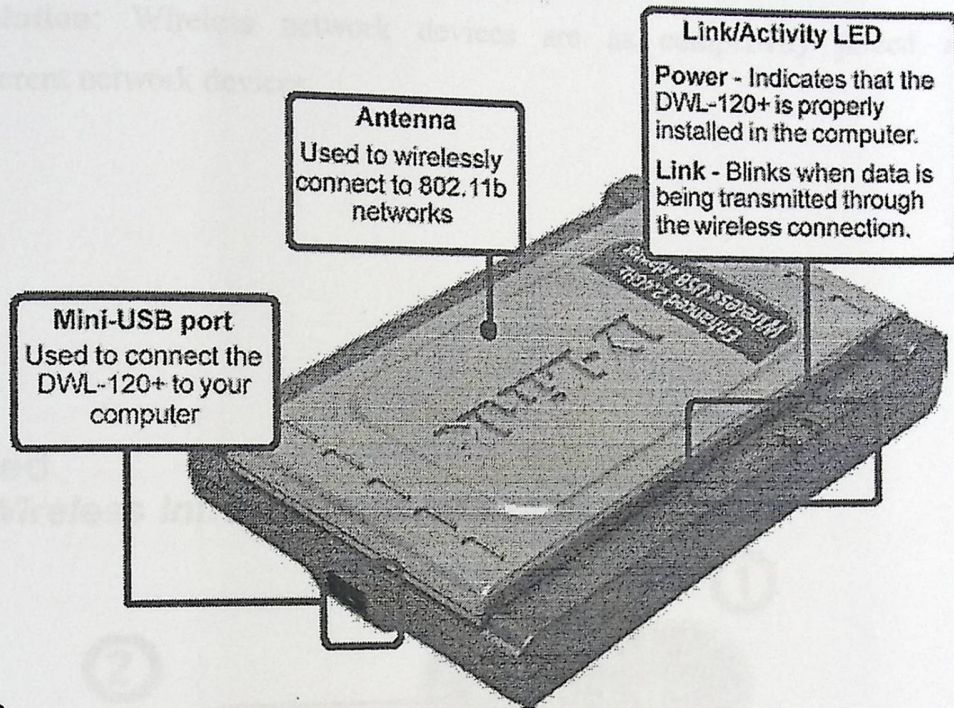
Wireles Basic

People use wireless LAN technology for many different purposes:

Mobility: productivity increase when people have acess to data in any locationn within the operating range of the WLAN.Mangement decision based on real-time information can significantly improve worker efficiently.

Low Implementation Costs: WALNs are easy to set up, manage, change and relocate.Networking that frequently change can benefit from WLAN ease of implementation .WLANs can operate in locations where instalation of wiring may be impractical.

Instalation and Networking Expantion: Installing a WLAN system can be fast and easy and can eliminate the need to pull cable through walls and ceillings.Wireless technology allows the network to ge where wires cannot go-even outside the home or office.

Scalability: WLANs can be configured in a variety of topologies to meet the needs of specific application and installation .Configuration are easily changed and range from peer-to-peer networks suitable for a small number of users to larger infrastrucure networks to accommodate hundreds or thousands of users ,depending on the number of wireless devices deployed.

Inexpensive Solution: Wireless network devices are as competivity priced as conventional Etherent network devices.

Getting Started
Setting up a Wireless Infrastructure Network

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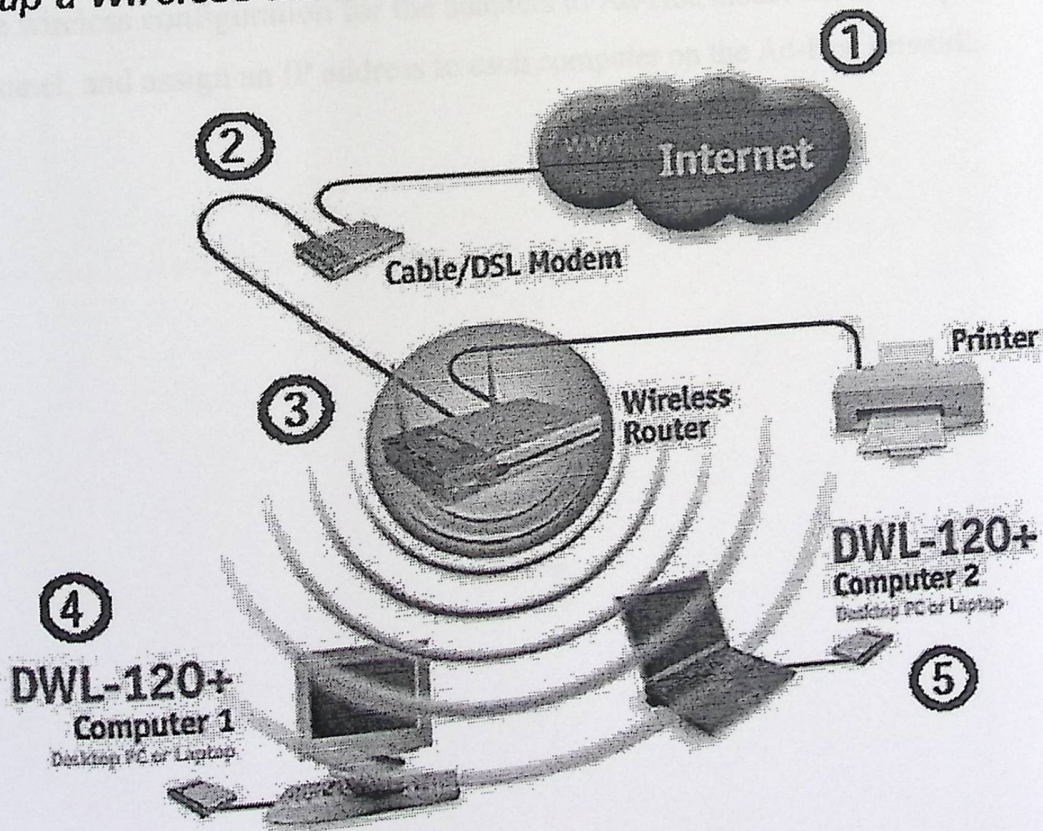
For a typical wireless setup as home (as shown above).Please do the following:

1. You will need broadband Internet access (a cable or DSL-subscriber line into your home or office.

2. Consult with your cable or DSL provider for proper installation of the modem.

3. Connect the cable or DSL modem to your broadband router.

4. Install the D-Link AirPlus DWL -120 wireless USB adapter into an available USB port on your desktop computer.

5.If you are connecting a laptop computer to your network .you can install the DWL -120+ into an available USB port on your laptop.

Getting Started

Setting up a Wireless Ad Hoc Network

1-Install the D-Link AirPlus DWL-120+ Wireless USB adapter into the desktop computer.

2. Install another DWL-120+into the laptop computer .Or you may install another Wireless adapter such as the D-Link AirPlus DWL -650+ wireless card bus adapter.

3. Set the wireless configuration for the adapters to Ad-Hoc mode. Set the adapters to the same channel, and assign an IP address to each computer on the Ad-Hoc network.

Check Your Package Contents

These are the items included with your DWL-120+ purchase:
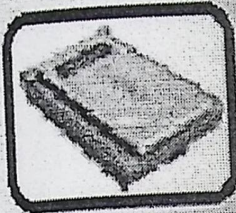
DWL-120+ Wireless USB Adapter

CD-ROM (containing Drivers, Manual and Warranty)
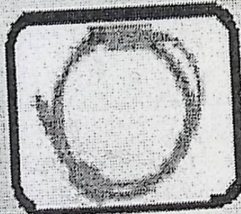
Mini-USB Cable

1. Insert the D-Link CD-ROM Into Your Computer

Turn on the computer and Insert the **D-Link** *Air* **DWL-120+** **Driver CD** in the CD-ROM drive.

The step-by-step instructions that follow are shown in Windows XP. The steps and screens are similar for the other Windows operating systems

> ⚠ Do NOT install the DWL-120+ USB Adapter into your computer before installing the driver software on the D-Link CD!

The Install Screen will appear.

Click Install Drivers

D-Link

Air Plus Wireless Network

DWL-120+

Enhanced 2.4GHz Wireless
USB Adapter

Antenna
Used to wirelessly connect to 802.11b networks.

Link/Power LED
Link - Blinks when data is being transmitted through the wireless connection.
Power - Indicates that the DWL-120+ is properly installed in the computer.

Mini-USB Port
Used to connect the DWL-120+ to your computer.
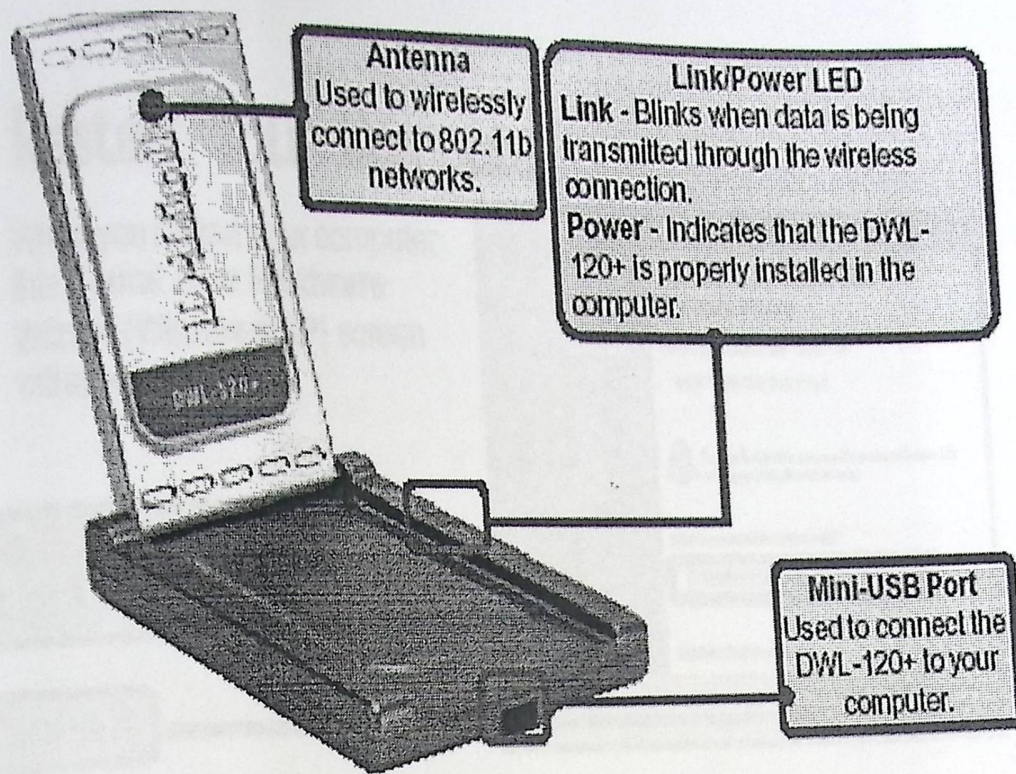
2 Installing the DWL-120+ Wireless USB Adapter to Your Computer

A. Make sure to turn off your computer.
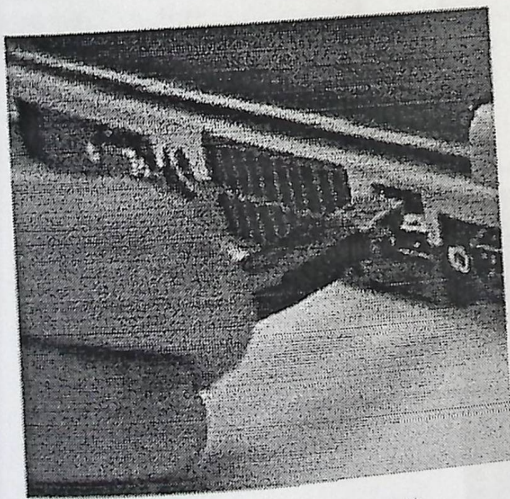
B. Firmly insert one end of the USB cable (larger plug) into your computer's USB Port.
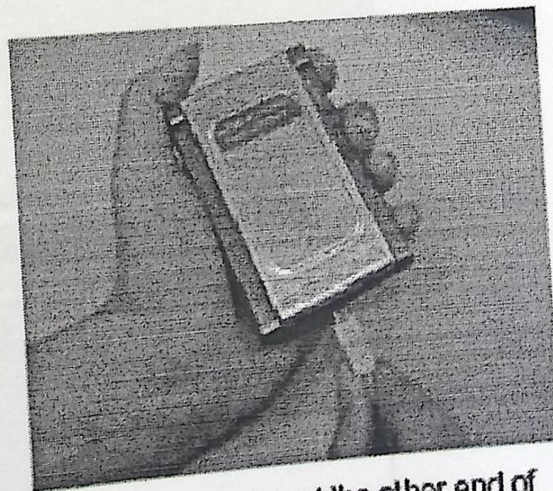
C. Firmly insert the other end of the USB cable (smaller plug) into the DWL-120+.

3 Restart Your Computer

When you restart your computer this Found New Hardware Wizard (Windows XP) screen will appear:

Select Install the software automatically (Recommended)

Click Next
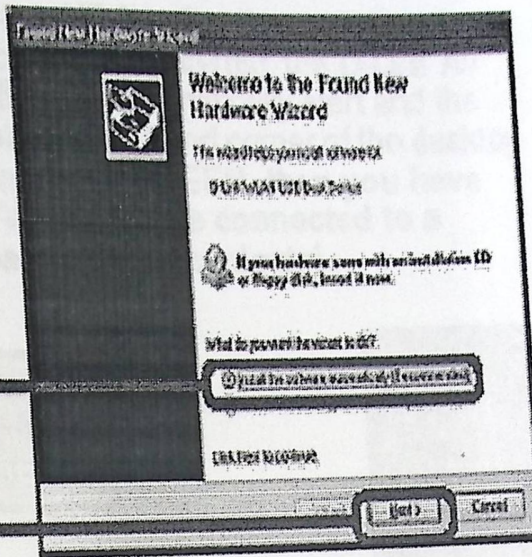
Windows XP will automatically load the driver files.

Click Finish

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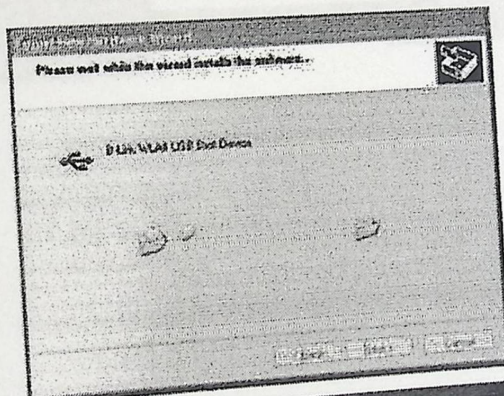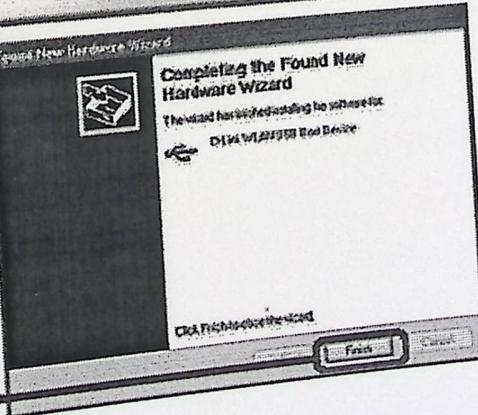
4 Your Installation is Complete!

After you've continued in Windows XP (or after the computer restarts in the other Windows operating systems), the D-Link *Air* DWL-120+ Configuration Utility will automatically start and the utility icon will appear in the bottom right hand corner of the desktop screen (systray). If this icon appears GREEN, then you have successfully installed the DWL-120+, are connected to a wireless network and are ready to communicate!

If the utility icon does not appear, double-click the shortcut icon that has appeared on your desktop.

Double-click the utility icon to use the configuration utility.

Uncheck "Use Windows to configure my wireless network settings."

Click OK

Using the Configuration Utility:

D-Link Air plus DWL-120+ uses the configuration utility as the management software .The utility provides the user as easy interface to change any settings related to the wireless adapter. When the computer is started, the configuration utility starts automatically and the system tray icon will start the configuration utility. Another way to start the configuration utility is to click on Start>programs>D-Link DWL-120+. If you are using Windows XP, you can use either the zero configurations utility or the D-Link configuration utility. To use the D-Link configuration utility with XP, click on the zero configuration utility in the taskbar in the lower corner of your computer screen and uncheck the box in the properties window that enables windows configuration .After you have done this, you can then use the D-Link configuration utility with XP.

Configuration Utility

A new icon will appear in your Icon tray. Double-click on the icon shown at right. The screen below will be displayed with the following default settings:

Status:
Displays the current connection state of the DWL-120+.

SSID:
The Service Set Identifier is the name assigned to the wireless network. The factory SSID setting is set to default.

Tx Rate:
The default setting is Auto; Tx Rate settings are automatically determined for optimal speed up to a maximum speed of 22Mbps.

Channel:
The default setting is 6.

Link Quality:
Displays the wireless signal strength for the DWL-120+ wireless connection to the access point.

Data Rate:
Displays the statistics of the data that is transmitted and received.
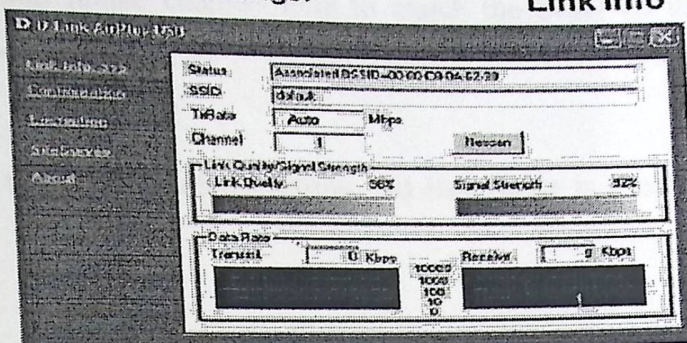
Using the Configuration Utility

Configuration

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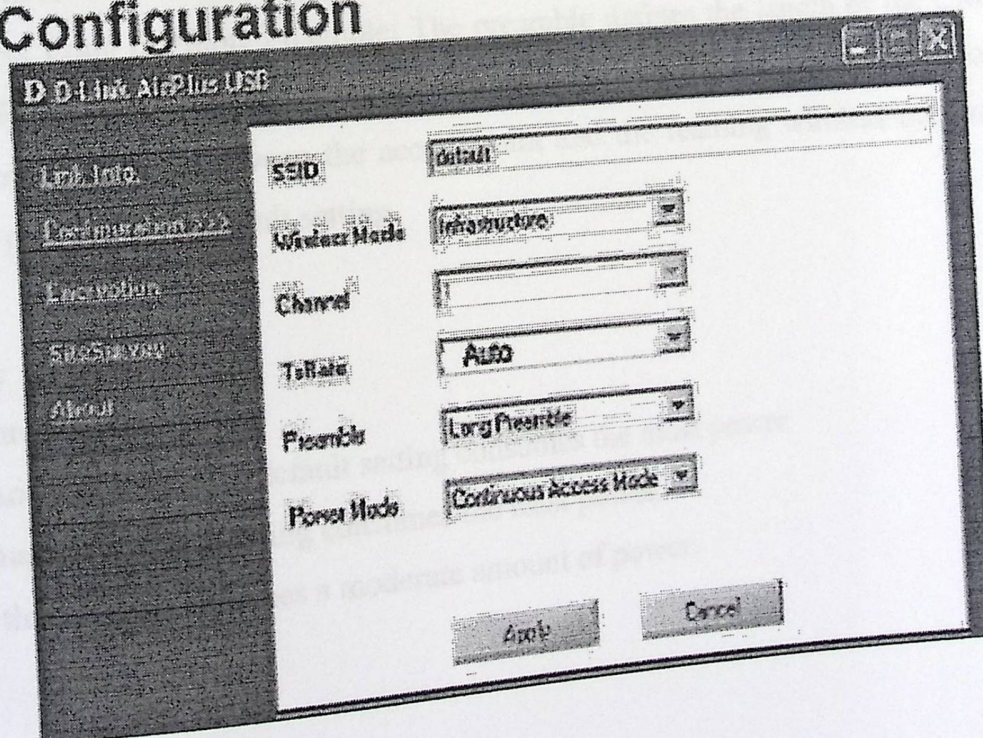
Using the configuration Utility:

SSID: The Service Set Identifier ids the name assigned to the wireless network. The factory SSID setting is set to default .make changes here to match the SSID on the existing Wireless router or access point.

Wireless Mode: Infrastructure is the factory default setting. Ad Hoc mode is used for peer-to-peer networking

Channel : The default channel setting is channel 6 .In infrastructure mode ,the DWL-120+ will automatically select the channel to match the channel setting for the selected access point In Ad Hoc mode, the channel must be manually set to the same channel for each wireless adapter.

TX Rate: You can adjust the transmission rate to get the signal possible depending on your usage and your environment .The TX Rate will be determined automatically by signal strength .Default is set to auto.

Preamble: Select Long or Short Preamble: The preamble defines the length of the CRC block (Cyclic Redundancy Check is common technology for detecting data transmission errors) for communication between the access point and the reaming wireless network adapter>Long permeable is default setting.

Power Mode:

Select from three modes:

Continuous Access Mode: this default setting consumes the most power

Maximum Power Save: this setting consumes the least power.

Power Save: this setting consumes a moderate amount of power.

Using the Configuration Utility

Site Survey

Properties

Profile: Current Setting

Profile Name	Current Setting/Default Setting
SSID	default
Wireless Mode	Infrastructure
Channel	6
Tx Rate	11 Mbps
Preamble	Long Preamble
Power Mode	Continuous Access Mode
☐ Data Encryption	
Auth. Mode	Auto
Passphrase	[Done]

Default Key	Network Key	Key Length
○ 1		64 bits
○ 2		64 bits
○ 3		64 bits
○ 4		64 bits
Key Format	HEX	

[OK]   [Cancel]

In this window you can configure all the properties of a profile in order to connect with a network of your choice.

About

The About tab displays the utility and the firmware versions.

Networking Basics

Using the Network Setup Wizard in Windows XP

Network Setup Wizard

Welcome to the Network Setup Wizard

This wizard will help you set up this computer to run on your network. With a network you can:

- Share an Internet connection
- Set up Internet Connection Firewall
- Share files and folders
- Share a printer

To continue, click Next.

| < Back | Next > | Cancel |

When this screen appears, **Click Next.**

Networking Basics

Please follow all the instructions in this window:

Network Setup Wizard

Before you continue...

Before you continue, review the checklist for creating a network.

Then, complete the following steps:

- Install the network cards, modems, and cables.
- Turn on all computers, printers, and external modems.
- Connect to the Internet

When you click Next, the wizard will search for a shared Internet connection on your network.

| < Back | Next > | Cancel |

Click Next

Network Setup Wizard

Select a connection method.

Select the statement that best describes this computer.

○ This computer connects directly to the Internet. The other computers on my network connect to the Internet through this computer.
View an example.

◉ This computer connects to the Internet through another computer on my network or through a residential gateway.
View an example.

○ Other

Learn more about home or small office network configurations.

[< Back]　[Next >]　[Cancel]

Enter a **Workgroup** name. All computers on your network should have the same **Workgroup** name.

Network Setup Wizard

Name your network.

Name your network by specifying a workgroup name below. All computers on your network should have the same workgroup name.

Workgroup name: Accounting

Examples: HOME or OFFICE

< Back   Next >   Cancel

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address:	192 . 168 . 0 . 2
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	. . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server:	. . . 1
Alternate DNS server:	. . .

Advanced...

OK   Cancel

*Checking the Wireless Connection by Pinging in Windows XP and 2000**

■ Go to **Start > Run >** type **cmd**. A window similar to this one will appear. Type ping **xxx.xxx.xxx.xxx**, where **xxx** is the **IP Address** of the Wireless Router or Access Point. A good wireless connection will show four replies from the Wireless Router or Acess Point, as shown.
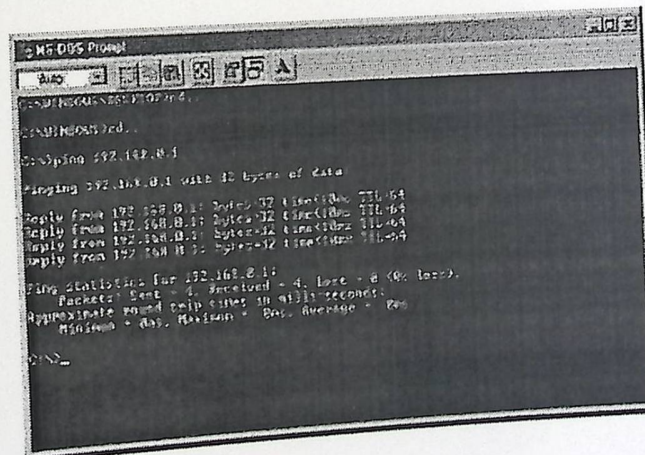
*Checking the Wireless Connection by Pinging in Windows Me and 98**

■ Go to **Start > Run** > type **command**. A window similar to this will appear. Type ping **xxx.xxx.xxx.xxx** where **xxx** is the **IP Address** of the Wireless Router or Access Point. A good wireless connection will show four replies from the wireless router or access point, as shown.

Troubleshooting:

What variables may cause my wireless products to lose reception?

D-Link products let you access you network from virtually anywhere you want .However, the positioning of the products within your environment will affect the wireless range. Please refer to installation considerations in the wireless basics section of this manual for further information about the most advantageous placement of your D-Link wireless products.

Appendix C

8051 Microcontroller

Appendix C

8051 Microcontroller
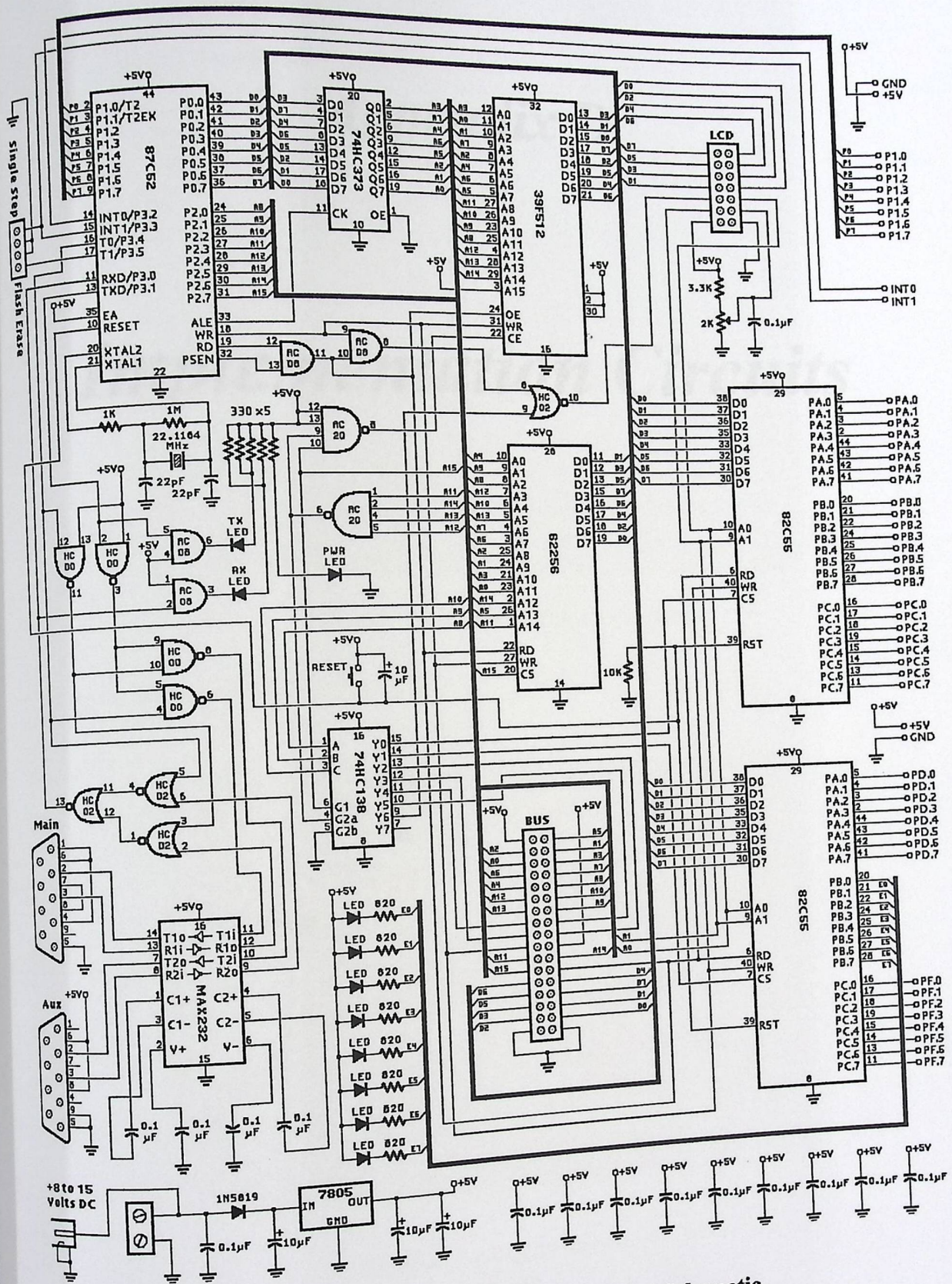
Fig C.1: Microcontroller Board Schematic

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Appendix D

Implementation Circuits

Digital to Analog Converter Testing
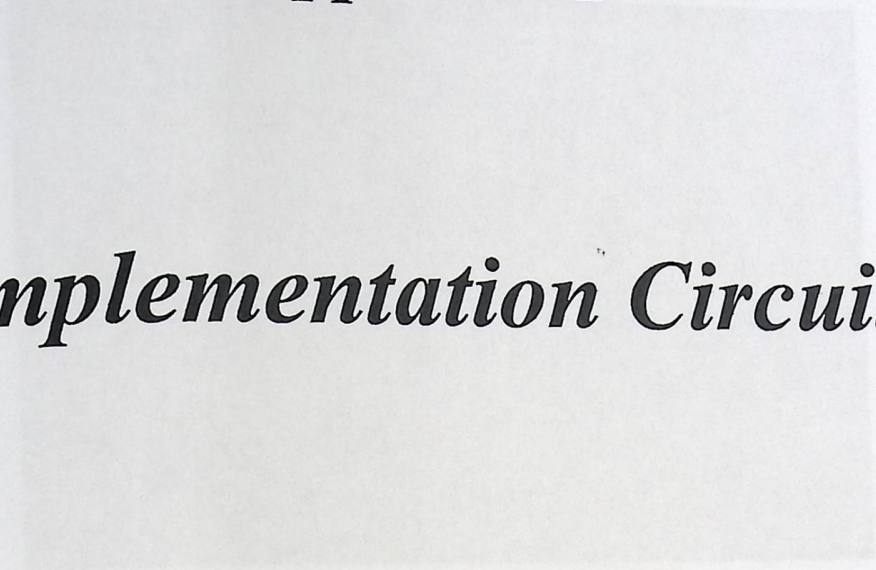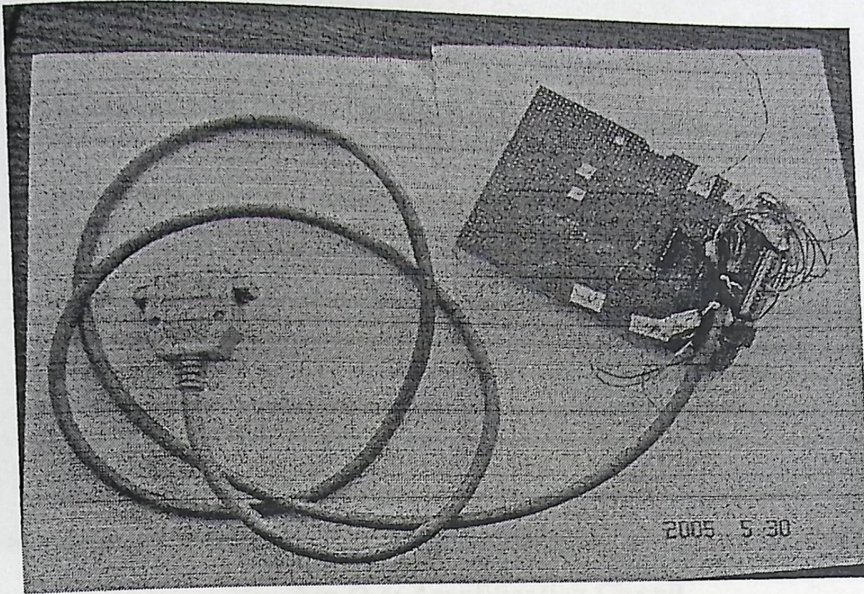
Fig D.1: Digital to Analog Converter
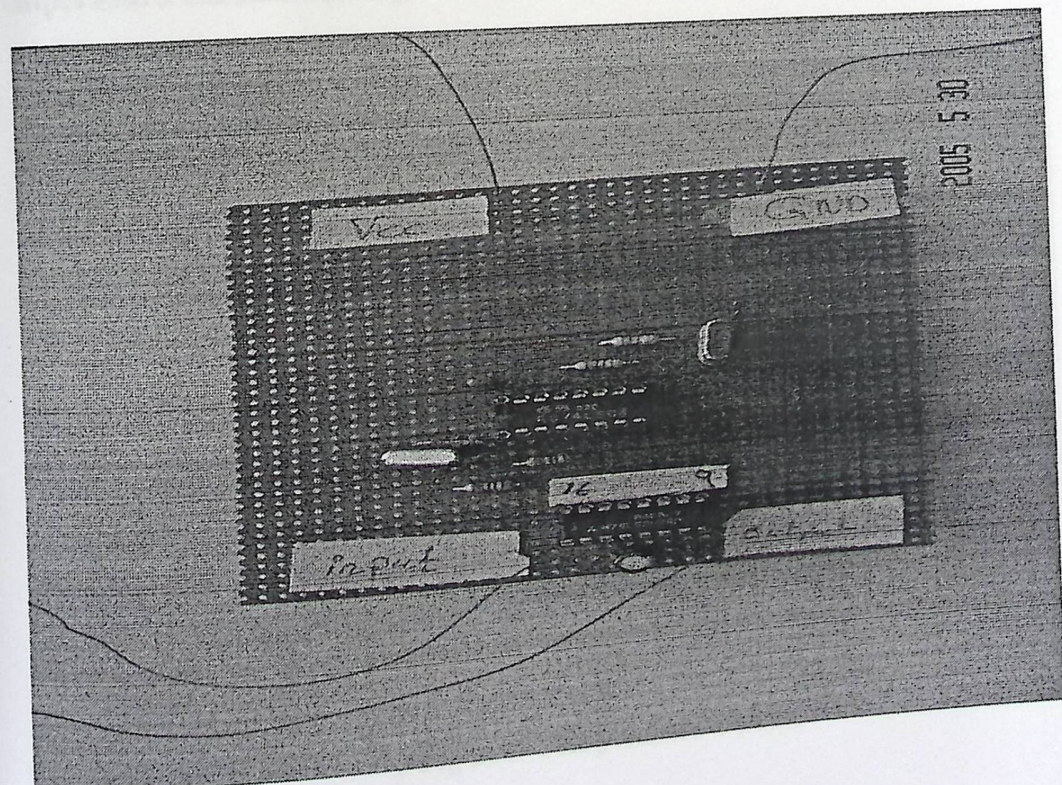
Analog to Digital Converter Testing
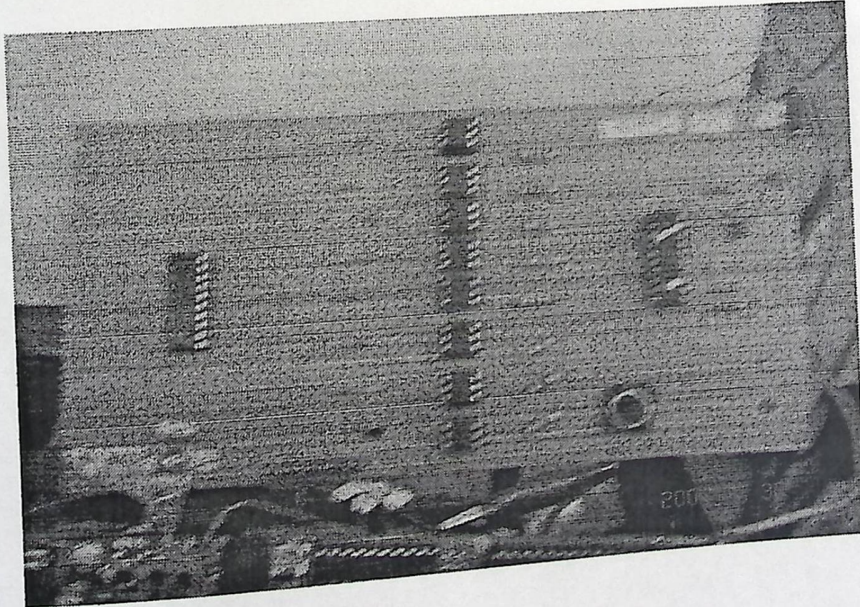
Fig D.2: Analog to Digital Converter

Amplification Circuit Testing
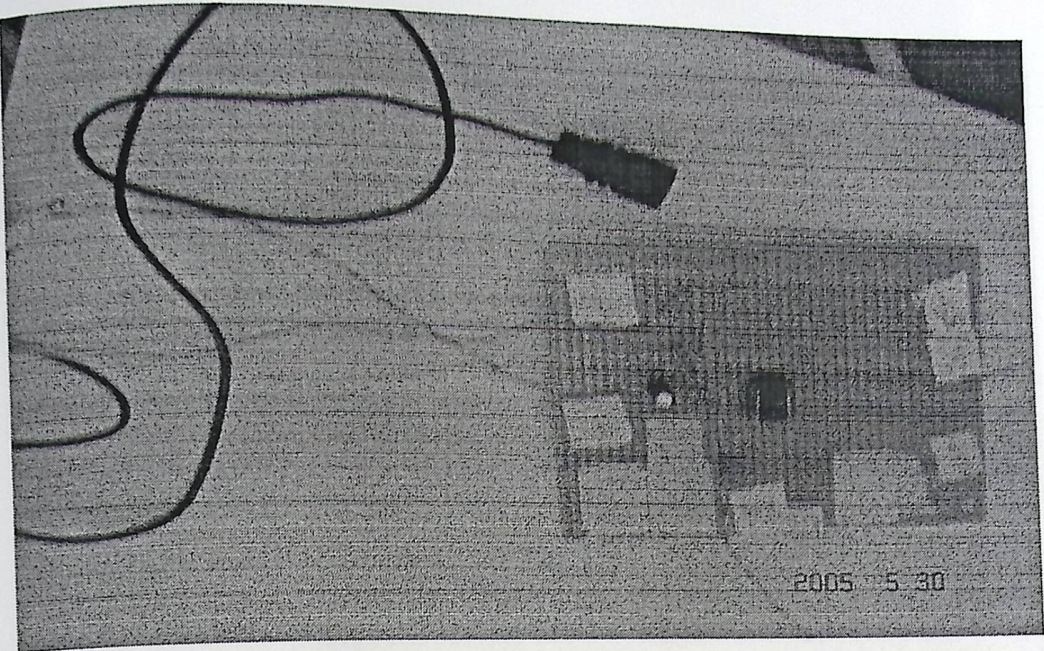
Fig D.3: Amplification Circuit

Transmission Part Testing

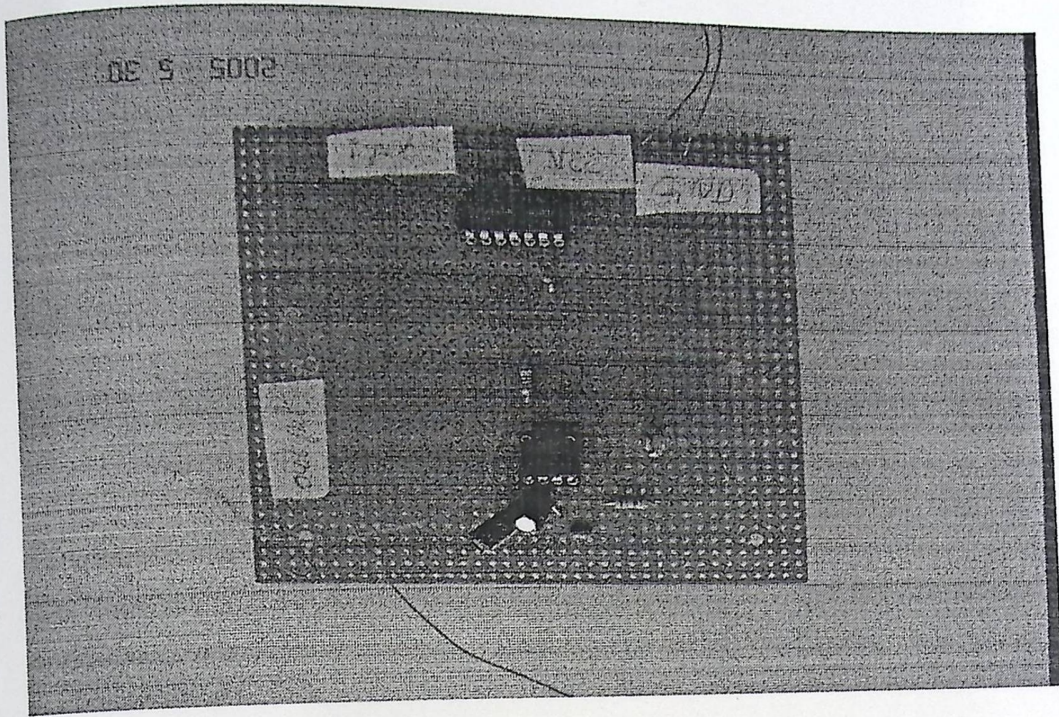**Fig D.4: Transmitting Circuit**

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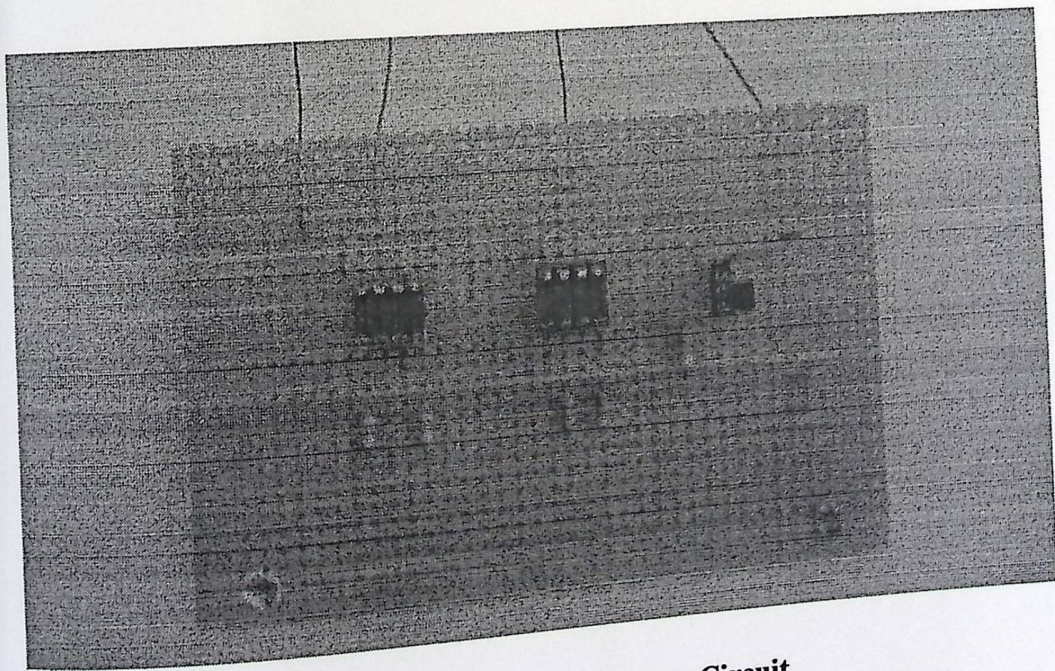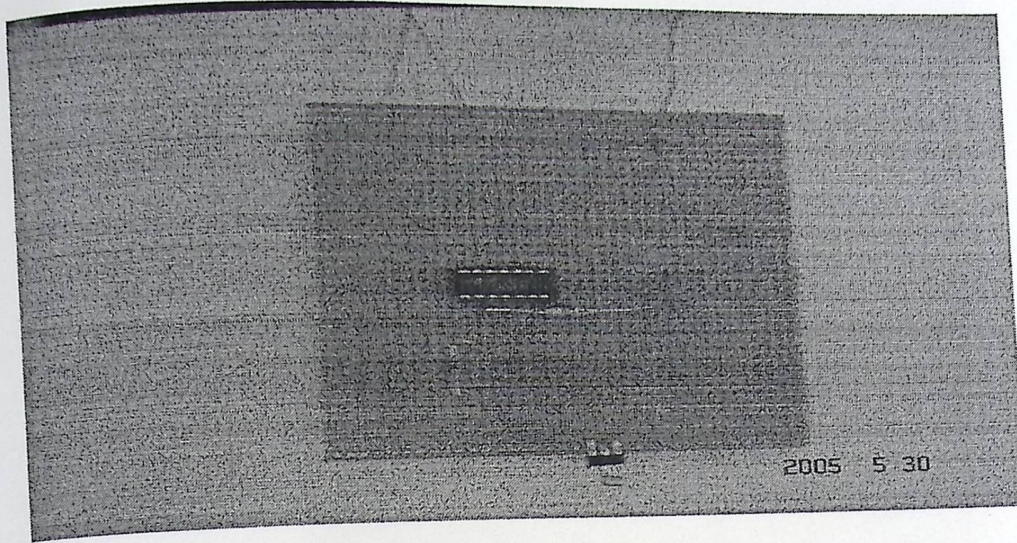**Fig D.5: Receiving Circuit**

Temperature Circuit Testing

Fig D.6: Temperature Circuit

Fig D.7: LDR Circuit