Palestine Polytechnic University

College of Engineering and Technology

Electrical and Computer Engineering Department

Communication and Electronic Engineering

Project title

''Wireless Technology Personality Television ''

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DEDICATION

To our parents;

To our families;

To our university president;

To our university vice president;

Dean of the Faculty of Engineering;

To our colleges and instructors;

To whom taught us any letter, word or information

ACKNOWLEDGMENTS

We would like to extend our special thanks to everyone who has helped us to complete this work.

We would like to express our deepest appreciation and thanks to our supervisor Dr.Murad Abusubaih for his valuable guidance and support. His cooperation and detailed approach along with his encouragement were the major factors to get this work what it is today. It was a great pleasure to work under his supervision through this semester.

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Our special thanks go to our parents, brothers, sisters, and friends. Without their support, this project would not have been possible

ABSTRACT

One of the most interesting ideas in communication systems is to work on TV systems by using wireless communication technique.

Wireless communication links have been used worldwide for many years as solutions for connectivity in point-to-point and point-to multipoint applications. The most common wireless solutions include AM and FM radio, television broadcast stations, mobile and cellular phones, radar and microwave systems.

In this project we will design a hardware for separating audio and image from the signal of the TV and keep the audio alone and transmit this audio to a receiver connected to head-phone.

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Chapter three: block diagram

Chapter four: System design

List of abbreviations:

Abbreviation	Definition
TV	**Television**
RF	Radio Frequency
IR	Inferred
$	Dollar
NO	Number
GHZ	Gigahertz
VCR	Video Cassette Recording
HZ	Hertz
g	Gram
MHZ	Mega Hertz
m	Meter
dB	Decibel
mW	Mele watt
KHZ	Kilo hertz
mm	Mele meter
NIMH	Nicle metal hybrid
SPL	Sound Pressure Level
MSK	Minimum Shift Keying
CRT	Cathode Ray Tube
CM	Centimeter
CATV	Community Antenna Television
DVD	Digital Versatile Disc
HDTV	High-definition television
CD	Compact Disc
LS	Loud speaker
AM	Amplitude Modulation
FM	Frequency Modulation
CW	Continuous Wave
STP	Shielded Twisted Pair
UTP	Unshielded Twisted Pair
Ω	Ohm
L.AUDIO	Left Audio
R.AUDIO	Right Audio
Tx	Transmitter
Rx	Receiver
PLL	Phase Locked Loop
AF	Audio Frequency
IC	Integrated Circuit
VFO	Variable Frequency Oscillator
VCO	Voltage Controlled Oscillator
LED	Light-Emitting Diode
AMP	Amplifier
PM	Phase Modulation

C	Capacitance
F	Frequency
VHF	Very High Frequency

Chapter one

Introduction

Chapter contents

1.1 Overview.

1.2 Motivation.

1.3 Challenges.

1.4 Objective.

1.5 Cost Estimation.

1.6 Time Plane.

1.7 Related Work.

1.8 Project Content.

1.1 Overview

This chapter focuses on the main idea of the project about TV and headphone. Moreover, it will state the most important challenges, as well as the aims and the previous works related to the project.

1.2 Motivation

At the beginning, we can say all the difficulty and the problems caused by wired networks lead to an increase need for the wireless communication. Consequently, the importance of wireless networks has become increasingly steadily.

The idea of this project is to develop a system that allows persons to watch TV without distributing others in the same home; we intend use the signal of the audio that comes from the receiver, connect it to a switch which works in two cases depending on a remote control. The first case is the audio transferred to a transmitter, then to a receiver located on headsets. The second case is that the switch is closed, so the audio continue to the original path (TV).

There are many different types of wireless headphones:

1- IR (Infrared) wireless headphones.
2- RF (Radio Frequency) wireless headphones.
3- Bluetooth wireless headphone .

Normally, all types of wireless technologies use a transmitter and a receiver. However, we will use the Zigbee headphone for some reasons which will be mentioned later. Another motivation for this system is an implementation of a new idea expected to be widely adopted by people.

Another feature of our planned system is that, the switching between the two modes will be controlled remotely through wireless instructions at the headsets. Therefore, no special plugs will be used at the TV side. Furthermore, we will try to reduce the system cost compared to other similar products in order to make the technology available for a wide spectrum for people.

1.3 Challenges

Despite the progress and the development of wireless communication systems, there are some challenges that reduce their performance. These challenges may come from the surrounding environment or a result of the development in technology and the introduction of new applications that require a highly accurate reception.

The most important challenges facing wireless communication systems that come from the surrounding environment is the impact of multipath; because the signal arrives from several different paths to the receiver causes time spread in the received signal. In an ideal radio channel, the received signal would consist of only a single direct path signal.

Another challenge we face is that we have different types of TV and receivers, each type has a unique circuit. In which, for example not all TVs and receivers have a plug for the headset; we did many experiments at different TVs and receivers to be sure that the audio will mute.

1.4 Objectives

This project aims to achieve the following objectives:

1- design a circuit for the transmitter and receiver that contains modulator and demodulator.

2- Understand how television works and how the signal is passed and processed.

3- Add some kind of privacy. For example, you are watching TV at the midnight and you don't want anyone to hear you, reduce the disturbance when listening to television.

4- Exploit what we have learned in the principles of communication in a practical application.

1.5 Estimated cost and budget

The initial cost of this project is about 80$, distributed as follows:

Table 1.1 Estimated cost

No.	Component	Price ($)
1	TV	300
2	Receiver	100
3	Headsets	200
4	Cables	20
5	Others	30

Table 1.1

1.6 Time plane

The project schedule will be divided into the following table (1.2):

Table 1.2 Layout of time

Week No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Choose project																
Gathering information																
Analysis and studying																
Writing and printing																

Table 1.2

1.7 Related Technologies:

1.7.1 Introduction:

Most people spend hours each day watching programs on their TV sets. However, many people might wonder how in fact, television works. There are many parts to this process and many technologies that are involved.

Separating image and audio is done by an inner circuit on TV so that the image can go to the TV for colour processing then, appear on a display and sound appear on speakers.

With the technological development, the plug which was added to the TV allowed connecting a headphone; consequently it prevents the audio from going to TV, but passed to the headphone so as to listen to the TV personally.

In modern receivers, there are normally three plugs, two for the Voice (left and right), and the other is for the image, so the image and the audio travel separately, while in the past the receiver was with one plug and one wire containing the audio and the image together and they were separated inside the TV.

Information in this section had been collected from the recent developments of the largest companies of headphones (Sony, Panasonic and Hitachi) and the local market. We will discuss on the types of wireless TV headphones.

Because of the rapid development of receivers, TV and the addition of plugs, the use of wired headphone was increased and moved now to wireless. Despite of this, it faces the problem of connecting these headsets to TV, so it works only by connecting the wire of transmitter to the plug to separate the audio from the TV speaker.

In this project, we will enhance these headphones by adding a switch to the cable that connects the receiver and use the Zigbee technology to carry the data between transmitter and receiver. Then the voice signal is passed to the headphone. Thus, the switch control wet her the voice is passed to TV speakers or to the headset.

1.7.2 RF Wireless Headphone

Radio Frequency (RF) wireless TV headphones tyPICally operate in the 800-900 MHz band although they may soon follow cordless phone technology and move on to higher frequencies like 2.4 GHz and 5.8 GHz. RF technology has the ability to penetrate through walls and obstacles which gives the added benefit of actually being able to receive wireless audio in several rooms of a house from a single source in one room. With RF wireless headphone transmission, the two stereo channels (left and right) are modulated onto a single frequency for transmission and then demodulated at the receiving side back into left and right channels. Finally, we'll present some of what was produced by many companies like Sony and Sennheiser in the following:

1) MDRIF240RK

The Son MDR-IF240RK Wireless Stereo Headphones System is a complete kit which includes a transmitter and Headphones. It offers features like its lightweight, open-air design, 30 mm Drive Units for deep bass, up to 60 hours of Battery Life with an optional alkaline battery or up to 35 Hours of Battery Life with the supplied NiHM Rechargeable Battery. Transmission Range is up to 24 feet. Also, it utilizes the a transmission Coverage Angle - up to 90°. Permitting an easy connection to your home - audio system, TV or VCR, the MDR-IF240RK provides a personal entertainment experience you can move to.

Technical Specifications:

- Easy Connection to TV, VCR and audio systems, through the supplied connecting cord and plug adapter.
- Open-Air Design lets you continue to hear ambient sound.
- 24 Foot Transmission Range for listening enjoyment throughout the room; lets you sit back from the TV set and still enjoy TV sound.
- Lower distortion and wider dynamic range; frequency response extends down to a low 18 Hz.

- Rechargeable Battery saves repeated trips to the store; automatically recharges when you place the headphones on the supplied transmitter.
- Automatic Headphones Power Switch conserves battery life; the headphones turn on when you place them on your head.
- Single Volume Control in one earpiece conveniently adjusts the volume for both channels.
- Infrared Modulation: Frequency modulation.
- Infrared Carrier Frequencies: Right 2.8MHz, Left 2.3MHz.

Headphones:

- Frequency Response: 18000- 22,000Hz.
- Battery Life: Approx. 35 hours with optional NiCad battery; approx. 60 hours with optional alkaline battery.
- Effective Range: 24 feet (7m); 10 feet (3m).
- Recharging Time: Approx. 16 hours.
- Headband: Wide, Self-adjusting.
- Power On/Off: Automatic switch.
- Weight: Headphones: 180 g (including battery), Transmitter: (125 g).

Features:

- Transmission Range Up To 24 Feet.

• Battery is Automatically Charged By Placing Headphones On The Cradle.

• Easy Connection to Home Audio System, TV or VCR.

2) MDRRF960RK

This system is developed from the previous type (MDRIF240RK). These developments are on the frequency, range, and rechargeable (it can work more time).

. Sony's MDR-RF960RK 900 MHz RF Wireless Headphones have a transmission range of 150 feet, allowing you to move about your house or yard without missing a beat (or word). The 900 MHz radio frequency delivers high quality sound, and the 30mm driver units provide deeper bass, lower distortion and a wider dynamic range.

These lightweight headphones are easily recharged by placing them on the transmitter, and the package includes rechargeable NiMH batteries. The MDR-RF960RK comes with automatic tuning for optimal reception of signal.

Technical Specifications:

- RF Modulation: Frequency modulation.
- Effective Range: 150 feet.
- Headphones:
  - -Frequency Response: 20-20,000Hz.
  - -Sensitivity: 105 dB/mW.
  - -Impedance: 24 ohms at 1 kHz.
  - -Tuning: Automatic.
  - -Volume: Rotary control.
  - -Power Handling Capacity: 1000mW.
- Weight: Headphones: 270g, Battery Transmitter: 195g.

Sony MDR-RF960RK Features:

- Volume Control is rotary type for easy, convenient adjustment.
- 3 Transmission Channels help ensure optimum signal reception; convenient tuning control on headphones.
- RF wireless headphone system using FM transmission system
- Up to 24 hours battery life using 2 AAA batteries; includes 2 NiMH rechargeable batteries with up to 15 hours' use.

- Automatic Power On/Off for both headphones and transmitter conserves battery life; transmitter turns on when it senses an input signal; headphones turn on when you place them on your head.
- Automatic Tuning on Headphones for best reception of signal.
- 150 Foot Transmission Range for listening enjoyment upstairs, downstairs, virtually everywhere in your home and outside in your backyard.
- 900 MHz Radio Frequency (RF) Transmission provides better sound quality and greater range than earlier wireless systems, and uses the same advanced technology as 900MHz cordless telephones.

3) Sennheiser RS 180 Wireless RF Headphones

No matter whether connected to a television set or a hi-fi system, the Sennheiser RS 180 digital wireless headphones guarantee an excellent sound experience. Dynamic sound transducers with powerful neodymium magnets ensure a clear, high-resolution audio playback whilst the Kleer transmission technology promises uncompressed transmission of the audio data.

The RS 180 is a two-part system that comes with wireless headphones, powered by two AAA NiMH batteries and a transmitter that connects to your output device. It's very simple to set up as the whole system is plug and play.

Designed for sound purists, the open design of the RS 180 ensures a particularly natural listening experience which can be set to individual preferences. Additionally, speech intelligibility can be improved through dynamic compression (Automatic Level Control) and the balance can also be individually adjusted. The RS 180's multi-functional transmitter doubles as an easy-charge cradle and docking station.

Technical Specifications

- Frequency response: 18 Hz - 21,000 Hz.
- Sound pressure level (SPL): 106 dB.
- Ear coupling: Around-the-ear.
- Impedance: 32 ohms.
- Wireless technology: Kleer.

- Modulation: MSK Digital.
- Range: Up to 320 feet (100m).
- Transducer principle: Sealed (closed).
- Operating time: Up to 24 hours per charge.
- Charging time: Empty to full--approximately 16 hours.
- Battery (headphones): 2 AAA NiMH rechargeable (included).
- Frequency: 2.4 - 2.8 GHz (auto selecting).

Features:

Dynamic headphones with clear and detailed audio reproduction

- Multipurpose transmitter-also functions as an "easy charge" cradle and docking station.
- Multi receiver transmission up to 4 people and listen from the same source.
- Automatic level control for optimum audio level.
- It uses KLEER wireless technology to send uncompressed digital audio up to 320' to the headphones. KLEER technology provides automatic, interference-free pairing.

Summary of RF wireless headphones types

- For (MDRIF240RK) type: it has less accuracy than the wired headphone. It has many characteristics; one is the capability to control voice and the channel through a switch on the headset. The other is it`s light weight and its price are relatively cheap. It uses low frequency, thus, the range is limited and the power consumed is high.
- For (MDRIF240RK) type: it is a good one because of it is range (about 150 ft) and is not affected by the environment like walls, chair, etc… So, the user can listen if he was not in the same room that contain TV.
- For Sennheiser RS 180: it uses a high frequency thus its range about 100m and is not affected by material and human body. It uses the clear wireless technology so

it reduces the noise, the transmitter can transmit to four headphone at the same time . But, the disadvantage of this type is the cost (expensive).

1.8 Report Contents

The documentation of this project is divided into four chapters, each chapter describes specific points in the project, and these chapters are divided as follows:

Chapter One: Introduction

This chapter includes a general overview about the project, the project objectives , previous technology, challenges schedule, and estimate cost.

Chapter Two: Theoretical Back ground

This chapter introduces the theoretical background related to the system, including TV, digital receiver, signal video/audio, wireless TV headsets.

Chapter Three: System Design

It present the transmitter and receiver design, modulator and demodulator and a switch build on a cable to listen to the audio.

Chapter Four: Switch Design

The chapter explains the system design including modulation both FM and AM.

Chapter Five: Implementation and Testing

The chapter including testing for each component , testing scheduling.

Chapter Two

Background

Chapter contents

2.1 Overview

This chapter focuses on the features, the development, the history of TV, receivers and headphone. Moreover; it will explain some types of these three devices.

2.2 Television systems

2.2.1 Introduction

One of the basic devices in the house is the TV. Nobody can imagine the life without this device. The use of the TV had been changed over years. The TV was considered as one of the accessories devises in the house but nowadays it has become a basic device.
In the past, few people had a TV in their houses, but now every house has a TV. Inventors focused on the development and on the enhancement of the TV by changing its size, shape and make it friendlier to the nature.

A big question appeared that is where the idea of the TV came from and what the history is of the TV. The answer of these two questions will be discussed in this chapter.

2.2.2 History

Television, TV for short, is a telecommunication medium that is used to transmit and receive moving images, either monochromatic or color, usually accompanied by sound. The word television has been derived from Latin and Greek words, which mean “far sight”. It took many inventors and engineers in various countries, over several decades, to develop the modern television. The history itself is complex and far-reaching. Television was developed over two overlapping lines, namely mechanical and electronic principles. Today, TV is a source of entertainment to people of all age groups. It has become an integral part of homes and it’s hard to imagine life without it. More interesting and amazing information on the origin and background of television can be found in [1].

The early stages of development of television saw inventors employing a combination of optical, mechanical and electronic technologies to capture, transmit and display a visual image. In the late 1800s, the first images were transmitted electrically via early mechanical fax machines, including the pan telegraph. Shortly after the invention of the telephone (around 1878), the concept of electrically powered transmission of television images in motion was sketched, which later came to be known as the telephonoscope. The science fiction authors stated that someday, light would also be transmitted through wires, just like sound.

In 1884, a 20-year old German student, Paul Gottlieb Nipkow patented the first electromechanical television system that employed a scanning disk (a disk with a series of holes spiraling towards the center) for rasterization (is the process by which a primitive is converted to a two-dimensional image). These holes were located at equal angular intervals, in such a way that the disk would allow light to pass through each hole in a single rotation and onto a light sensitive selenium sensor, which produced the electrical pulses. Nipkow's design was useful for transmitting still "halftone" images only. It wasn't practical until amplifier tube technology was further advanced. [1]

With time, came up designs that used a rotating mirror-drum scanner to capture the image and a cathode ray tube (CRT) as a display device. Even then, moving images were not available due to poor sensitivity of the selenium sensors. In 1907, a Russian scientist named Boris Rosing used a CRT in the receiver of an experimental television system. To transmit simple geometric shapes to the CRT, he used mirror-drum scanning. In 1925, Scottish inventor John Logie Baird exhibited the transmission of moving silhouette images in London.[1]

Baird further displayed moving monochromatic images in 1926. The scanning disk produced by him revealed an image of 30 lines resolution, which was sufficient to discern a human face, from a double spiral of lenses. In 1927, Baird became the first person to invent a video recording system called "Phonovision". He used conventional audio recording technology to modulate the output signal of his TV camera, down to the audio range and capture the signal on a 10-inch wax audio disc. A few of his "Phonoviosn" recordings survived and were decoded and renewed into viewable images in 1990s, using modern digital signal-processing technology.

In 1926, Hungarian engineer Kalman Tihanyi used fully electronic scanning and display elements to design a television system that employed the principle of “charge storage” within the scanning tube. Another Russian inventor Leon Theremin developed a mirror drum-based television system, which used interlacing to achieve an image resolution of 100 lines in 1927. In the same year, Herbert E. Ives of Bell Labs transmitted moving images from a 50-aperture disk. It produced 16 frames per minute over a cable from Washington to New York City, and from Whippany in New Jersey, via radio. The screens used were 24 by 30 inches (60 by 75 cm).[2]

Philo Farnsworth developed a working television system that included electronic scanning of both the PICkup and display devices. He first displayed this system to the press on September 1, 1928. Germany was the first country to put television into practice, in 1929. The OlymPIC Games held in Berlin in 1936 were broadcasted on television stations in Berlin and Leipzig for the public, to enable them to view the games live. The first flat panel system, plasma television was developed by Kalman Tihanyi in 1936. The modern changeable television receiver was first invented by Louis Parker, who received its patent in 1948. [2]

The mountains of Pennsylvania gave birth to the cable television that was formerly known as Community Antenna Television or CATV in 1940. The first successful color television system was commercially broadcasted by the FCC on December 17, 1953. In 1950, Zenith Electronics Corporation developed the first TV remote control called “Lazy Bones”, which first entered the American homes in June, 1956. On August 19, 1950, American Broadcasting Company aired Saturday morning TV shows for children for the first time. Donald Bitzer, Gene Slottow and Robert Wilson collectively invented the first prototype for a plasma display monitor in 1964.

On July 20, 1969, as many as 600 million people watched the first TV transmission from the moon. By 1972, around 50% of the televisions used in homes were colored. In 1982, Dolby surround sound for home sets was introduced. In 1996, the web TV rolled out. The year 2000 saw DVDs taking over the market, which later became a major player in the home entertainment field. Flat Screen TVs and HDTV later came to take over the market. Today, it is Plasma TVs and LCD TVs that have the television viewers hooked on! [2]

2.2.3 How TV works.

There are a lot of TV types because of the different TV companies in the world, but all the TVs have the same work principle and contain common basic work stages despite the different electronics circuit. We will show you a two- block diagrams for

- Monochrome (black and white)TV
- Colour TV

2.2.4 Colour Receiver.

A colour receiver is similar to the black and white receiver as shown in Fig. 2.1. The main difference between the two is the need of a colour or chroma subsystem. It accepts only the colour signal and processes it to recover (B-Y) and (R-Y) signals. These are combined with the Y signal to obtain VR, VG and VB signals as developed by the camera at the transmitting end. VG becomes available as it is contained in the Y signal. The three colour signals are fed after sufficient amplification to the colour PICture tube to produce a colour PICture on its screen.[5]

As shown in Fig. 2.1, the colour PICture tube has three guns corresponding to the three PICk-up tubes in the colour camera. The screen of this tube has red, green and blue phosphors arranged in alternate stripes. Each gun produces an electron beam to illuminate corresponding colour phosphor separately on the fluorescent screen. The eye then integrates the red, green and blue colour information and their luminance to perceive actual colour and brightness of the PICture being televised. The sound signal is decoded in the same way as in a monochrome receiver. [6]

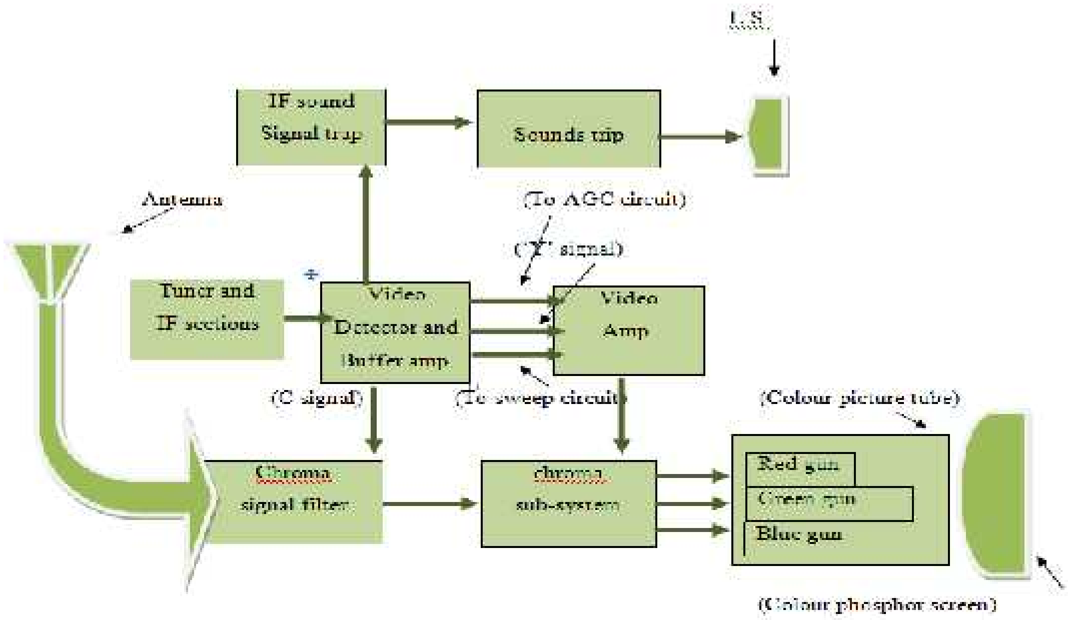


Fig. 2.1. An oversimplified block diagram of a color receiver.

An oversimplified block diagram of a monochrome TV transmitter is shown in Fig. 2.2. The luminance signal from the camera is amplified and synchronizing pulses added before feeding it to the modulating amplifier. Synchronizing pulses are transmitted to keep the camera and PICture tube beams in step. The allotted PICture carrier frequency is generated by a crystal controlled oscillator. The continuous wave (CW) sine wave output is given large amplification before feeding to the power amplifier where its amplitude is made to vary (AM) in accordance with the modulating signal received from the modulating amplifier. The modulated output is combined (see Fig. 2.2) with the frequency modulated (FM) sound signal in the combining network and then fed to the transmitting antenna for radiation. [7]

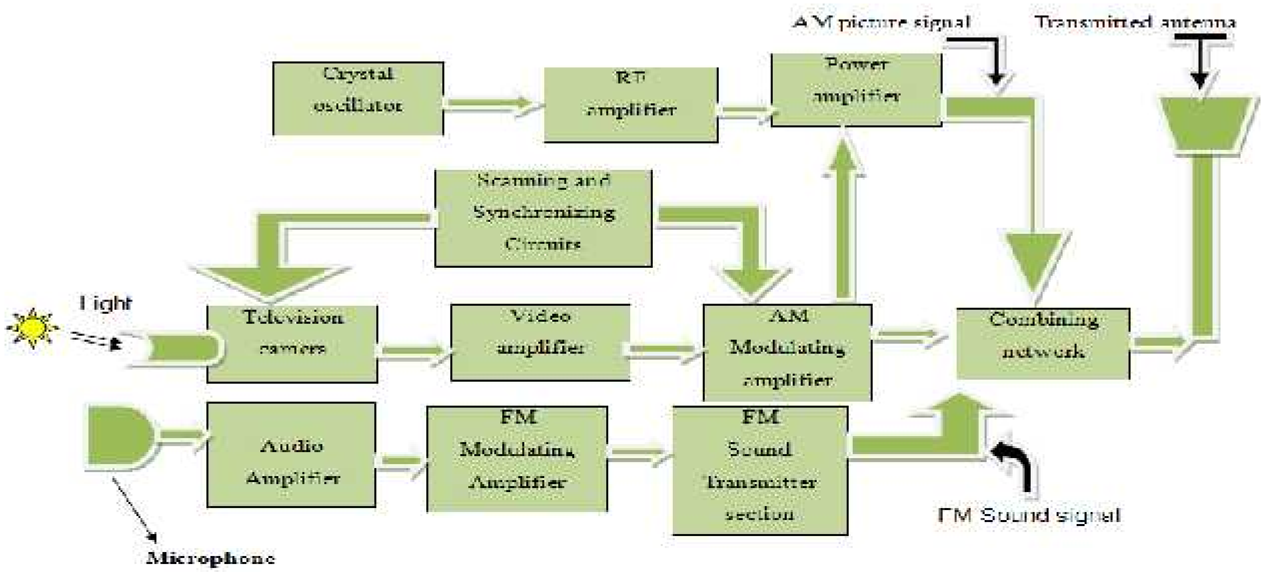


Fig. 2.2. Elementary block diagram of a monochrome television transmitter.

A simplified block diagram of a black and white TV receiver is shown in Fig.2. 3. The receiving antenna intercepts radiated RF signals and the tuner selects desired channel's frequency band and converts it to the common IF band of frequencies. The receiver employs two or three stages of intermediate frequency (IF) amplifiers.

The output from the last IF stage is demodulated to recover the video signal, this Signal that carries picture information is amplified and coupled to the picture tube which converts the electrical signal back into picture elements of the same degree of black and white. [7]

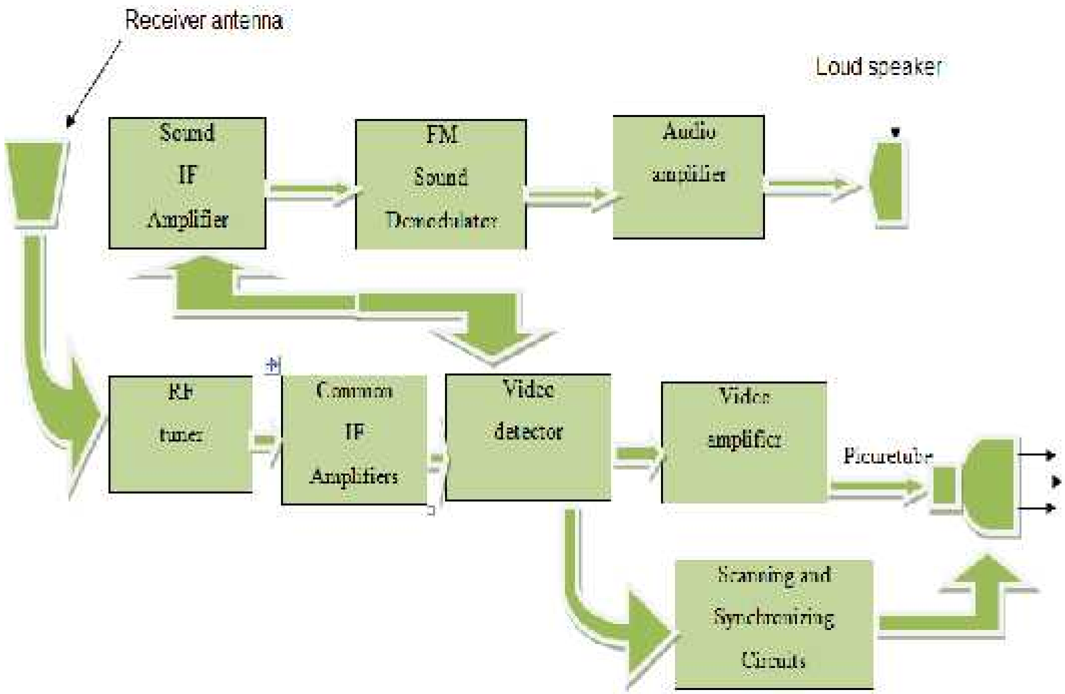


Fig.2.3. Simplified block diagram of a black and white TV receiver.

2.2.5 Sound Reception.

The path of sound signal is common with the picture signal from antenna to video detector section of the receiver. Here the two signals are separated and fed to their respective channels. The frequency modulated audio signal is demodulated after at least one stage of amplification. The audio output from the FM detector is given due amplification before feeding it to the loudspeaker. [5]

2.2.6 Synchronization.

It is essential that the same co-ordinates be scanned at any instant both at the camera tube target plate and at the raster of picture tube, otherwise, the picture details would split and get distorted. To ensure perfect synchronization between the scenes being televised and the picture produced on the raster, synchronizing pulses are transmitted during the retrace, *i.e.*, fly-back intervals of horizontal and vertical motions of the camera scanning beam. Thus, in addition to carrying picture details, the radiated signal at the transmitter also contains synchronizing pulses. These pulses which are distinct for horizontal and vertical motion control are processed at the receiver and fed to the picture tube sweep circuitry thus ensuring that the receiver picture tube beam is in step with the transmitter camera tube beam. As stated earlier, in a colour TV system additional sync pulses called colour burst are transmitted along with horizontal sync pulses. These are separated at the input of chroma section and used to synchronize the colour demodulator carrier generator. This ensures correct reproduction of colours in the otherwise black and white picture. [5]

2.3 Receiver system.

The work of the receiver begins from the antenna which collects the transmitted signal to pass it to the amplifiers which strengthen the received signal. Then it is sent to other stages inside the receiver like filtering and defines the whole signal and separate the audio signal from the image, the audio plug and the video arrived to the video plug. [8]

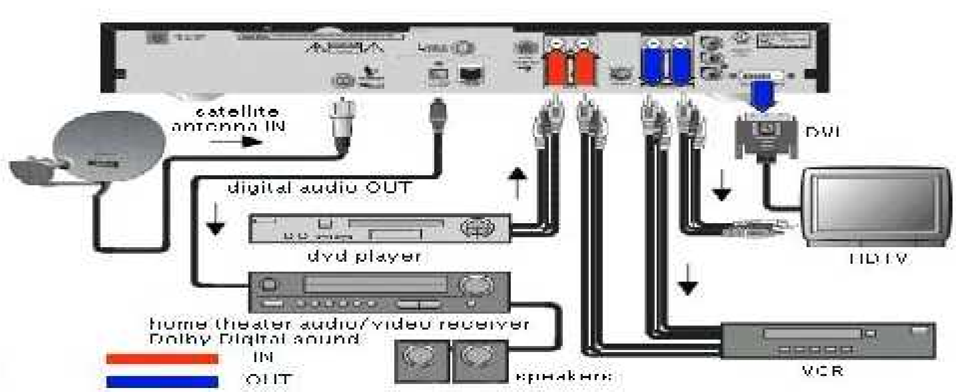


Fig.2.4 receiver connections

2.3.2 General definition

Signal: The satellite TV receiver receives a digital broadcast signal via cable from the satellite dish. The signal contains all the programming information which was originally broadcast from the provider. [9]

Decoding: The satellite receiver decodes the encrypted digital signal. The receiver includes a decoder chip for this. Signals are encrypted to ensure that anyone who receives them is a paying subscriber. As a paying customer, you have the receiver with the appropriate chip, to decode satellite programming that you've subscribed for. [9]

Conversion: The signal is then converted from digital to analog so that the television is able to read and display the programming information. Satellite receivers may have a HD or standard tuner depending upon what type of satellite TV package that we have. [9]

Channels: Finally, the receiver is responsible for splitting the full programming signal into the individual channels that we tune into. Along with the channels, the receiver sends enhanced programming guide information to the television which details the channel and program to allow us to view what's on. [9]

2.4 Cables.

In this section we will talk about an important component that connects between TV and receiver which is the cable. We mean by cable a wire that acts as interface between TV and receiver .Cables has different types and different technologies have been used when designing it. Each one deals with a specific application so the user should know how to choose the cable. For example, we can’t use the coaxial for carrying high data rates for long distances. In this case fiber optic is the selection. The most famous cables are three which are: [3]

2.4.1 Coaxial Cable.

This cable used for connecting between TV and receiver, the project is based on it so it will be discussed clearly.

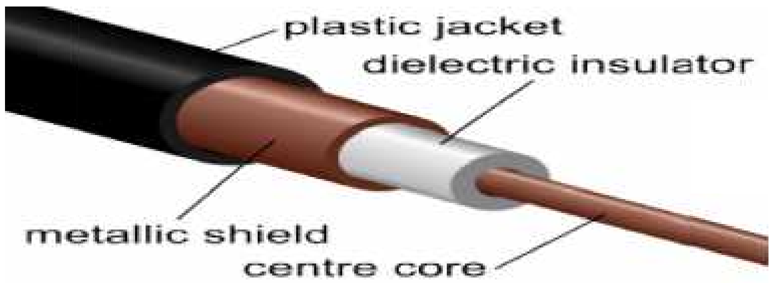


Fig.2.5 coaxial cab

2.4.2 Twisted Pair:

Twisted pair cable consists of a pair of insulated wires twisted together. It is a cable type used in telecommunication for very long time. Cable twisting helps to reduce noise PICkup form outside source and crosstalk on multi-pair cables. [4]

Twisted pair cable is good for transferring balanced differential signal. The practice of transmitting signals differentially dates back to the early days of telegraph and radio. The advantages of improved signal-to-noise ratio, crosstalk, and ground bounce that balanced signal transmission brings are particularly valuable in wide bandwidth and high fidelity systems. By transmitting signals along with 180 degree out-of-phase complement, emissions and ground currents are the oretically canceled this eases the requirement on the ground and shield compared to single ended transmission and results in improved EMI performance. It has two types. [4]

- ✓ Shielded twisted pair (STP).
- ✓ Unshielded twisted pair (UTP)

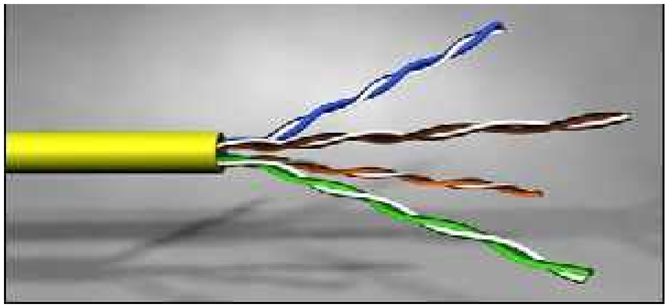


Fig.2.5. twisted pair cable

2.4.3 Fiber Optic

In recent years it has become apparent that fiber-optics are steadily replacing copper wire as an appropriate means of communication signal transmission. A fiber-optic system is similar to the copper wire system that fiber-optics is replacing. The difference is that fiber-optics use light pulses to transmit information down fiber lines instead of using electronic pulses to transmit information down copper lines. Looking at the components in a fiber-optic chain will give a better understanding of how the system works in conjunction with wire based systems. [18]

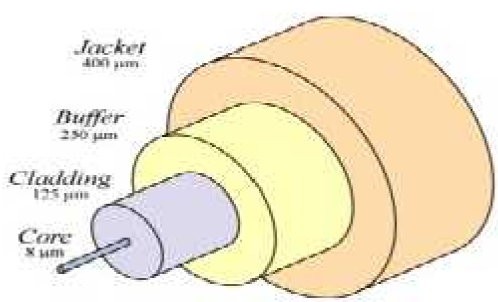


Fig.2.6 Fiber Optic cable

2.4.4 Coaxial Cable

Coaxial cable is an electrical cable with an inner conductor surrounded by a flexible, tubular insulating layer, surrounded by a tubular conducting shield. The term coaxial comes from the inner conductor and the outer shield sharing the same geometric axis. Coaxial cable was invented by English engineer and mathematician Oliver Heaviside, who first patented the design in 1880.

Coaxial cable is used as a transmission line for frequency signals, in applications such as connecting radio transmitters and receivers with their antennas, computer network (Internet) connections, and distributing cable television signals. One advantage of coax over other types of radio transmission line is that in an ideal coaxial cable the electromagnetic field carrying the signal exists only in the space between the inner and outer conductors. This allows coaxial cable runs to be installed next to metal objects such as gutters without the power losses that occur in other types of transmission lines and provides protection of the signal from external electromagnetic interference. [4]

Coaxial cable differs from other shielded cable used for carrying lower frequency signals, such as audio signals, in that the dimensions of the cable are controlled to give a precise, constant conductor spacing, which is needed for it to function efficiently as a radio frequency line. it is the most common one and it used for simple application and it isn't expensive when we compare it with fiber optic cable . [4]

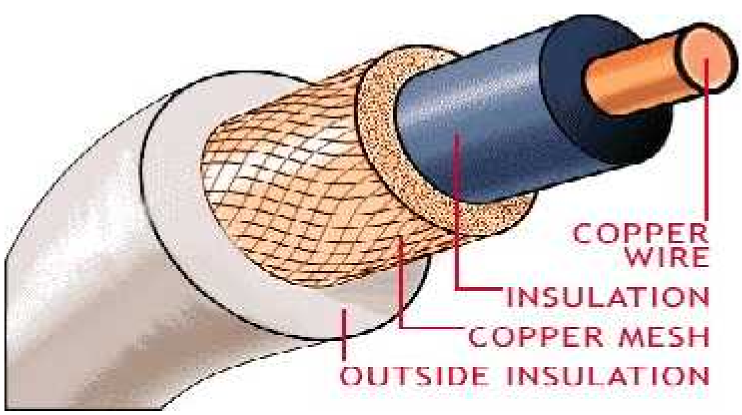


Fig.2.7. cross section for coaxial cables

The types of coaxial cables are:

1-Hard line:

Hard line is used in broadcasting as well as many other forms of radio communication. It is a coaxial cable constructed using round copper, silver or gold tubing or a combination of such metals as a shield. Some lower quality hard line may use aluminum shielding, aluminum however is easily oxidized and unlike silver or gold oxide, aluminum oxide drastically loses effective conductivity. Therefore all connections must be air and water tight. [3]

The center conductor may consist of solid copper, or copper plated aluminum. Since skin effect is an issue with RF, copper plating provides sufficient surface for an effective conductor. Most varieties of hard-line used for external chassis or when exposed to the elements have a PVC jacket; however, some internal applications may omit the insulation jacket. Hard line can be very thick, tyPICally at least a half inch or 13 mm and up to several times that, and has low loss even at high power. These large scale hard lines are almost always used in the connection between a transmitter on the ground and the antenna or aerial on a tower. Hard line may also be known by trademarked names such as Heliax (Andrew), or Cable wave (RFS/Cable wave). [3]

Larger varieties of hard-line may consist of a center conductor which is constructed from either rigid or corrugated copper tubing. The dielectric in hard line may consist of polyethylene foam, air or a pressurized gas such as nitrogen or desiccated air (dried air). In gas-charged lines, hard plastics such as nylon are used as spacers to separate the inner and outer conductors. [4]

The addition of these gases into the dielectric space reduces moisture contamination, provides a stable dielectric constant, as well as a reduced risk of internalarcing. Gas-filled hardlines are usually used on high powered RF transmitters such as television or radio broadcasting, military transmitters, as well as high powered amateur radio applications but may also be used on some critical lower powered applications such as those in the microwave bands. Although in the microwave region waveguide is more often used than hard line for transmitter to antenna, or antenna to receiver applications. [3]

The various shields used in hard line also differ; some forms use rigid tubing, or pipe, others may use corrugated tubing which makes bending easier, as well as reduces kinking when the cable is bent to conform. Smaller varieties of hard line may be used internally in some high frequency applications, particularly in equipment within the microwave range, to reduce interference between stages of the device. [3]

2- Radiating.

Radiating or Leaky Cable is another form of coaxial cable which is constructed in a similar fashion to hard line; however it is constructed with tuned slots cut into the shield. These slots are tuned to the specific RF wavelength of operation or tuned to a specific radio frequency band. This type of cable is to provide a tuned bi-directional "desired" leakage effect between transmitter and receiver. It is often used in elevator shafts, underground, transportation tunnels and in other areas where an antenna is not feasible. One example of this type of cable is Radix (Andrew). [4]

3- RG-6.

RG-6 is available in four different types designed for various applications. "Plain" or "house" wire is designed for indoor or external house wiring. "Flooded" cable is infused with heavy waterproofing for use in underground conduit (ideally) or direct burial. "Messenger" may contain some waterproofing but is distinguished by the addition of a steel messenger wire along its length to carry the tension involved in an aerial drop from a utility pole. "Plenum" wire comes with a special Teflon outer jacket designed for use in ventilation ducts to meet fire codes.[4]

4- Triaxial cable.

Triaxial cable or triax is coaxial cable with a third layer of shielding, insulation and sheathing. The outer shield, which is earthed (grounded), protects the inner shield from electromagnetic interference from outside sources. [3]

5- Twin-axial cable.

Twin-axial cable or twinax is a balanced, twisted pair within a cylindrical shield. It allows a nearly perfect differential signal which is both shielded *and* balanced to pass through. Multi-conductor coaxial cable is also sometimes used.[3]

6-Biaxial cable

Biaxial cable, biax or *Twin-Lead* is a configuration of two 50 Ω coaxial cables, externally resembling that of lamp cord, or speaker wire. Biax is used in some proprietary computer networks. Others may be familiar with 75Ω biax which at one time was popular on many cable TV services.[3]

7-Semi-rigid

Semi-rigid cable is a coaxial form using a solid copper outer sheath. This type of coax offers superior screening compared to cables with a braided outer conductor, especially at higher frequencies. The major disadvantage is that the cable, as its name implies, is not very flexible, and is not intended to be flexed after initial forming. (See "hard line")

Conformable cable is a flexible reform able alternative to semi-rigid coaxial cable used where flexibility is required. Conformable cable can be stripped and formed by hand without the need for specialist tools, similar to standard coaxial cable.[3]

2.4.3 Coaxial cable uses:

Short coaxial cables are commonly used to connect home video equipment, in ham radio setups, and in measurement electronics. They used to be common for implementing computer networks; in particular Ethernet, but twisted pair cables have replaced them in most applications except in the growing consumer cable modem market for broadband Internet access.[4]

Long distance coaxial cable was used in the 20th century to connect radio networks, television networks, and telephone networks though this has largely been superseded by later methods (fiber optics, T1/E1, satellite). Shorter coaxial still carry television signals to the majority of television receivers, and this purpose consumes the majority of coaxial cable production.[4]

Micro coaxial cables are used in a range of consumer devices, military equipment, and also in ultra-sound scanning equipment.

The most common impedances that are widely used are 50 or 52 ohms, and 75 ohms, although other impedances are available for specific applications. The 50 / 52 ohm cables are widely used for industrial and commercial two-way radio frequency applications (including radio, and telecommunications), although 75 ohms is commonly used for broadcast television and radio. [4]

Coaxial cables problems: this type of coaxial cable faces the EMI problem which called signal leakage that is the passage of electromagnetic fields through the shield of a cable and occurs in both directions. Ingress is the passage of an outside signal into the cable and can result in noise and disruption of the desired signal. Egress is the passage of signal intended to remain within the cable into the outside world and can result in a weaker signal at the end of the cable and radio frequency interference to nearby devices.[3]

Since cable signals use the same frequencies as aeronautical and radio navigation bands. CATV operators may also choose to monitor their networks for leakage to prevent ingress. Outside signals entering the cable can cause unwanted noise and PICture ghosting. Excessive noise can overwhelm the signal, making it useless. [3]

An ideal shield would be a perfect conductor with no holes, gaps or bumps connected to a perfect ground. However, a smooth solid copper shield would be heavy, inflexible, and expensive. Practical cables must make compromises between

Shield efficacy, flexibility and cost, such as the corrugated surface of hardline, flexible braid, or foil shields. Since the shields are not perfect conductors, electric fields can exist inside the shield, thus allowing radiating electromagnetic fields to go through the shield.

Consider the skin effect. The magnitude of an alternating current in a conductor decays exponentially with distance beneath the surface, with the depth of penetration being proportional to the square root of the resistivity. This means that in a shield of finite thickness, some small amount of current will still be flowing on the opposite surface of the conductor. With a perfect conductor (i.e., zero resistivity), all of the current would flow at the surface, with no penetration into and through the conductor. Real cables have a shield made of an imperfect, although usually very good, conductor, so there will always be some leakage. [4]

The gaps or holes, allow some of the electromagnetic field to penetrate to the other side. For example, braided shields have many small gaps. The gaps are smaller when using a foil (solid metal) shield, but there is still a seam running the length of the cable. Foil becomes increasingly rigid with increasing thickness, so a thin foil layer is often surrounded by a layer of braided metal, which offers greater flexibility for a given cross-section. This type of leakage can also occur at locations of poor contact between connectors at either end of the cable.[4]

2.4.5 Types of TV Cables

Five different kinds of cable are available for television and entertainment, each with varying qualities and types of signals. [3]

1. **Component Video Cables**

- Component video cables transmit high definition video signals by splitting the signals into three different parts.
- Composite Cable:

  These cables are common and the jacks are found on almost all entertainment equipment. They do not, however, transmit high-quality signals.
- Coaxial RF Cable:

  These are the lowest-quality cables, but they transmit audio and video signal within one cable. It is recommended that they are only used with TVs that do not have any other input options.
- S-Video Cable:

  S-Video cables are cable producing high-quality images in great detail because they transmit color and brightness separately.

DCI and HDMI Cables:

- Digital Video Interface and High Definition Multimedia Interface cables are capable of transmitting standard and high definition signals. Most modern TVs and other pieces of equipment come with one of these two inputs.

2.5 Connectors:

The connector is the part of a cable that plugs into a port, or interface to connect one device to another. Most connectors are either *male* (containing one or more exposed pins) or *female* (containing holes in which the male connector can be inserted).

There are two types of electrical connectors for carrying audio signal and video signal.

1. Audio connector:

Audio connectors are electrical connectors designed and used for audio frequencies. They can be analog or digital.

2. Video connector:

Video connectors are electrical connectors designed and used for video frequencies. They can be analog or digital.

2.6 Wireless TV headphone

2.6.1 Introduction

In this section we will talk about headphone taking in to consideration types, all technologies used in wireless headphone, the use of wireless headphone.

2.6.2Headphone/ headsets:

There is a common mistake for peoples when they said headphones and headsets because there’s a difference between them this difference is that the headsets are a headphones combined with a microphones. Headsets provide the equivalent functionality of a telephone handset with hands-free operation. Headsets tyPICally have only one speaker like a telephone, but also come with speakers for both ears. They have many uses including in call centers and other telephone-intensive jobs and for personal use at the computer to facilitate comfortable simultaneous conversation and typing. [16]

2.6.2 Types Of Wireless TV Headphone:

There are two main different types of wireless headphone technologies:

1) IR (Infra red) wireless headphones:

   Headphones use line-of-sight technology, which means that the users have to be lined up with the transmitter (within line of sight) in order for them to receive sound

2) RF (Radio Frequency) wireless headphones:

Headphones transmit sound through walls and ceilings, which means that you can move from room to room (and even use a Treadmill) and still receive audio. Compatible with plasma and LCD HDTV's.

Both types of wireless technology incorporate a transmitter and receiver system. The wireless headphone transmitter is what connects to the audio source (stereo, TV, etc.), while the receiver is actually built in to the headphones. We will state all the characteristics of each one separately as follows:

2.6.2.1 RF Wireless TV Headphone

The radio frequency, or RF, wireless headphones currently operate in the 800 to 900 MHz band, but eventually they may change over to higher frequencies, like the range from 2.4 GHz and 5.8 GHz. Radio frequency technology is able to penetrate walls and other objects in its line of sight. It means that the user can have wireless audio in many rooms from only one transmitter. In RF wireless technology, the left and right stereo channels are modulated into one frequency for transmission. Then they are demodulated into right and left channels at the receiver, so that the users hear in stereo.

Fig.2.8. RF headphone

With RF wireless TV headphones, there is the possibility of signal loss and interference. Interference comes from other radio frequency wireless devices transmitting within range of the receiver. Sometimes, a signal from a wireless router, cordless phone, or wireless video transmitter, can cause static in the headphones. This problem is most severe when the two devices are operating at a similar frequency.

Signal loss doesn't necessarily mean the signal is gone. It could just be a weak signal. Signal loss causes loss of sound altogether, static, or bad audio quality. There are two main causes of signal loss. The distance from the receiver and transmitter being too far is one cause. The signal being blocked by obstacles is another.

Metal and water are obstacles that RF signals have a hard time getting through. The metal might be a metal firewall or a network of metal plumbing pipes or duct work inside walls. Because the human body carries a certain amount of water, it, too can be an obstacle to RF signals. For that reason, keeping the transmitter over head level may solve the problem. [16]

In this project we will benefit from the principle of RF wireless headphone to work with Zigbee and control the switch.

2.6.2.2 IF Wireless TV Headphone

Infrared wireless TV headphones operate by sending their signal in the form of a beam of light tyPICally in the 2-4 MHz band and IR, wireless TV headphones work by sending their signal in the form of infrared light a wavelength that is invisible to the human eye. Because the transmitter emits light, IR headphones are considered a "line of sight" instrument. The user has to be able to actually see from the transmitter to the receiver in order to receive the signal in the headphones.

Fig.2.9.IF headphone

In general, IR wireless TV headphones have a range of about 30 feet, assuming a clear line of sight. The user gets true right and left channel stereo separation, so the sound quality is really good. Because it is a line of sight technology, the user doesn’t has to worry so much about interference. The user could have another set of IR wireless TV headphones in the next room, and it wouldn't affect the reception unless the user moved into that set-up's line of sight. [17]

2.7.3 How to connect headphone to TV

If the user likes to watch TV late at night and worried about the children, headphones are an obvious solution.

1- Set up the transmitter. Wireless headphones rely on a transmitter that sends audio via infrared or radio waves to the headset. Use the digital audio output (coaxial or optical), RCA outputs (red and white) or headphone jack on the TV to connect the transmitter. Connection will depend upon which outputs are available on TV and/or the transmitter. [17]

2- Use an RCA to headphone adapter. If the user doesn't have a headphone jack on the TV and the transmitter includes only a headphone connection, connect an RCA to female headphone connector. This will allow plugging the wireless transmitter into the female headphone end and then hooking the RCA ends into the television's audio outputs. The user may also need a 3.5 mm (mini jack) to 1/4 inch adapter if the headphone plug on the transmitter doesn't match the television jack. [17]

3- Plug the transmitter in and turn it on. Charge the headphones if necessary. The headphone probably charge by being docked to the transmitter itself.[17]

4- Turn the headphones on. Adjust the volume and settings and be ready to watch TV. The headphone could be recharged by connecting it to the transmitter.[17]

Finally, we will explain how the transmitter and the receiver will be built, how signal moves between them and how to deliver this signal to the headphone in the next chapter.

This project has at least three great features will be explained in this section.

Firstly, it is an implementation of a new idea; in addition it will use the (RF) technique which has three advantages over IR and Bluetooth and other techniques. These advantages are:

1- RF reaches distances further than IR and Bluetooth.

2-RF can penetrate the walls and human body.

3-RF has low response to noise.

Another feature of the planned system is that, the switching between the two modes will be controlled remotely through wireless instructions at the headsets. Therefore, no special plugs will be used at the TV side. Furthermore, we will try to reduce the system cost compared to other similar products in order to make the technology available for a wide spectrum for people.

Chapter three

Block diagram

Chapter contents:

3.1Overview:

This chapter will illustrate the work principle of the proposed system through embodiments of its parts by using block diagrams to make it easier to understand and give a clear image about the components which will be used later.

3.2 System block diagram:

The first step in this project is to follow the path of the signal from the antenna until it reaches the final destination (TV). As show in the figer3.1, the signal always transfers from the antenna to the receiver which separates the image and audio and passes them to the TV by a cable which works into cases.

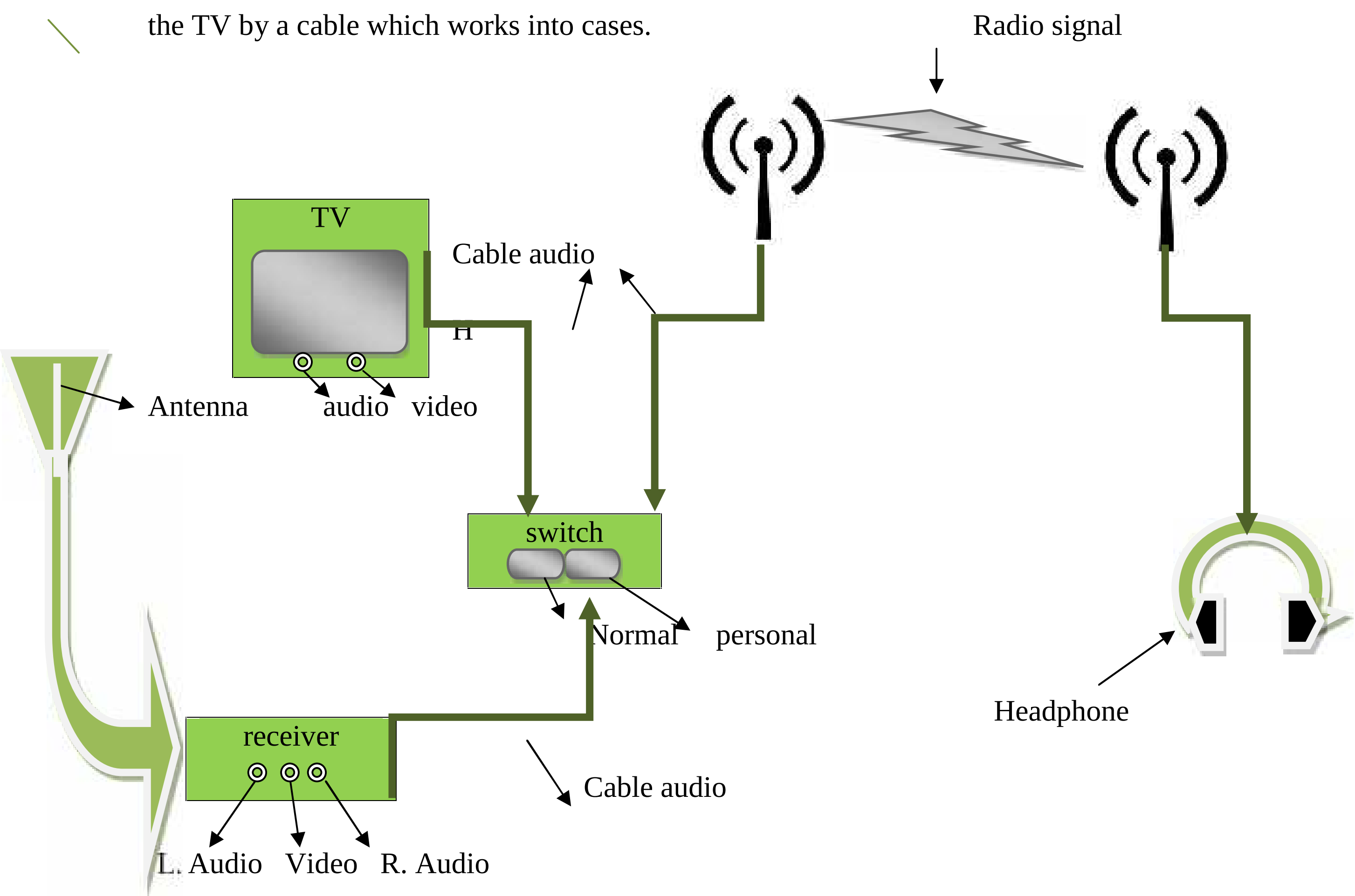


Fig.3.1system design

The system is comprised of the following entities:

3.2.1TheTV:

The TV converts the image and audio to electrical signal, which is then converted into video visual inside the TV, in which there's a microphone that PICks up the audio and passes it to the headphone.

3.2.2 The Antenna

The power adapter is designed to carry and receive the electromagnetic waves or in other words, the antenna converts the electromagnetic waves to electrical currents and vise verse. The antenna is used widely in TV broadcasting, wireless communication from point to point, and Rader systems. The antenna is used in the space but it can be used under water. Or even through the soil by using certain frequencies over short ranges.

3.2.3 The Headphone

Wireless TV headphones work on certain frequencies, usually Megahertz (MHz); it receives the signal from the sender to the headphone. In this project, the RF wireless headphone will support ranges up to 50 meters. This type of headphone isn't affected by any thing around it.

3.2.4 Receiver

The signal reaches the receiver compactly (which audio, video), the receiver receives these compact signals and analyses them.

3.3 The cable

The cable which is used between TV and receiver is coaxial one; the main function of this cable is to carry the data between TV and receiver. There's a complete explanation for the coaxial cable in chapter two.

A coaxial cable is the cable you plug in the back of a TV, with a pin in the middle. It screws on to the socket, not all the cables used in are TV is a coaxial but we focus our attention on this cable because it's the one we will deal with (the switch will be placed in the middle of it). [4]

3.4 The switch:

We will focus our attention on the switch which will be placed in the middle of the cable that connects the receiver and the TV. So, this switch will have the lions share to control the signal and decides whether to move it to the TV or send it to the wireless receiver fixed on the headset.

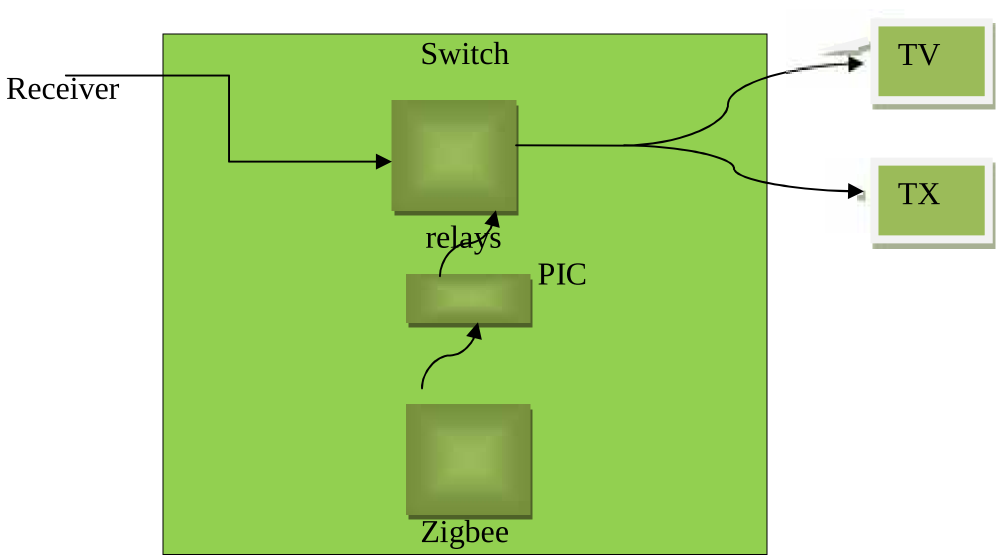


Fig3.2 block diagram of switch

3.5 The transceiver

The word transceiver consists of two words (transmitter, receiver). Our transmitter will be a FM for many reasons that will be explained in chapter four. The block diagram of the transceivers is shown in figure3.3. It is comprised of the following component. [9]

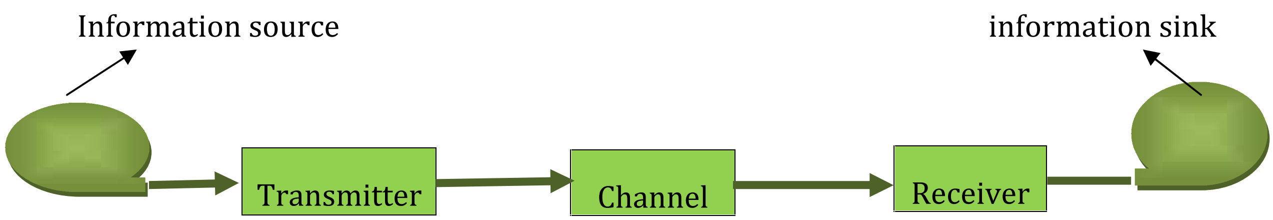


Fig 3.3 block diagram of communication system

1. Transmitter: the basic function of the transmitter is to take the information bearing signal produced by the source of information and modify it into a form suitable for transmission over the channel. [9]
2. Channel: it provides the physical means for transporting the signal produced by the transmitter and delivering it to the receiver. [9]
3. Receiver: it operates on the received signal to produce an estimate of the original information –bearing signal. We say estimate rather than exact because of noise, fading and other interference. [9]

The transmitter and receiver circuit for sound had been separated from the transmitter an receiver circuit for controlling the switch, i.e. the controlling circuit is based on Zigbee technology and the sound circuit is sent through FM technique .

3.5.1 AM, FM modulation

AM: An amplitude modulated signal that contains the carrier signal and the two sidebands the lower sideband and the upper sideband. This was the first type of modulation used for communicating signals from one point to another and is still the simplest to understand.

FM: The process of combining the message signal with the carrier signal that causes the message signal to vary the frequency of the carrier signal.

Table (3.1) shows the comparison between frequency and amplitude modulation.

M.T.	Advantage	Disadvantage
AM	Simple modulator and demodulator. Narrower bandwidth than wide band FM.	Susceptible to man –made noise. Audio strength falls with decreasing RF signal. Strength Inefficient power usage. Limited dynamic range. Transmitter output power not easily adjusted.
FM	Less susceptible to noise. Constant audio level to almost the end of radio range. Capture effect in receiver. More power – efficient transmitter output power easily adjustable.	Wider bandwidth. Capture effect may be undetected e.g. aviation communication.

Table 3.1

3.6 FM Transmitter:

As it was mentioned before, this project is based on two techniques. One of them is the FM for carrying the sound. Here we will explain the principles of the FM transmitter with its components.

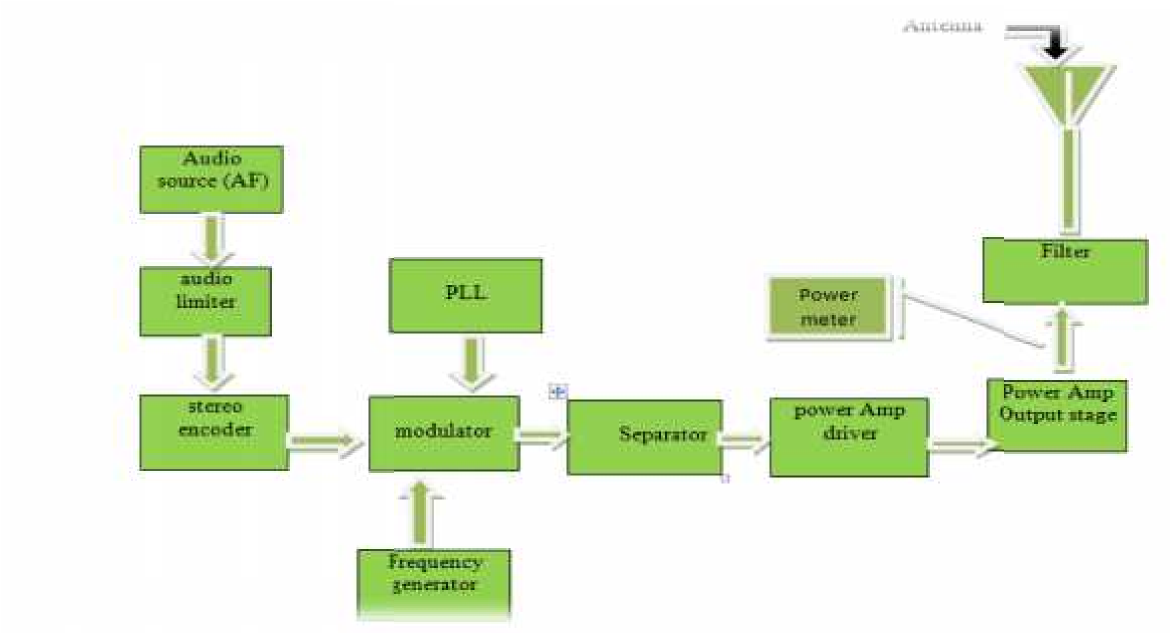


Fig.3.4 Block diagram for the FM transmitter [12]

This is a block diagram for the FM transmitter; it shows the basic stages of the FM transmitter. We would like to describe each of these blocks independently so it could help the beginners seeing the big PICture and thus better understand how transmitters are designed.

3.6.1 Audio Source

Also referred to as Audio Frequency (AF) which is usually around 20Hz-20 KHz. This can be either CD player, computer, tape, microphone or just about any other audio device. The audio signal should have as good characteristics and quality as possible. Connectors from Audio Source to the Audio Limiter should also be of a better quality to make sure that there isn't any noise coming to the audio stages of a transmitter. [6]

3.6.2 Audio Limiter

Also known as Compressor or Automatic Level Control, this circuit is usually built using operational amplifiers in conjunction with other controlling IC's. And these are the following tasks of this device: [6]

1. It Provides 100% of allowable modulation. In other words, the level of incoming sound is the maximum that a modulator can handle (perfectly matched with the sensitivity of the modulator). That's why the sound on the receiver is very high but at the same time very clear.
2. It prevents over modulation. The best thing is to keep modulation to the maximum (100%) but if that allowable line is crossed, then there would be over modulation of audio cycle when the RF carrier is removed completely from the air, thus producing distortion in the transmission. How does that happen? In most of the transmitters the same block or even a transistor is responsible for both modulation and generation of the carrier frequency (88-108MHz). If over modulation takes place, transistor (Q1) becomes so unstable that it cannot generate a clear carrier frequency consequently we hear the distortion.
3. It keeps the audio on the same level. This is especially crucial when using microphone as a source because its dynamic (audio levels) are never steady. When playing music, some of the tracks might be recorded at different audio levels and when a user receives a given radio station, he or she doesn't want to set the audio level every few minutes or so, you want the sound loudness to be always the same.

If we just want to build a simple transmitters so we can transmit the music around the house we can live without automatic level control but then we will need to make sure that audio signal of our source is set to minimum level and that it is matched with our transmitter.

3.6.3 Stereo Encoder

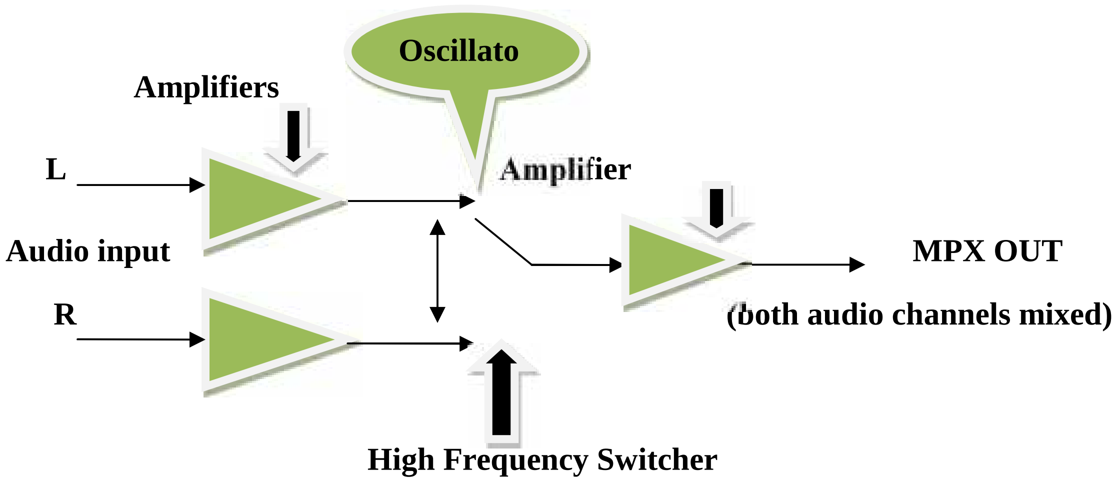


Fig.3.5 Sample stereo Encoder [5]

Also known as encoder, coder or multiplexer (MPX) . Stereo encoder is a circuit that takes both channels of audio (L and R) and mixes it into one called MPX channel. Stereo encoder uses a process called multiplexing which allows transmitting more than one signal over a single link, route, or a channel. The circuit is driven by an oscillator that switches between the two channels of audio with a frequency of 38 KHz per second to merge these channels into one. Additionally, 38 KHz frequency is divided in half to produce a 19 KHz PILOT tone that a receiver will need to use to decode MPX signal back into two audio channels. Once the two audio channels are mixed and 19 KHz frequency is generated, they are then merged together to form a MPX signal that FM transmitter will transmit. [5]

3.6.4 Modulator

This block places audio frequency on the top of a carrier frequency (frequency in which one wants to transmit. In our case 88-108MHz. This may be referred as a block as a mixer because it mixes two different frequencies. [13]

3.6.5 Oscillator

Just as the name implies oscillator oscillates or generates a carrier frequency (88-108MHz).An oscillator can generate various types of frequencies and may be used for many different purposes. It can be found in most of the electronic devices and in our case it is found in all FM transmitters and receivers as well. A simple one transistor FM transmitter is in fact nothing else but an oscillator and a modulator. The output power of one transistor oscillators found in these transmitters is often very small, 50mW or below. If such transmitter does not have at least a separator or an amplifier then, in that case this oscillator is very prone to frequency drifts. A single touch to its antenna may cause a slight frequency change. [13]

Oscillator Types [13]

1. VFO (Variable Frequency Oscillator) - An oscillator whose output frequency can be changed by adjusting a variable inductor or variable capacitor.

2. VCO (Voltage Controlled Oscillator) - An oscillator whose output frequency is controlled or changed by an application of external voltage. VCO uses varicap diode that changes the capacitance as different levels of voltage are applied.

3. PLL (Phase Locked Loop) - A circuit that synchronizes a frequency of VCO with a frequency of a reference oscillator by using a comparison of phase between the two signals. PLL takes frequency of VCO, divides it into a lower frequency which can be compared with a stable reference oscillator. Then amplifiers are used to send an appropriate voltage back to the VCO to keep the desired frequency stable.

4. Crystal Oscillator -An oscillator that uses a crystal to generate a frequency.

3.6.6 Separator

This is usually a single transistor that separates a low oscillator's signals from an antenna or the rest of the blocks. When a separator is in places it usually brings a greater oscillator's stability especially in low power transmitters where there is no amplifier at all. When an amplifier is used, this part may be omitted because an amplifier acts as a separator too. [12]

3.6.7 RF Amplifier

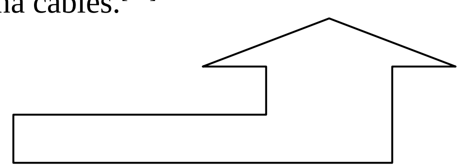
RF amplifier is a circuit that takes small incoming RF signal and increases its strength multiple times. Most amplifiers use several transistor stages; driver and output stages that amplify RF signal gradually. For instance if we connect a 50mW signal to a 10W transistor, we cannot expect a 10W output signal. This is because such transistor might need at least 1W of incoming signal to produce an output at its maximum power peak. [11]

3.6.8 Power Meter

This device is connected to an output of an amplifier to see how many watts are being transmitted. You may also connect it to the end of the antenna cable if it's a long one to see how much power has been lost through that cable. In lower power transmitters we may use a single transistor and a LED as a power indication, but to have a precise measurement you will definitely need a power meter. [11]

3.6.9 Antenna

Antenna is an equally important element of every transmitter, because it is used to dispatch or radiate the signal of the transmitter. We may have a powerful amplifier, but if we have a poor antenna, only a fraction of the signal's strength will be transmitted to the air. Transmitter's amplifier should always be matched with the antenna by using variable capacitors to achieve maximum signal performance. Avoid running a long antenna cables form your amplifier to an antenna to minimize the power loss, and if we have no choice, use better quality antenna cables.[12]



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3.7 FM Receiver:

Here we will explain the operation principles of the FM receiver with its component's

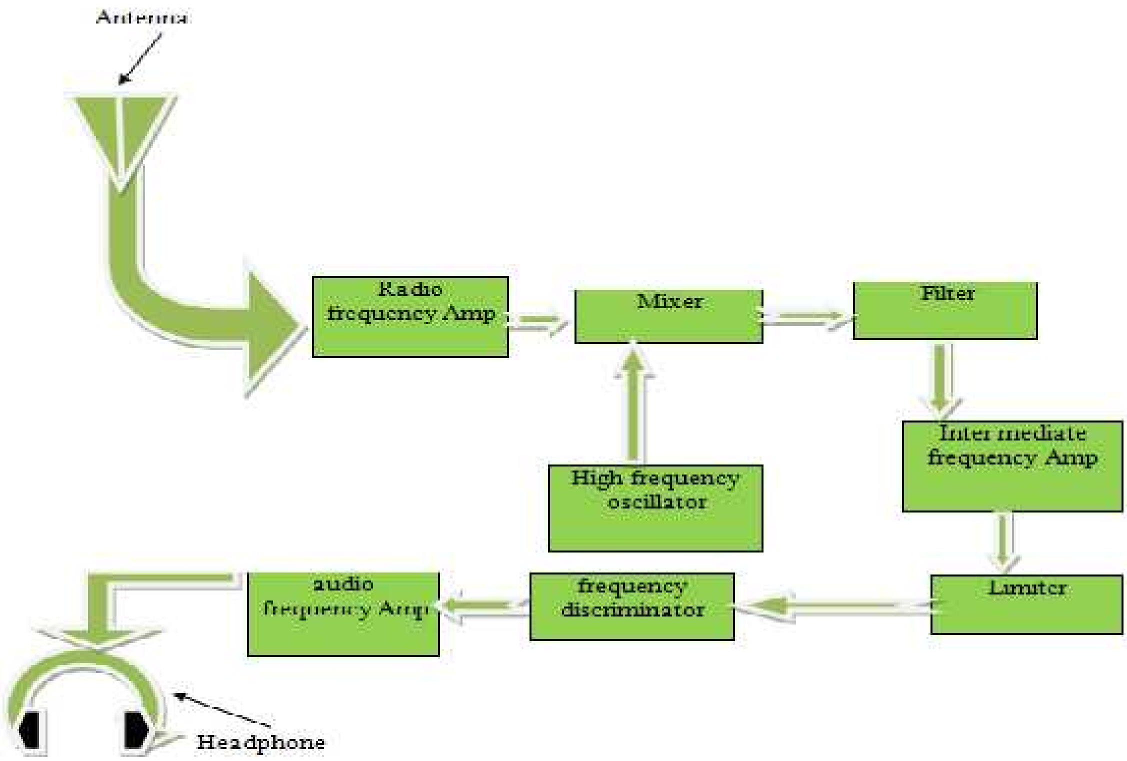


Fig 3.6.block diagram FM receiver

3.7.1 Mixer

A Mixer is a nonlinear circuit or device that accepts at its input two different frequencies and presents at its output a mixture of signals at several frequencies, the sum of the frequencies of the input signals.

The difference between the frequencies of the input signals both original input frequencies these are often considered parasitic and are filtered out. [6]

The manipulations of frequency performed by a mixer can be used to move signals between bands, or to encode and decode them. One other application of a mixer is a product detector :

Ideal mixer

(Multiplier)

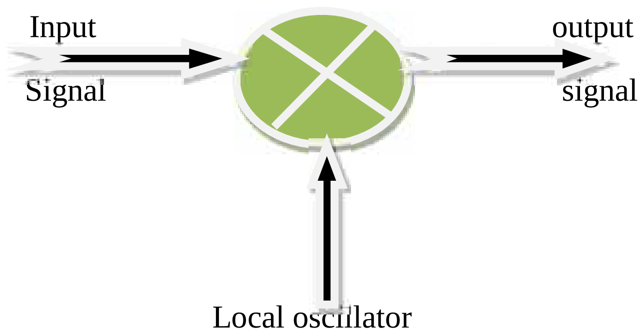


Fig 3.7 to mixer

3.7.2 Local Oscillator

A local oscillator is a device used to generate a signal which is beat against the signal of interest to be mixed to a different frequency .The oscillator produces a signal which is injected into the mixer along with the signal from the antenna in order to effectively change the antenna signal by heterodyning with it top

Produce the sum and difference (with the utilization of trigonometric angle sum and difference identities) of that signal one of which will be at the intermediate frequency which can be handled by the IF amplifier. These are the beat frequencies. Normally, the beat frequency is associated with the lower sideband, the difference between the two.[6]

3.7.3 Limiter

A limiter is a circuit that allows signals below a set value to pass unaffected, as in a Class A amplifier, and clips off the peaks of stronger signals that exceed this set value, as in Class C amplifier.Removes all traces of AM from the received signal, improves S2N ratio, removes static crashes [12]

3.7.4 Demodulator

A demodulator is an electronic circuit used to recover the information content from the carrier wave of a signal. The term is usually used in connection with radio receivers, but there are many kinds of demodulators used in many other systems. Another common one is in a modem, which is a contraction of the terms modulator/demodulator. [14]

3.7.5 Frequency Discriminator

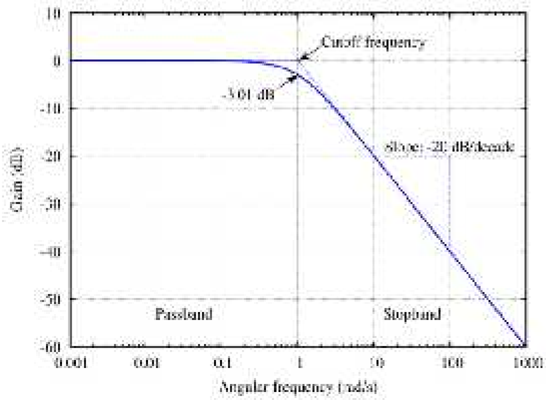
The frequency discriminator controls the varicap. A varicap is used to keep the intermediate frequency (IF) stable. Gives our a faithful reproduction of the original audioConverts frequency variations to voltage variation varicap diode, varactor diode or tuning diode is a type of diode which has a variable capacitance ,Capacitance is a measure of the amount of electric charge stored. [12]

3.7.6 Intermediate Frequency

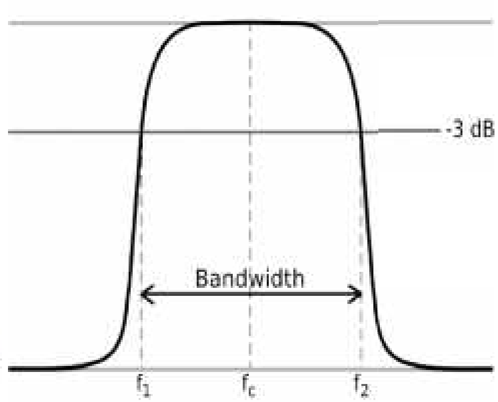
An intermediate frequency (IF) is a frequency to which a carrier frequency is shifted as an intermediate step in transmission or reception. It is the beat frequency between the signal and the local oscillator in a radio detection system. If is also the name of a stage in a super heterodyne receiver. It is where an incoming signal is amplified before final detection is done. There may be several such stages in a super heterodyne radio receiver. [12]

3.7.7 Filter

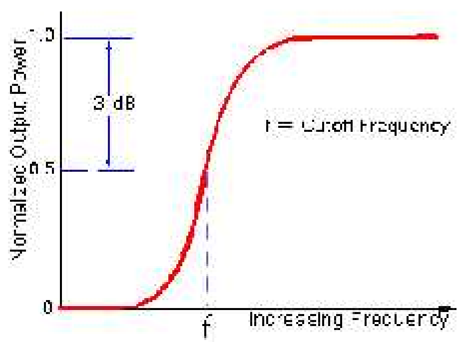
Electronic are electronic circuits which perform signal processing functions, specifically intended to remove unwanted signal components and/or enhance wanted ones. Low-pass filter - Low frequencies are passed, high frequencies are attenuated. High-pass filter - High frequencies are passed, Low frequencies are attenuated. Band-pass filters - Only frequencies in a frequency band are passed. Band-stop filter - Only frequencies in a frequency band are attenuated . [14]



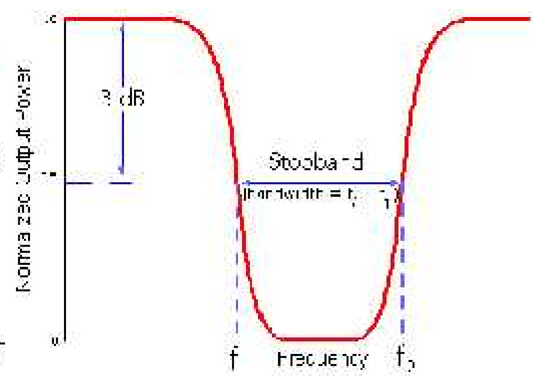
LOW PASS



BAND PASS



HIGH PASS



BAND STOP

Fig 3.8 filters

Chapter Four

Switch Design

Chapter contents:

4.1 Overview

This project devlops a headphone in which the user can hear TV audio, instead of hearing it from the TV speakers. The user will hear the audio in a personal mode. The audio will reach the headphone wirelessly. We need to control the headphone through an automatic switch.

To transmit the audio signal to the headphone, there are two design options .The first would be the development of a complete wireless transceiver. This will include building of either AM or FM radios at the electronic components level.

The second option would be would be the usage of one of the available wireless communication technologies, such as Zigbee or WiFi programmable transceivers.

We intend to develop a complete wireless transceiver.

4.2 Introduction

Through our studying and researching in the previous semester, we were able to make a complete image about the system which will be built.

Firstly, we specify the technique which will be used for the transmission and reception which was the RF technique. We faced some problems that prevent our project to be accomplished, so we study other techniques. After study we found that we should use the Zigbee technique which could allow us to control the switch in a better mode and give us more flexibility to control the system by programming the Xbee for controlling the sound and other options like changing the channel, turn on/off the receiver and raises /reduces the sound after the programming .

4.3 Why we use the Zigbee technique?

Zigbee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. The technology is intended to be simpler and

less expensive than other WPANs such as Bluetooth. Zigbee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory.
Zigbee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. Data transmission rates vary from 20 to 250 kilobits/second.

Because Zigbee nodes can go from sleep to active mode in 30 ms or less, the latency can be low and devices can be responsive, particularly compared to Bluetooth wake-up delays, which are typically around three seconds.
Because Zigbee nodes can sleep most of the time, average power consumption can be low, resulting in long battery life.

Key Features Long XBee

- Indoor/Urban: up to 100’ (30 m).
- Outdoor line-of-sight: up to 300’ (100 m).
- Transmit Power: 1 mW (0 dBm).
- Receiver Sensitivity: -92 dBmXBee-PRO.
- Data Rate: 250,000 bps.

Low Power XBee

- TX Current: 45 mA (@3.3 V).
- RX Current: 50 mA (@3.3 V).
- Power-down Current: < 10 µAXBee.

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An important advantage for the Zigbee technique is that it uses the DSSS which is used to overcome the jamming problem so we can say it is a highly Secure .

An additional advantage of the Zigbee is that it's easy to used. This is because it has no complicated configuration and it has a free software called X-CTU used for identify some parameters like baud rate and PAN-ID.

System design

The project has two main circuits. The first one is takes the sound from the satellite receiver and transmitted it over air by FM. Second circuit is demodulated sound from air and amplifies it and sends it to the speaker or headphone. So we can receive the sound in a good quality.

In this system, we used a lot of electronic and electrical components like diodes,
Led's cables . . . .
First, we start with the Zigbee chip. The X-CTU has been used to program the chip. The Zigbee chip was connected to MAX232. Using X-CTU, it is possible to specify important parameters for the operation of Zigbee chip. Such parameter include baud rate which was set to 3600 bps and PAN-ID (1989). The PIC has been programmed using C programming language.

some tests on Zigbee and PIC by the PC to be sure that the system will work probably before connection.

The schematic diagram of the sender side circuit is shown figure 4.1. This will be fixed near the TV set.

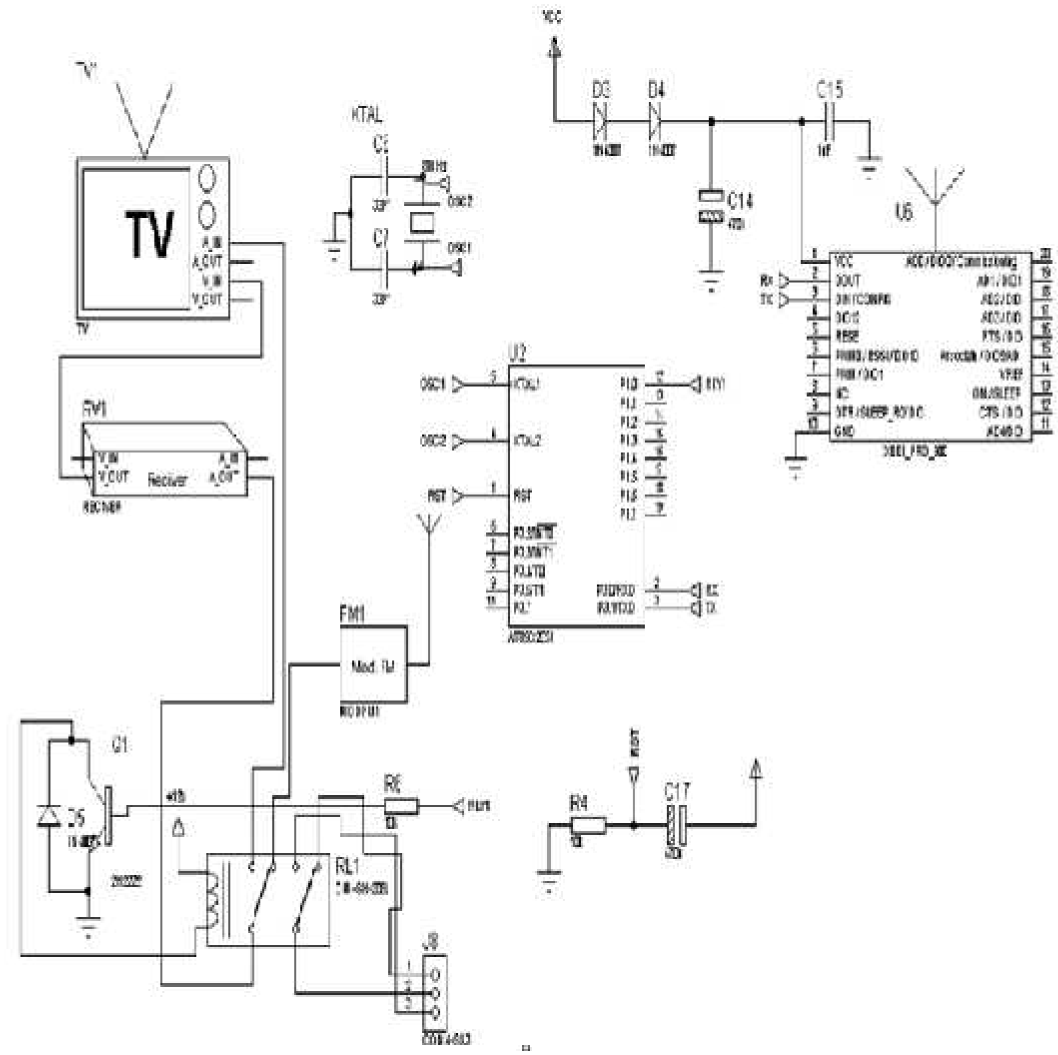

Fig. 4.1 (schematic diagram of the sender)

Figure 4.2 shows the schematic design of the headset circuit.

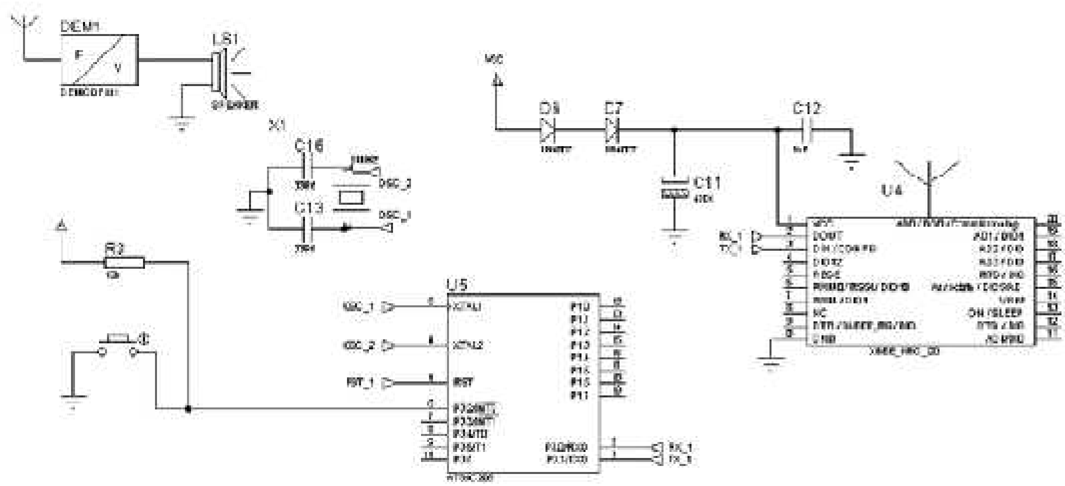

Fig.4.2(schematic design of the headset)

System components:

In this project we used the following components:

1. PIC (18f252)U2
2. Relays(R1,2,3,4,5).
3. Transistors(Q1)
4. Resistances(R)
5. LEDs
6. Diodes(D5)
7. Cables
8. FM transmitter(FM1)
9. FM receiver(DM1)
10. Batteries(vcc)
11. Regulator
12. Crystal(XTAL)

We will explain each component in details:

PIC (18f252) U: an IC use for encoding / decoding on the transmitter / receiver, it's also used as an interface between switches and Zigbee on the transmitter side, an interface between the relays and Zigbee on the receiver side ,it has 28 pins, it works on voltage between (2-5.5)V and on temperature between (-40-125)C.

Fig.4.3(PIC (18f252)U2**)**

Relays:

Is an electrical component consists of mechanical key can be controlled by applying voltage to the existing coil inside it. It contains eight pins some of them connected to the coil and the others connected to the device which will be activated so when supplying a voltage to the coil a magnetic filed will be generated that cause the rely to be normally closed.

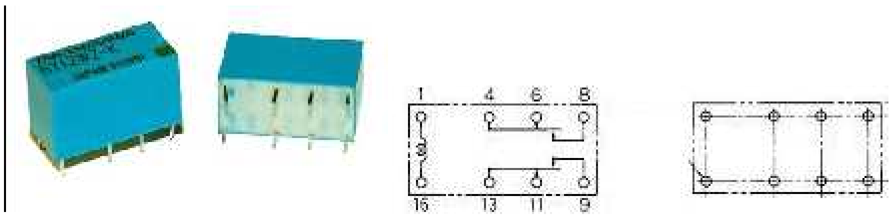

Fig.4.4(Relays(R1,2,3,4,5)**)**

Transistors:

We used the transistors to connect between the PIC and relay. The PIC works in 5v and the relay works in 12v. So, we can't used the relay without using a transistor which amplifies the 5v.

Fig.4.5(Transistors(Q1)**)**

Resistances

It's used for protection from the high current for the transistors, diodes and leds.

Fig.4.6(Resistance)

LEDs

Optional component used as signal indicator.

Fig.4.7(LED)

Diodes

Used for discharging the power which comeback from the relay when the signal separated from the transistor

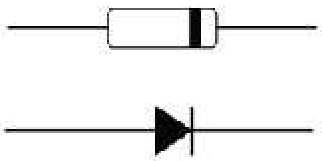

Fig.4.8(Diod,D5)

Cable

We used the coaxial cable to carry the voice signal from the satellite receiver to the TV. We connect the relay to control the voice signal to go ether to the TV or to the FM transmitter

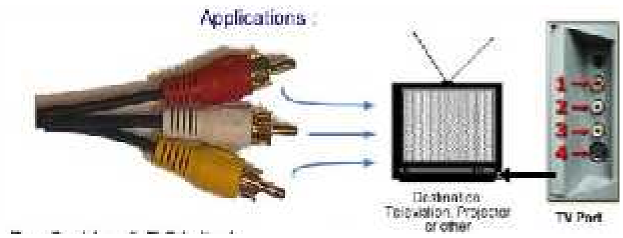

Fig.4.9(Cable)

FM transmitter

It was explained with details in chapter 3 with its principles of operation it was used to carry voce signal to the FM receiver using radio frequency.

FM receiver

It’s used to received the voice signal and pass it to the headset.

Batteries

For running the circuit and the components. We need an electrical potential coming from this battery and the headset receiver circuit was supplied with 3.6v battery for active.

Regulator

It was used to reduce the voltage to 5v because the PIC only works at 5v.

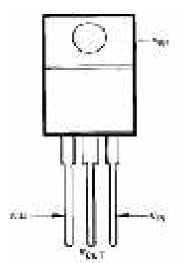

Fig.4.10(Regulator)

Crystal

It provides the PIC with the clock pulse to let the PIC performs one million instructions per second. Its frequency is 4 MHz.

Fig.4.11(Crystal)

Connections:

After programming Zigbee, and the PIC we connected them as shown in figure 4.12:

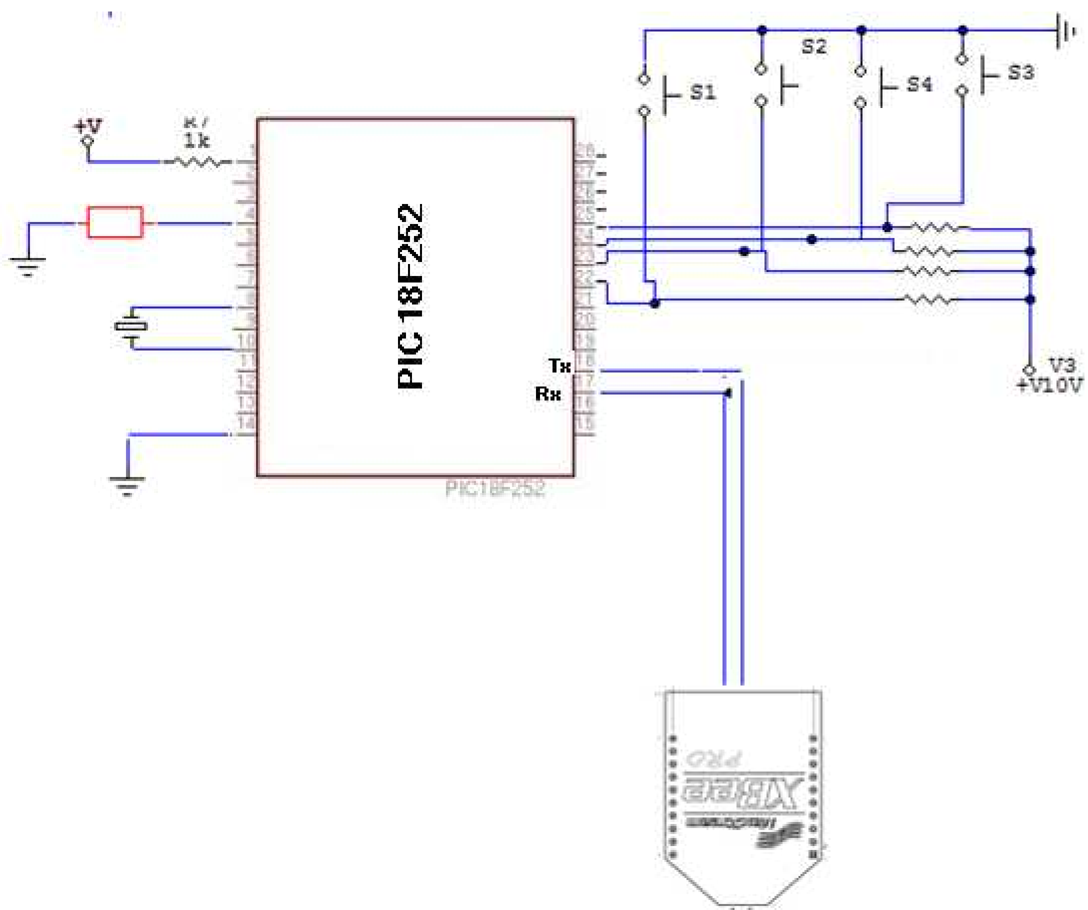

Fig.4.12(connecting switch with PIC)

As it can be seen the PIC will be activated by 5V,the Vcc which is come from the regulator was connected the PIC. Also there was a crystal with 4MHz frequency connected to it. Is the output of the PIC you can see pins (b0-b3) connected with Vcc and then to switches ,C7 is connected to Dout on the Zigbee ,this means c7 received from

Dout and C6 connected to Din, and then transmit to the Zigbee. No we detail the receiving circuit.

The circuit is used to separate the sound from the and transmit it over air by the FM transmitter. Besides we will switch off/on the satellite receiver and change between channels.

Between the PIC and the relays there is transistor, resistors and leds , for controlling the options we used five relays as the following :

1) Two relays to control the sound either to complete its path to the speaker or passed it to the FM transmitter.
2) Two relays for changing the channel
3) One relay for turn on/off the satellite receiver.

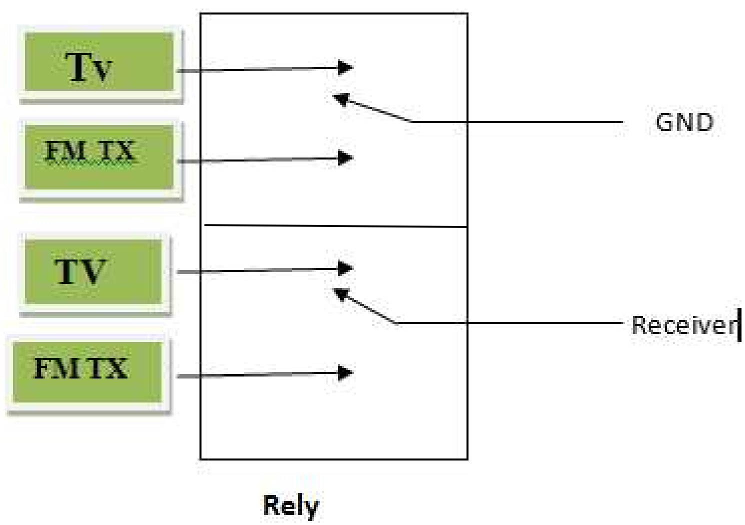

Fig 4.13(Relay principle)

Work Principle

At the beginning, the satellite receiver carries the voice signal through the coaxial cable, and then to the relay. This relay either be normally open (let the signal complete its path to the TV headphones)or be normally close (move the signal to the FM transmitter). The FM transmitter to be activated it waits for a command from the Zigbee on the headset to the Zigbee on receiver side , so the signal will pass to FM transmitter by activating the relay using the switch. After that, the sound signal reach the FM receiver. We can select additional commands from the Zigbee at the headset like changing the channel turn of f the satellite receiver.

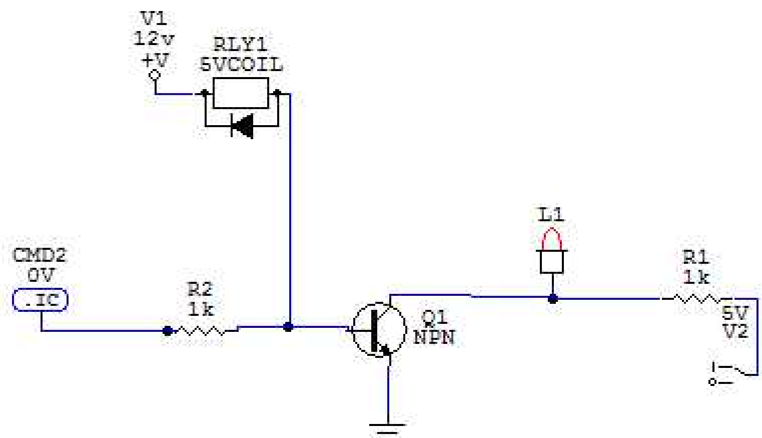

Fig.4.14

Chapter Five

Implementation and testing

***Chapter contents**:*

5.1 Introduction.

5.2 Testing scheduling.

5.3 Testing procedure.

5.4 Challenges.

5.5 Comparison.

5.1 Introduction

This chapter covers the testing of the PIC 18f252 and the Zigbee. The PIC was used as an interface between the relays and Zigbee at the transmitter side. And interface between the Zigbee and switches at the headset side. The Zigbee was used to send and receive data by the user command. The chapter will also talk about the comparison with other systems through:

- Cost.
- Sound quality.
- Failure Rate.

5.2 Testing Scheduling

Week No. / **Testing Process**	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Unit Testing																
Sub-System Testing																
System Testing																
Acceptance Testing																

Table 5.1 Testing Scheduling

5.3 Testing Procedure

5.3.1 Unit Testing

To test the system, each unit must be tested, so each task of the project would be tested individually. The Zigbee, PIC microcontroller and Switches was tested independently. Additionally, the connecting cables and all the pins were tested. The software codes also were tested by using C program language. All parts have been found to work properly as planned.

5.3.2 Sub-System Testing

The main target of testing parts is to test the main operations of each sub systems and to ensure it is working properly. There are three operations in the system. The first one is interfacing the Zigbee with PIC microcontroller and exchanging data between them. The second operation is sending data from the Zigbee at transmitter side to the Zigbee at the receiver side. The last one is interfacing between the Zigbee with the switches on headset.

1. **First operation test**

   The first operation is interfacing the Zigbee with PIC microcontroller; we make this test by three steps as follows:

   A. The first step: connect one side of max232 to the transmitter and receiver of the PIC microcontroller pins (pin 19 is Rx and pin is 18 Tx) and the other side to the com port of the PC**.**

   B. The second step: connect the Zigbee to PC using USB Port.

   C. The third step: open C program on each PC, the speed of Baud Rate were selected to3600 bps.

Firstly, we connect the coaxial cable of the transmitter to a mobile plug for checking if the sound signal can be carried by the FM transmitter to the FM receiver and then to the headphone. We play a song from a mobile and we press the switch which is responsible for carrying the sound signal to the FM transmitter which was tuned on (92.3 MHz) at the same time we operate on the fm receiver and we also tuned it on (92.3 MHz). After that, the sound signal reached the headphone, so the test was completely succeeded.

5.3.4 Acceptance testing

In this section, the system will be tested to see if it meets the requirements were the system was built for, and at this point the system did meet the needed tasks in the system.

5.3.5 White Box Testing

	Unit	Function	Expected Result	Actual Result	Verification
1	Zigbee	Used for sending and receiving data	Receive and send data	It received and sent data	pass
2	PIC(18f252)	Interfacing and controlling	Interface between relays and Zigbee ,interfacing between Zigbee and switches	It interfaced between the relays and Zigbee and between Zigbee and switches	pass
3	Relays	Control the sound to be on TV speaker or on headphone	When the relay is N.O the sound appears on the TV speakers and when it is N.C the sound appears on headphones	When the relay was N.O the sound appears on the TV speakers and when it was N.C the sound appeared on headphones	pass
4	FM transmitter	Sends the sound by using FM modulation	Sending the sound after the switch was pressed	It sent the sound by FM Modulation	Pass

5	FM receiver	Receives the sound from air	It receives the sound after it is sent from FM transmitter	It received the sound after it was sent from FM transmitter	Pass
6	Regulator	It reduces the voltage	It reduces the voltage to 5 v	It reduced the voltage to 5 v	Pass
7	Crystal	Clock pulse	It gives the PIC the needed clock pulse	It gave the PIC the needed clock pulse	Pass

Table 5.2 White Box Testing

5.4 Challenges:

- The unavailability of the system components in west bank.
- The components became inoperative as a result of the wrong connection of some wires
- The difficulty of programming the PIC.

5.5 Comparison:

If we make a comparison between the developed system and what we have in the market, we can fined that all devices work on IR or RF technologies whose range is limited and the in price is high (at least 200$). But, the device system works on both RF and the new technology Zigbee. But, the proposed system only costs(80$).The user of the headphone can operate the system using buttons which are connected to the receiver. Moreover, we made a revolution to control the satellite receiver by using this buttons so the user can turn off the satellite receiver and change from channel to another from a range nearly (100-180) m. So, we developed a complete and comprehensive system that controls the satellite receiver in a cheap price which can be offered to every person. On the other hand our evaluation has shown that the system operation was successful in a number of 17 from 20 trails. Additionally, the test result by different people have been rated as acceptable operation as well as quality.

5.5.1 sound quality

When the sound signal is sent into air by FM transmitter unwanted signal will be added to the original signal and consequently, the received signal at the FM receiver will not be the original signal so the sound quality will be bad, but in this system a quadtrture detector is used as a FM demodulator by using this demodulator is used is integrated circuit, the direct FM signal and the same signal shifted of 90 degree are multiplied between them and the resulting signal is proportional to the frequency deviation of the input FM signal, so the sound will be received in a good quality without any unwanted signal that is added during transmission.

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