ANALYSIS AND INVESTIGATION OF IMAGE TRANSMISSION VIA RADIO FREQUENCY

(VHF BAND)

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ELECTRICAL & ELECTRONICS ENGINEERING

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by

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15909

Dissertation submitted in partial fulfilment of
the requirement for the
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CERTIFICATION OF APPROVAL

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UNIVERSITI TEKNOLOGI PETRONAS
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JANUARY 2016

CERTIFICATION OF ORIGINALTY

This is to certify that I am responsible for the work submitted in this project, that the original work is own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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(KISHEN RAJ A/L RAJU)

ABSTRACT

In the present day an assortment of correspondence mediums are enhancing of innovation and make the life more less demanding. The enormous change of innovation has definitely given a positive effect to the innovation of correspondence. Moreover, in this cutting edge world information transferring turn out to be extremely urgent for all of as we all need to be quick and productive. In this way, to fulfil these necessities, Radio Frequency (RF) correspondence can be an essential option venture to overcome correspondence issues.

Consequently this undertaking is centredon planning low speed computerized transceiver circuit trough RF, client can send the information, picture and realistic to distinctive client that has same gear in another station contingent upon the handset. In addition, it is likewise conceivable to utilize handy talkie in transmitting voice date.

As a conclusion, we can guard this venture will be exceptionally valuable in using Radio Frequency as a superior correspondence medium for present and future days. Other than that, radio recurrence will be proficient correspondence with regards to absence of correspondence sign, similar to no Internet association, no Bluetooth range, no scope for cellular telephone or when going in the mountain and woodland where there are spots that have line coverage.

The fundamental reason is RF correspondence is not relies on upon nearby receiving wire whereby it relies on upon handy talkie reception apparatus. At last, RF correspondence will be exceptionally valuable in crisis time, for example, regular catastrophes. It will ceaselessly give us a medium for correspondence in spite of the fact that the line scope is down.

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Last but not least, to my parents and brothers who have been contribute for this project directly and indirectly, thank you so much and all your effort shall not to be forgotten. Thank you.

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Abby	Definitions
ADC	Analogue to Digital Converter
AM	Amplitude Modulation
DAC	Digital to Analogue Converter
FM	Frequency Modulation
HF	High Frequencies
QPSK	Quadrature Phase Shift Keying
PSNR	Peak Signal to Noise Ratio
PSK	Phase Shift Keying
RF	Radio Frequencies
SDR	Software Define Radio
SIMO	Single Input Multiple Outputs
SNR	Signal to Noise Ratio
SPHIT	Set Partitioning in Hierarchical Trees
SSTV	Slow Scan Television
UHF	Ultrahigh Frequency
VHF	Very High Frequency
LF	Low Frequency

CHAPTER 1

INTRODUCTION

This project is related to wireless communication through radio frequency. It is digital type of data transmission used to link thecomputers [17]. This project consists of designing an effective wireless data communication using radio frequency as a transmission medium.

The concept of this project is similar to communication via telephone method and it is using computer telecommunications using VHF (Very High Frequency) frequency band. The soundcard will replace the telephone modem, while the transceiver (hand held) will replace the telephone. The microwaves transmission will replace the wired telephone line (144 MHz-148 MHz). Basically, data s send by the computer and it is transmitting to another radio station by a different radio similarly equipped. The image can be transmit and receive by many receiver using the concept of SIMO (Single Input Multiple Outputs) .The illustration of SIMO is shown in the FIGURE 1.1.

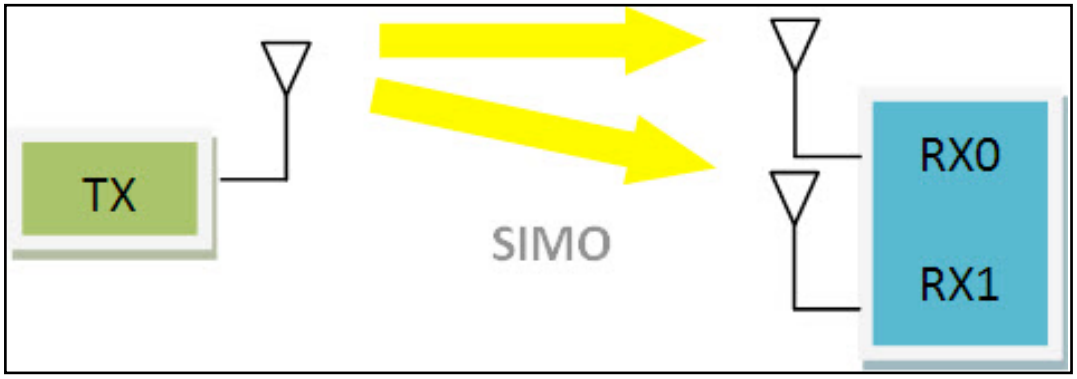


FIGURE1.1.The Transmission Mode of SIMO (single input multiple output)

1.1 Project Background

The speed improvement of technology has tremendously changed the technology of communication system. To meet the requirements of the present day technology needs, data transfers rate at higher speeds are very much needed in this current new era. People keep moving fast with these technologies to carry out their daily activities. Basically, people using various type of communication medium such as Bluetooth wireless, internet connection, email and many more to communicate, share information and transfer data as well, but there is limitation or communication barriers to those type of communications. For example, distance range to transfer data, connection loss, heavy battery drain and etc. Moreover, most importantly there will be connection loss especially during disaster/emergency time. A good quality wireless communication medium with sufficient distance coverage is very much needed in this situation. This problem can be achieved or solved by Radio Frequency (RF) communication. The main advantage of Radio Frequency(RF) communication is helpful in providingemergency/alert communication when everything else shutdown using VHF or UHF frequency band.

1.2 Problem Statement

The main purpose of this project is to provide a communication medium during emergency/disaster time and provides a communication link in rural area where very weak of communication signal can be received. This wireless communication during emergency time is very crucial and important to save people life. This problem can be solved by developing a long range and stable wireless transmission via VHF frequency band.Furthermore,by integrating a PSK (Phase Shift Keying Modulator) interface and circuit design for transceiver in VHF band, this project able to extend the range of the wireless communication. This project have an advantage of not depends on existing Telco communication services, and it able to provide a telecommunication channel all the time.

1.3 Objectives

The objectives of this project are to develop the wireless image transmissions using Radio Frequency (RF) technology with the following criteria:

1. To design, develop and analysis PSK modulator circuit
2. To transmit image data by interfacing to VHF transceiver circuit using a wireless communication medium through Radio Frequency (RF).
3. To fabricate and testing the wireless communication in emergency/disaster time using VHF transmission.

CHAPTER 2

LITERATURE REVIEW & THEORETICAL BACKGROUND

2.1 Literature Review

Radio Frequency (RF) has gotten to be one of the best correspondence medium these days. RF and remote have been around since long time back in participation with Sir Oliver and Popov Alexander Lodge had led the examination and work for Guglielmo Marconi's remote radio improvements in the mid twentieth century. In December 1901, Marconi performed his best investigation, where he at long last transmitted Morse code.

RF itself has been exceptionally acquainted with high-recurrence signals and remote. Essentially, it depicting anything related from Amplitude Modulation (AM) radio. The frequency extent used between 535 kHz and 1605 kHz to PC (LANs) is at 2.4 GHz. The RF module, as the name proposes, works at Radio Frequency. The comparing frequency range fluctuates between 30 kHz and 300 GHz. In this RF framework, the computerized information is spoken to as varieties in the abundances of bearer wave. This sort of regulation is known as Amplitude Shift Keying (ASK).

Transmission through RF is more superior to IR (infrared) in light of numerous reasons. Firstly, transmissions through RF can go through bigger separations making it more applicable for long range applications [14]. Likewise, while IR generally works in observable pathway mode, RF signs can travel notwithstanding when there is a check between transmitter and recipient. Next, RF

transmission is more solid and dependable than IR transmission. RF correspondence utilizes a particular recurrence not at all like IR signs which are influenced by other IR transmitting sources.

This RF module involves a RF Transmitter and a RF Receiver. The transmitter/beneficiary (Tx/Rx) pair works at a frequency of 434 MHzA RF transmitter receives information and transmits it remotely through RF waves. The transmission takes place at the rate of 1Kbps - 10Kbps. The transmitted information is gotten by a RF recipient working at the same recurrence as that of the transmitter.The RF module is frequently utilized alongwith a couple of encoder/decoder. The encoder is utilized for encoding parallel information for transmission while is decoding the information back is done by a decoder. HT12E-HT12D, HT640-HT648, and so forth are some regularly utilized encoder/decoder pair ICs.

Moreover, the Radio Frequency characterized the recurrence range from a couple kHz to roughly 1 GHz. In the event that consider microwave frequencies as Radio Frequency, this reach stretches out up to 300 GHz. The TABLE 1.0 underneath demonstrates the distinctive sort of band and its recurrence run together with the wavelength [1].

TABLE2.1. Different frequency band

Band	Frequency range	Wavelength range
Extremely low frequency (ELF)	< 3 kHz	>100 km
Very low frequency (VLF)	3 - 30 Hz	10 - 100 krn
Low frequency(LF)	30 - 300 kHz	1 - 10 km
Medium frequency (MF)	300 kHz - 3 MHz	100m - 1km
High frequency (HF)	3 - 30 MHz	10 - 100m
Very high frequency (VHF)	30 - 300 MHz	1 - 10m
Ultra high frequency (UHF)	300 MHz - 3 GHz	10cm - 1m
Super high frequency (SHF)	3 - 30 GHz	1 - 10cm
Extremely high frequency (EHF)	30 - 300 GHz	1mm - 1cm

Vector examination, unearthly investigation and system examination are the three noteworthy classifications of estimation approach for radio recurrence. Among the decisions, range examination is the most prevalent sort of Radio Frequency instrument. This is on the grounds that it gives essential estimation capacities and can be use in numerous broadly useful. For instance, the data of force versus recurrence can be seen, and can once in a while demodulate simple arrangements, for example, stage adjustment (PM), modulation (AM), and recurrence tweak (FM) utilizing range analyzer.

Make and transmit electromagnetic waves at a source and having the capacity to get those electromagnetic waves at a particular destination is the working rule of Radio recurrence correspondence. The air turns into the travel medium for the electromagnetic waves. Besides, these electromagnetic waves travel almost the rate of light [2]. The thought is wavelength of an electromagnetic sign is contrarily corresponding to the recurrence. Subsequently, as the recurrence is higher, the length of sign wavelength gets to be shorter [3].

Collector and transmitter are utilized for the spread and capture of radio waves. A radio wave assumes a part as a bearer of data flags; the data may be encoded specifically on the wave by occasionally interfering with its transmission (as in dab and-dash telegraphy) or urged it by a procedure called modulation [6]. The

real data in an adjusted sign is put away in its sidebands. Frequencies will be added to the transporter wave, as opposed to in the bearer wave itself. Various adjustment (AM) and recurrence balance (FM) are the most well-known sorts of balance utilized as a part of radio.

In the transmission framework advanced radio, the signs proliferate as discrete voltage beats, that is, as examples of numbers. To be more exact, before transmission, a simple sound sign is changed over into an advanced sign. At that point the sign may be transmitted in the AM or FM recurrence range. An advanced radio telecast offers reduced plate quality gathering and multiplication on the FM band and FM-quality gathering and generation on the AM band. For the most part, radio is utilized for the transmission of sounds (music and voice) and pictures (TV).

Mouthpiece (sounds) or camcorder (pictures) will change over the pictures and sounds into electrical signs by a receiver (sounds) or camcorder (pictures). At that point, the signs will be opened up, and used to tweak a transporter wave that has been produced by an oscillator circuit in a transmitter. The balanced bearer is likewise opened up, and then connected to a receiving wire.

Superhererodyne is the most productive and most basic circuit for radio-recurrence choice and intensification utilized as a part of radio collectors is the superheterodyne[6]. In that framework, signal from a nearby oscillator will blend with approaching signs to create moderate frequencies (IF). This is equivalent to the arithmetical distinction and total of the nearby frequencies. One of those frequencies is connected to an intensifier. The IF enhancer can be constructed for ideal selectivity and pick up as it just works at a solitary recurrence, named the transitional recurrence. Nearby oscillator recurrence is balanced by the tuning control on a radio recipient. In the event that the approaching signs are over the limit of affectability of the recipient and if the collector is the approaching signs are tuned to the recurrence of the sign it over the edge of affectability of the beneficiary. At that point, it will open up the sign and sustain it to circuits that demodulate it, i.e., separate the bearer wave from sign wave itself.

There are a few contrasts in the middle of AM and FM beneficiaries. In an AM transmission the transporter wave is changes in various (quality) and steady in recurrence as indicated by the sounds present at the mouthpiece. Besides, in FM the bearer will shifts in recurrence and consistent in sufficiency. As the wideband FM beneficiaries are inalienably less delicate to clamour in light of the fact that the commotion that influences radio signs is halfway however not totally, showed in various varieties. The limiter and discriminator stages are circuits that react exclusively to changes in recurrence in the FM collector. Other than that, alternate phases of the FM recipient are like those of the AM collector yet require more consideration in get together and outline to make full utilization of FM's points of interest. FM is additionally used in TV sound frameworks. In both TV and radio collectors, the procedure of changing over into sound and visual picture will happen once the fundamental signs have been isolated from the bearer wave they are nourished to an amplifier or a presentation gadget

The data transferringby radio can be displayed in its most straightforward structure with square - chart as on. That is a transmission acknowledged by adequacy - tweaked signal. In addition, it is being refined by an amplifier. The low - recurrence (LF) voltage at amplifier yield that speaks to the electrical “picture” of the sound being exchanged is being taken into the transmitter.

Other than that, the method called adequacy tweak is being completed, and on its yield high - recurrence (HF) voltage is produced, under the impact of LF sign. Though, its adequacy fluctuates as indicated by the present estimation of LF sign. The producing of electromagnetic field occurs when HF voltage makes HF current in the radio wire. This field spreads through the surrounding space, being typically appeared on with dashed circles and it going at the velocity of light (c=300 000 km/s). In the recipient, the intensification and discovery are completed in the first place; coming about with the LF voltage on its yield, this voltage is then changed into sound by amplifier, that sound being precisely the same as the sound that followed up on the receiver.

Back to reality, because of the impact of different unsettling influences and in addition gadget defect and breakdown, the sound follows up on the receiver layer will be contrasts from sound being produced by the amplifier. The diagram on FIGURE 2 (barring the HF signal shape) is likewise relevant on the off chance that recurrence adjustment completed the radio transmission. All things considered, in the transmitter the recurrence regulation is being done, under the impact of LF sign originating from the amplifier. In this manner HF signals on FIGURE 3 and 4 having constantand consistent adequacy, and their recurrence being change as per the genuine estimation of LF sign from the receiver.

To begin with, through the suitable converter the data being sent is constantly changed into electrical sign. In telegraphy this converter is the pushbutton, in radio phony it's a mouthpiece, while in TV building a picture examination cathode beam tube (CRT) and so forth. At that point, the regulation is being finished with this "electrical picture" of data. The adjusted HF sign is being moved into reception apparatus and transmitted. Once the sign came to gathering put, the tweaked signal from the gathering receiving wire is being enhanced and again with the suitable converter (pen recorder, amplifier, TV CRT and so forth.), the data is changed once more into its unique structure.

Be that as it may, the Radio Frequency characterized the recurrence range from a couple kHz to around 1 GHz. In the event that consider microwave frequencies as Radio Frequency, this extent reaches out up to 300 GHz. The TABLE 1.0 beneath demonstrates the distinctive kind of band and its recurrence go together with the wavelength [1].

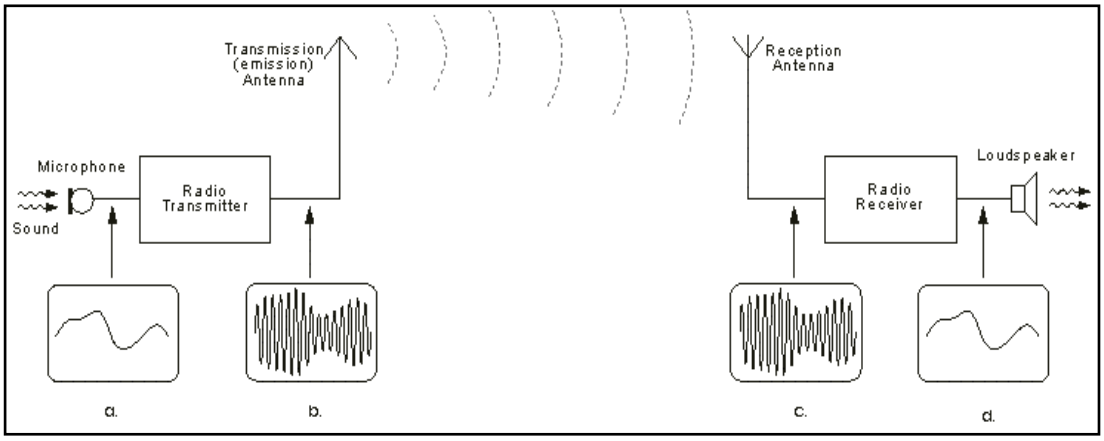


FIGURE 2.1. Radio transmission block –diagram

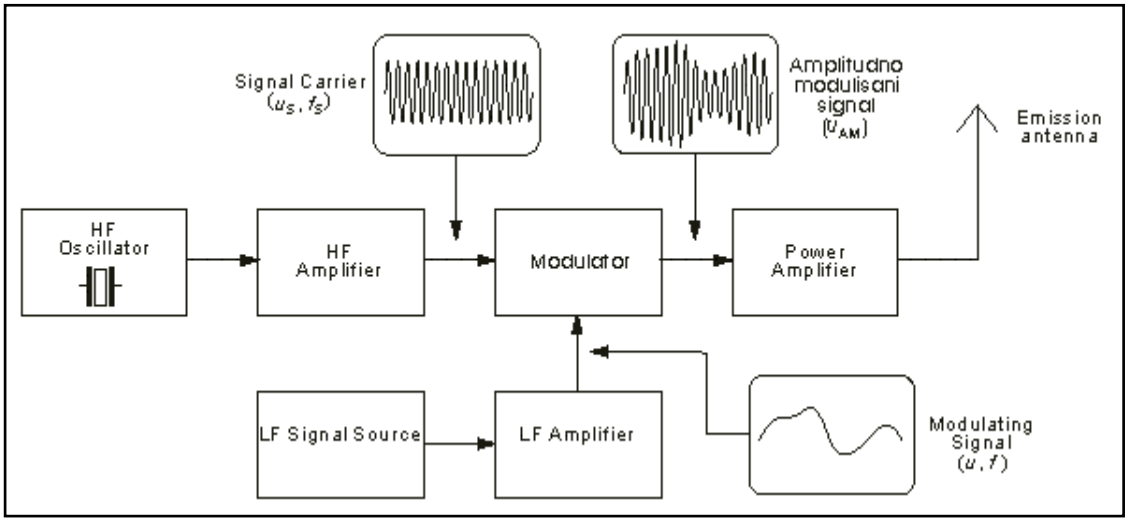


FIGURE 2.2. AM transmitter block-diagram

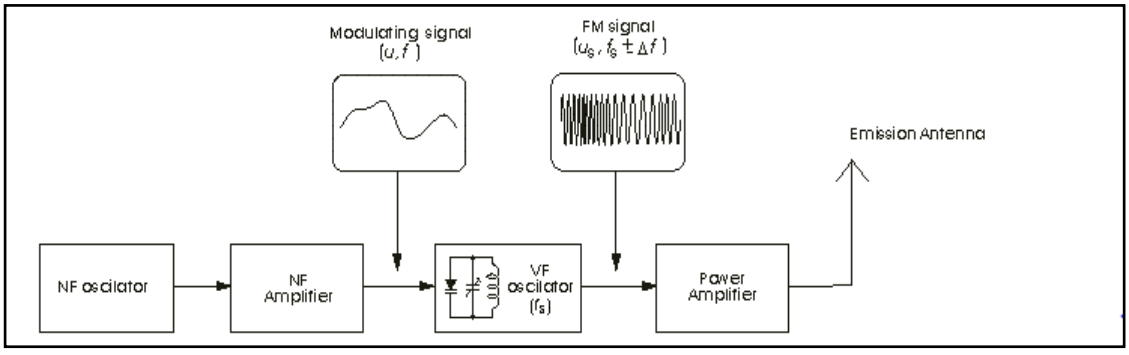


FIGURE2.3. FM transmitter block-diagram

2.2 Theoretical Background

2.2.1Overview of the Proposed Design and Implementation

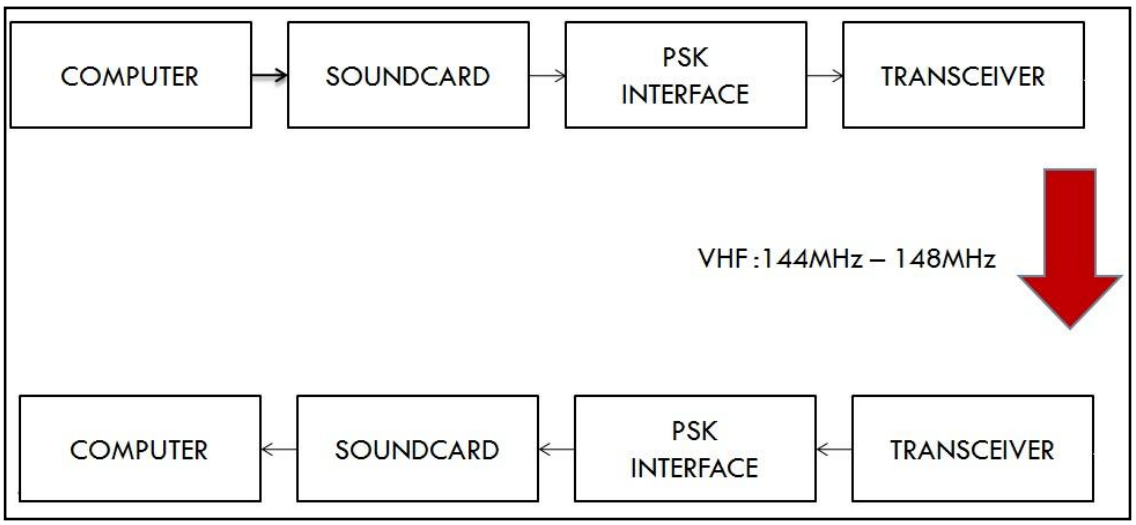


FIGURE2.4. Project block diagram

Above all else, this task comprises of a PC as the primary I0 fringe, a soundcard, which utilized as a modem, a PSK interface or PTT interface circuit furthermore a handset with a reception apparatus. The principle capacity of inherent soundcard in the PC or a portable PC is to prepare all the information into a coded signal for transmission and through the terminal. Also, client can show the records or things they need to send, for example, realistic pictures, message documents or organizers.

To be more exact, the soundcard as the modem assumes an earlier part in this task, will balanced the computerized signals from the terminal(computer) to anolog signals. For (PC) these ports are called COM or serial ports. Furthermore, the PTT OR PSK interface circuit was utilized as an interface between the handset and the terminal. The information of the sound card is straightforwardly associated with the yield of collector through the PTT interface. The PC or the terminal will show the information when client chooses or sorts the picture or graphics to be sent. At that point radio wave (RF) will be the travel medium for the information to be sent

naturally through the circuit from the handset to another station through radio wave (RF).

2.2.2 Phase-shift keying (PSK)

Phase shift keying, PSK, is usually utilized these days inside a large portion of radio correspondences frameworks. They, stage shift scratching gives preferred execution over Frequency Shift Keying, FSK in empowering information to be carried on a radio interchanges signal in a more effective way and some different types of regulation[19].

There are numerous types of correspondences exchanging to advanced configurations from simple organizations. Moreover, information correspondences are becoming quickly and significantly, alongside it the different sort of balance that can be use for information conveying. In as straightforward, PSK can be clarified as the component of stage movement scratching (PSK) is it as advanced regulation plan that change information by balancing, changing the period of reference sign (transporter wave) [2].

There are a few sorts of stage movement keying, PSK that are helpful for different reason. To settle on the right decision, it is necessary to have a decent learning and essential comprehension of how PSK functions.

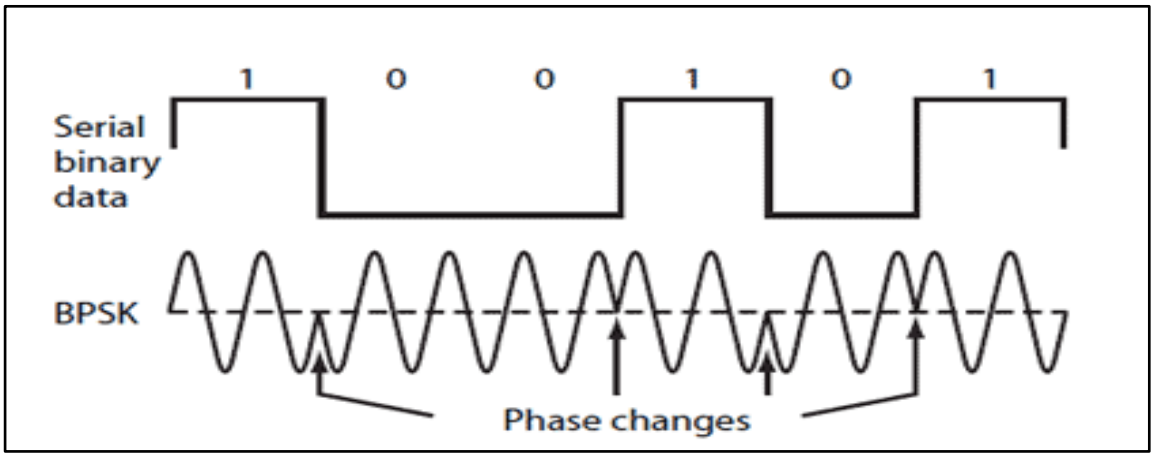


FIGURE2.5. PSK shift modulation

2.2.3 Soundcard

A sound card assumes a key part in this task. On the other hand, the sound card also can be called as sound board in the pc framework. It is an interior PC extension card that encourages the info and yield of sound signs to and from a PC. A sound card goes about as IC or development card for delivering sound on a PC that can be heard through earphone or speakers. Other than that, the term sound card is additionally relevant to outer sound interfaces that utilization programming to create sound, instead of utilizing equipment inside the PC. Illustration of soundcard shows in FIGURE 7 underneath. Moderately, we can finish up soundcard is imperative in the pc and in addition to the venture. The normal employments of soundcards incorporate giving the sound part to mixed media applications, for example, music organization, altering sound or video, instructive programming, business presentations, record correspondences, voice acknowledgment, excitement (amusements) and video projection.

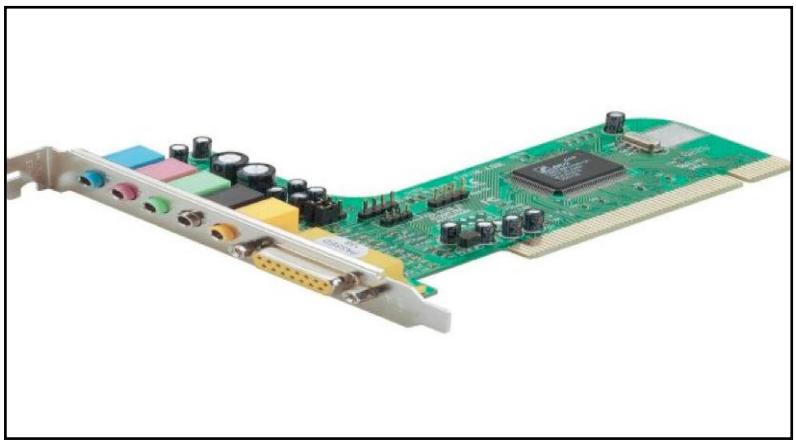


FIGURE 2.6. Example of a soundcard that used in CPU

2.2.4 Transceiver communication

A handie talkie is a gadget that incorporates of both recipient and a transmitter. The handset fills in as a transmitter of the information furthermore portrayed as a recipient of the information. The beneficiary and transmitter consolidated and had the same hardware in a solitary lodging.

Moreover, for the radio interchanges, the radios in handie talkie contain all the fundamental gear with another station. An average radio utilized as a station which coordinates a walkie talkie with a hitter and a reception apparatus in one bundle. The type of handheld utilized as a part of this project is shown in FIGURE 8. The handie talkie are prepared to do just FM voice correspondences transmissions and extraordinarily intended for operation on the VHF novice radio groups. They have constrained transmitter power, normally underneath 1W, to preserve battery power utilization furthermore to cover a nearby scope of regularly a couple of miles. TABLE 2 underneath is the band of recurrence extent and it appears there the VHF (high recurrence) scope of the radio range is the band stretching out from 30MHz to 300MHz. In addition, for the portable two way radio correspondence, the most famous band is VHF band. This is on the grounds that VHF band makes a stable and perfect arrangement of TV and satellite correspondence. The wavelengths comparing as far as possible frequencies are 10 meters 1 meter.

FIGURE2.7. Transceiver

2.2.5 Digital Image Processing

The concept of digital image processing is overall about using computer algorithms to perform image processing on digital images. Furthermore, compared to analogue image processing, digital image processing has much more advantages. For example, digital image processing can avoid problems and disturbances such as signal distortion and build-up of noise during processing [12]. Furthermore, it also provide a good wider range of algorithms to be applied to the input[4]. FIGURE below shows the illustration process of digital image processing. From the illustration below the process of digital image processing is clearly shown. The difference of the picture captured, is clearly shown before and after digital image processing. The picture after digital image processing is more focused particularly and the clarity of image is wider and focused

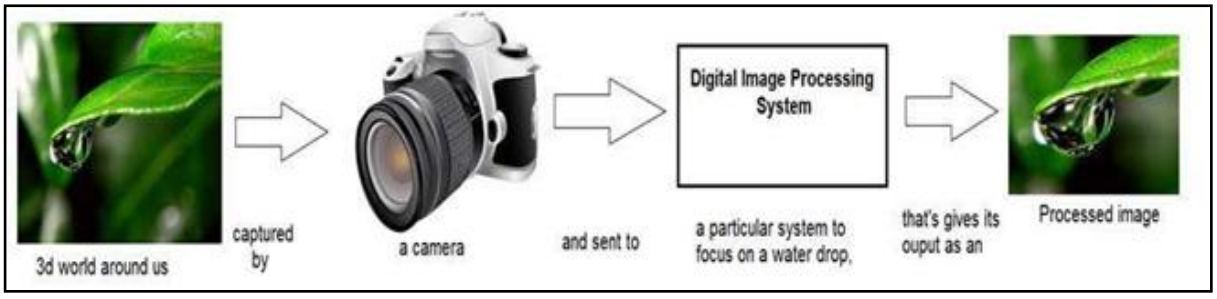


FIGURE2.8. Illustration of digital image processing

Digital image processing is all about digital images through a digital computer.It means Digital image processing focus particularly on images although it is a subfield of signals and systems.Furthermore, it using efficient Algorithms as a system processes the input of that system.To understand the digital image processing,it is recommended to have basic understanding of probability, differential equations and calculus.Moreover,some of basic programming skills on C++, Matlab, and Java will make the process on Digital image processing much simpler.

Thesignal becomes a medium that conveys any information in physical world between two observers. For example, as we talk, our voice is converted to a signal and changed with respect to the time to destination of the person.Other than that, data image process is very useful and widely used in many fields.Some of them are

medical field, image sharpening and restoration, microscopic imaging, video processing, machine/robot vision,remote sensing, pattern recognition and etc[4].

2.2.6Slow- scan television (SSTV)

SSTV is software used for image transmission technique and mainly by amateur radio operators, to receive and transmit static picture via radio in color or monochrome.Usually, the maximum bandwidth taken up by SSTV is up to 3 kHz [11]. In early 2000's, SSTV is slower compared to current technique with few developments on the software; it opens the possibilities to digital SSTV to transmit on the HF BANDS with good quality of images.SSTV software is really helpful because it helps in enabling the radio ham to receive and send many other modes such as Olivia, PSK, QPSK and FSK [16].

Moreover, Slow Scan Television SSTV uses air wave as medium to carry on transmission process of sending images.This software working by simply codes the color into an audible frequency tone that can be interfaced into the radio microphone system. Furthermore, eachof color has its own specific frequency in SSTV. Finally, the receiving end software simply decodes the frequency back into the color[5].

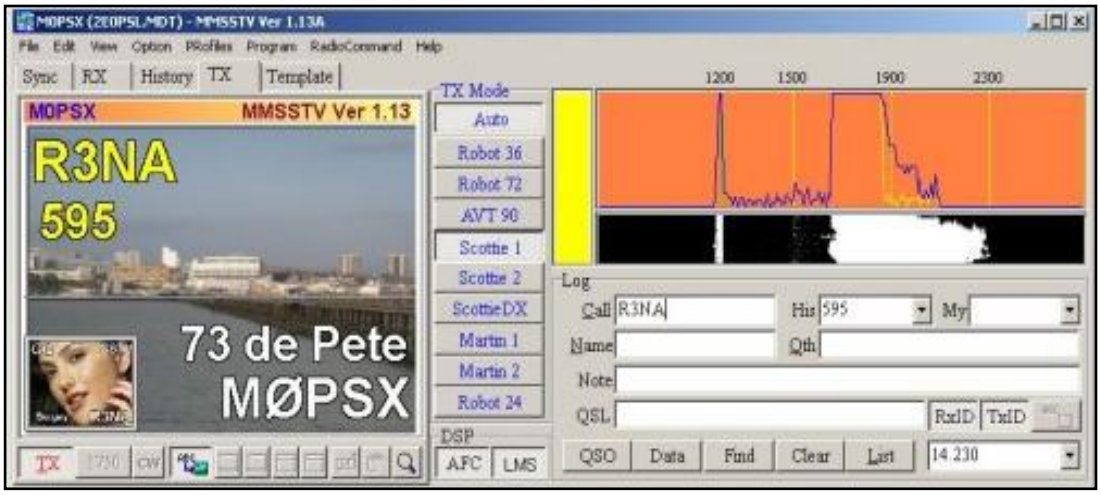


FIGURE2.9. MMSSTV Application

A modern system uses special software and a personal computerin place with consists mostly of the custom equipment. Especially, the sound card of a PC, which acts as a mode is with special processing software. The output is provided by the computer screen while the input provided by small digital camera or digital photos. By using analog frequency modulation in SSTV, every different value of brightness in the images gets a different audio frequency. In other words, the signal frequency shifts up to designate brighter pixel and shifts down to designate darker pixels. Moreover,color is achieved by giving the brightness of each color component (usually green, blue and red) separately. This signal can be fed into an SSB transmitter, which in part modulates the carrier signal

CHAPTER 3

METHODOLOGY

The methodology, procedures and steps taken in order to reach the objectives of project are explained in this section. Each factors considered to be implemented in this project are explained briefly the following section. There are 2 main sections of projects which considered important steps for the implementation of the project, which are the hardware and software development. Before deciding the selection of the software and hardware part, the review of the each components in the system architecture are extensively conducted to minimized an error and problems of interfacing and integration of each component parts.

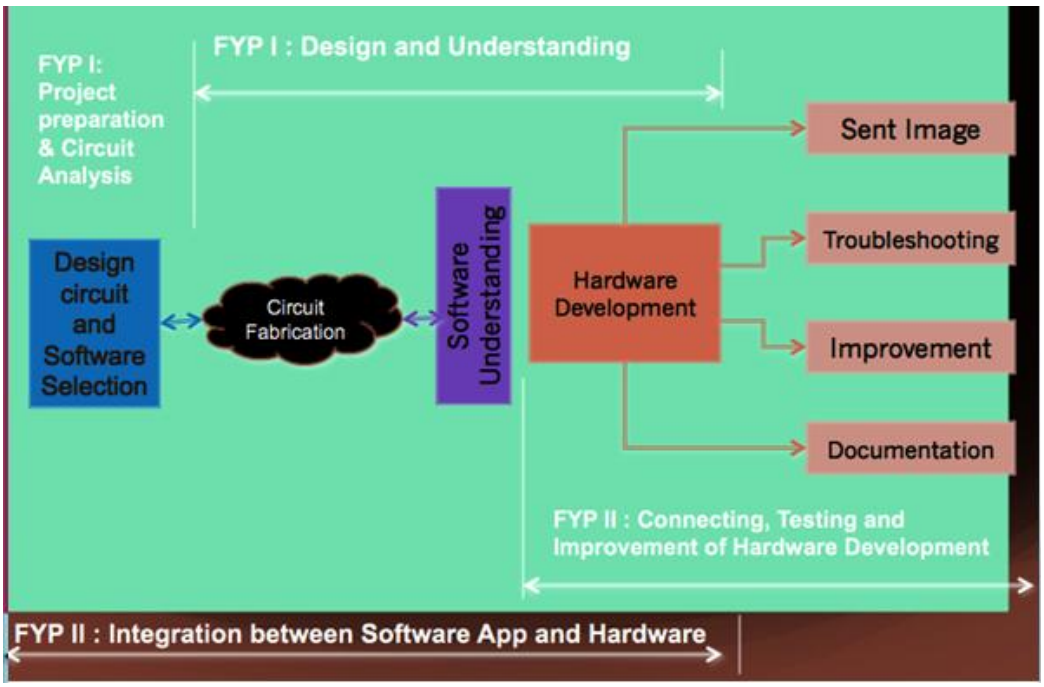


FIGURE3.1. Project planning

Software and hardware is main two things involve in this project. The project flow is started on building suitablecircuit and find suitable component for the circuit behaviour. Then, it is continued with construction of circuit and finally testing the circuit. The final step is combined with the software. FIGURE 3.1shows the flowchart of the projectprocess that will be done and discuss here. It's the guideline to complete the project

3.1 Flow chart

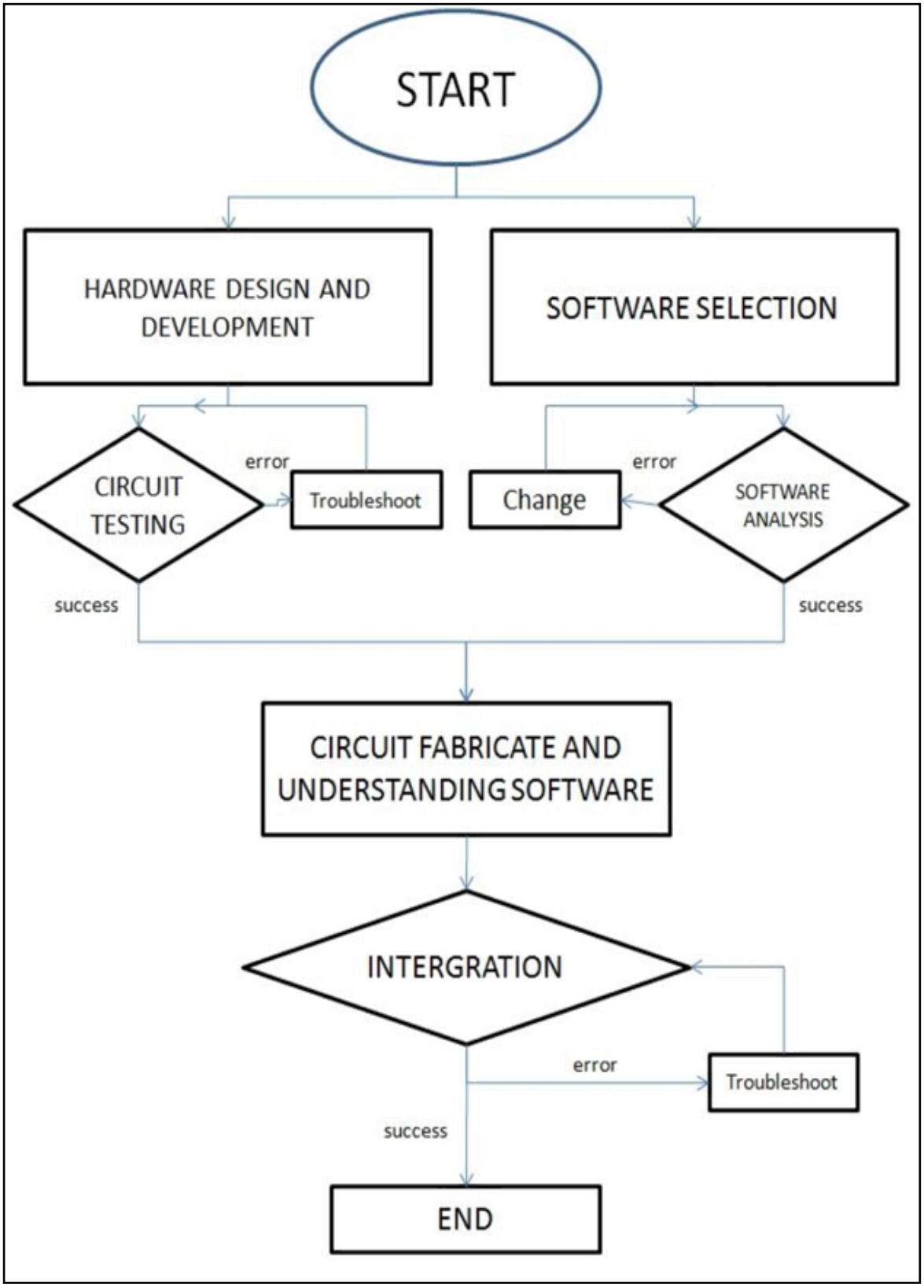


FIGURE3.2. Project methodology in a flow chart

First part to be carried out is hardware designing and development. Initially the design for the circuit has to be built for the hardware design. The circuit must be tested first before implement to check if encounter any problems anddo some simulation. Troubleshoots have to be carried out if the simulations meet any error to recognize the problem.

Software selection will be the second part of this project. The software, called MMSSTV is usedbecause it was designed to program the transmission. This software can transmit orreceive any transmission that been detected by the PC microphone.MMSSTV is an amateur radio (or ham radio) application focused at those inspired by radio methods. With this SSTV (slow scan television) utility, pictures can be sent and received utilizing a PC, a keying circuit and a ham radio. The ham radio can be VHF or UHF. SSTV, otherwise called narrowband television, is a strategy for transmitting and accepting static pictures by means of radio. The program offers a few valuable choices, for example, auto incline change, auto mode select, Morse ID and others. The view options include spectral display (FFT or FM demodulator), spectral display change, sensitivity, response and also spectral trail. Other than that, a digital scope also available in the viewing options. Thumbnail browsing is quick and OLE backing is guaranteed. Setting up the sound levels for accepting and transmitting will require some testing, generally as the case is with different bits of programming as well. A few SSTV modes can be picked, including Martin 1 and 2 and Scottie 1 and 2. Once SSTV signal is discovered, manual tuning can be performed effortlessly enough. In conclusion, MMSSTV is a slow scan television utility for transmitting and getting information utilizing the radio frequency spectrum.FIGURE 3.3 below shows the main screen of SSTV and the labelling of main parts in SSTV. The working method of SSTV software must understand completely before implement it. FIGURE 3.4 shows the audio spectrum in SSTV software. The tone will be varying according to colour images it scanned to transmit.

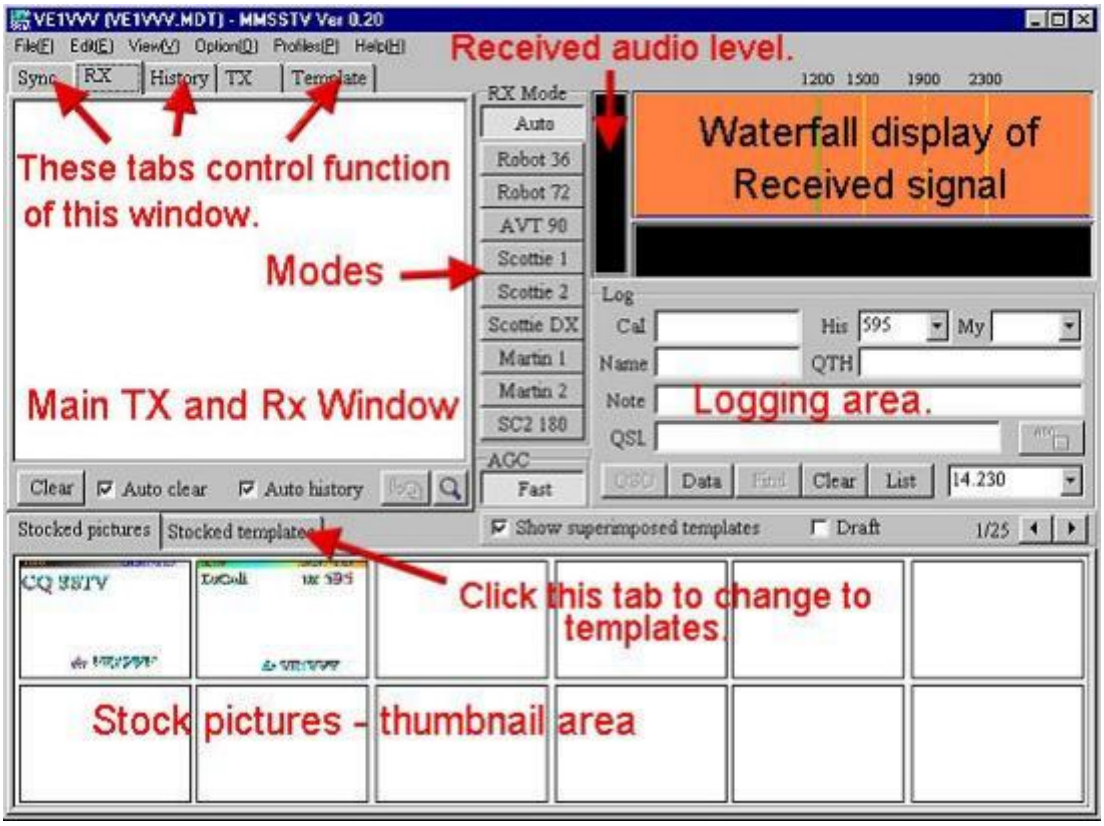


FIGURE3.3.Main screen of SSTV software

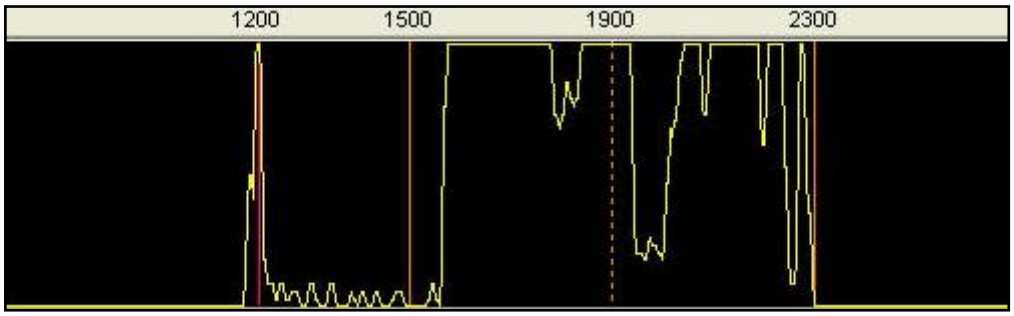


FIGURE 3.4. Audio spectrum of a typical SSTV image

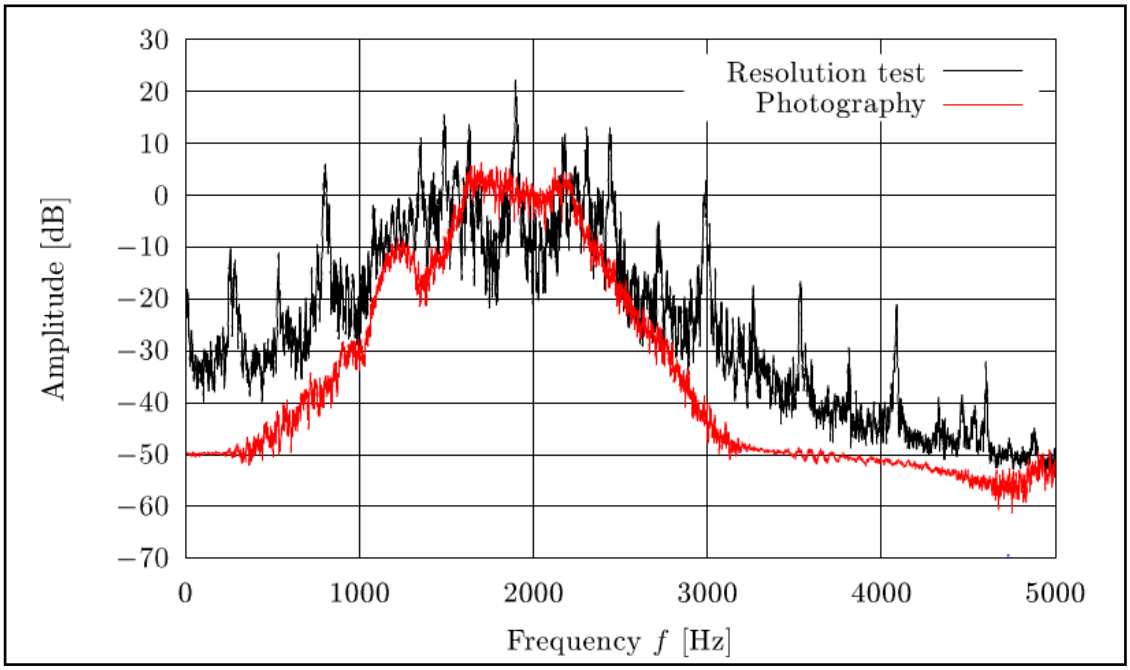


FIGURE 3.5. SSTV frequency spectre for two various image transmitted

TABLE 3.1. SSTV Modes

Mode	Duration (sec)	Lines	Method
Robot 36	36	240	Color differentiation
Robot 72	72	240	Color differentiation
AVT 90	90	240	RGB (no synchronization pulse involved)
Scottie 1	110	256	RGB
Scottie 2	71	256	RGB
Scottie DX	269	256	RGB
Martin 1	114	256	RGB
Martin 2	58	256	RGB
SC2-180	182	256	RGB

The modulating frequency changes around 1500 and2300 Hz, relating to the intensity of the color segment. The modulation can be sampled in any rate even though the horizontal resolution is always defined as 256 or 320 pixels. The picture angle proportion is traditionally 4.3. Lines as a rule end in a 1200 Hz even synchronization beat of 5 milliseconds (after all color components of the line have been sent); in a few modes, the synchronization pulse lies in the middle of the line.

SSTV Software, the transmission comprises of horizontal lines, checked from left to right. The shading segments are sent independently one line after another. The shading encoding and request of transmission can shift between modes. Most modes

use a RGB shading model and a few modes are highly contrasting, with one and only channel being sent. Alternate modes utilize a YC shading model, which comprises of luminance (Y) and chrominance (R-Y and B-Y).

Furthermore, for digital SSTV system is used tuning indicator, which displays spectrum of Single Side Band (SSB) channel. Discrete Fourier transformation will create the image showed by the indicator. The indicator will shows new samples on upper top part while the old samples will be disappeared to the bottom. The whole spectrogram is moving down and the indicator was nicknamed as waterfall as shown in the FIGURE 3.6 below. The theory and principal of the term " waterfall " is based on Fourier transformation and it explains that the signal can be compiled from a huge number of harmonic waves.

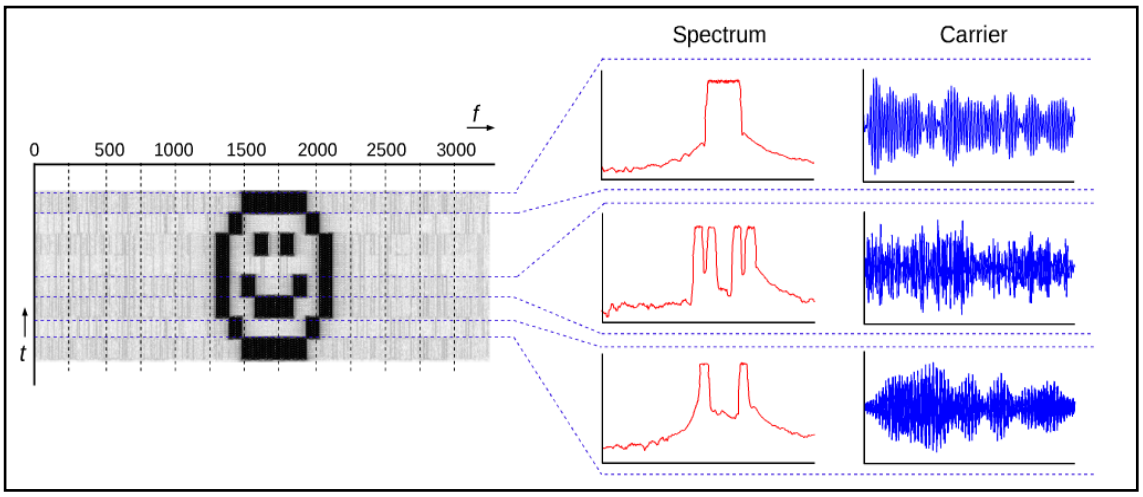


FIGURE3.6. The principal of waterfall image display

3.2 Soundcard

A sound card is an internal computer expansion card that facilitates the input and output of audio signals to and from a computer under control of computer programs. The term sound card is also applied to external audio interfaces that use software to generate sound, as opposed to using hardware inside the PC. Uses of sound cards include providing the audio component for multimedia applications such as music composition, editing video or audio, presentation, education and

entertainment (games) and video projection. The built-in soundcard in the computer or a laptop will later process all the data into a transmittable signal. In this project, the soundcard act as modem which any data it receives from the terminal in the form of digital signals will be modulated into an analog signal form. For personal computers these ports are defined as serial port. The software used the computer's soundcard to generate the SSTV audio tone, which is fed into the microphone input of a transceiver. It also used the soundcard to decode the incoming signal.

3.3 RS232 COM Port

Basically in telecommunication field, RS – 232 is known as standard for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment), such as a modem. It formally used in computer serial port. The main purpose of using RS-232 connection is for connect to modems, printers, mice, data storage, uninterruptible power supplies, and other peripheral devices.

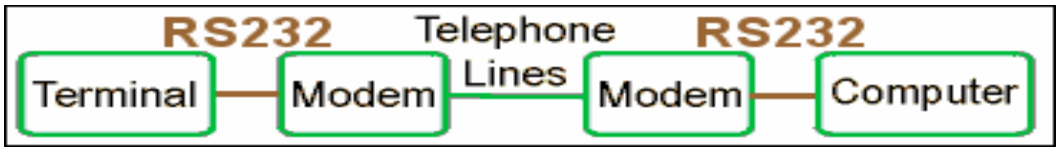


FIGURE 3.7. RS 232 Connections in communication

The meaning for RS is recommended standards. The serial connector used in this project is RS232 DB9. The smaller DB9 version is commonly used for personal computers. Furthermore, most new PC’s are equipped with male D type connectors having only 9 pins.

The pin out and diagram of DB9 connector commonly used for serial ports (RS-232) is shown in FIGURE 3.8 and FIGURE 3.9 respectively.

Pin	SIG.	Signal Name	DTE (PC)
1	DCD	Data Carrier Detect	in
2	RXD	Receive Data	in
3	TXD	Transmit Data	out
4	DTR	Data Terminal Ready	out
5	GND	Signal Ground	-
6	DSR	Data Set Ready	in
7	RTS	Request to Send	out
8	CTS	Clear to Send	in
9	RI	Ring Indicator	in

FIGURE 3.8.Pin outin DB9 connector

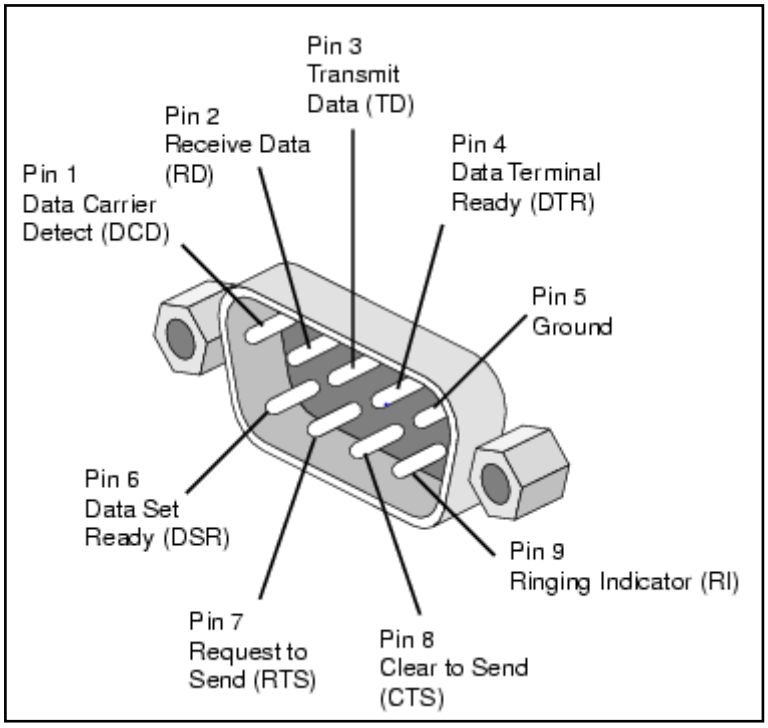


FIGURE3.9. Diagram of DB9 connector

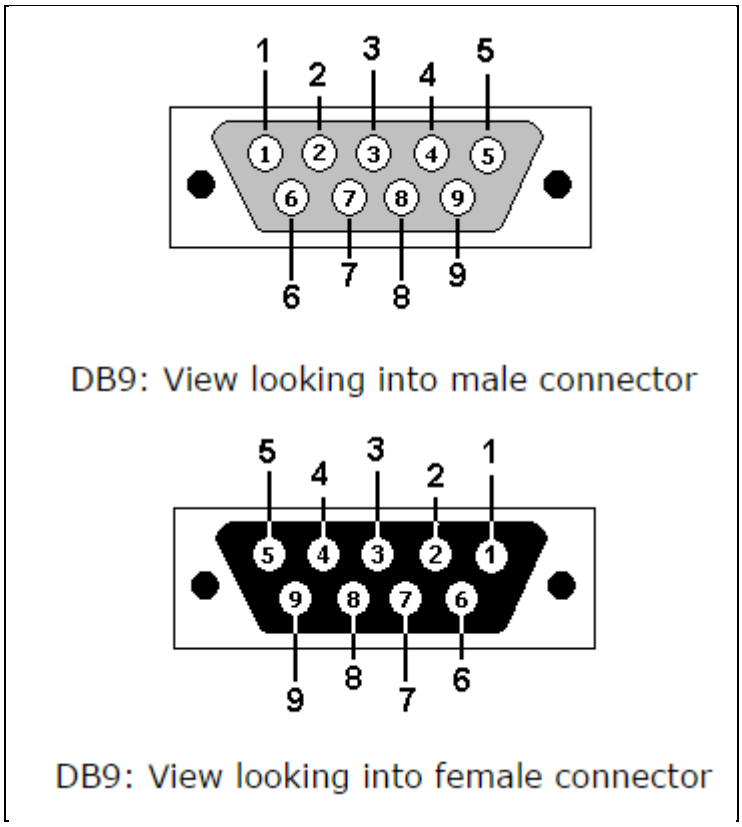


FIGURE 3.10. Difference between male and female DE9 connector

FIGURE 3.11. Com port connection (RS 232)

The overall project is divided into small partitions and by parts because it is easier totroubleshoot if encounter any error or problem. The next process of merging software and hardware will be continued if the software development and the

hardware design have no errorsand counter no problem. Then, the complete combination of both will be tested in MMSSTV software. If the transmission of image is failed, the project should will be analyzed and modified in the troubleshooting process. The project can be move on to further development if the project can run successfully and smoothly withoutencounter any technical problem.

3.4Gantt Chart and Milestone

The assigned period for this exploration investigation of the last year task is 8 months which is begin from September 2015 for final year project I and will be proceed on definite final year project II which is on January 2016 to finish the investigation and analysis. The Gantt outline and turning point arranging is appeared in table underneath:

3.4.1 Gantt Chart (FYP I)

TABLE3.2: Gantt Chart(FYP 1)

WEEK / ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Literature Review														
Research on SSTV software														
Learning to work on SSTV software														
Study on PSK interface circuit														
Research on image transmission														
Study on Radio frequency														
Research the functionality of each components in overall project														
Develop PSK interface circuit														

3.4.2 Gantt Chart (FYP 2)

TABLE3.3: Gantt Chart (FYP II)

WEEK / ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Finalise PSK modulator circuit														
Fabricate PSK modulator circuit														
Integration of All Subcomponents														
Troubleshooting and Improvement														
Complete Prototype Development														
Testing and Measurement														
Report / Thesis														

3.4.3 Key Milestones

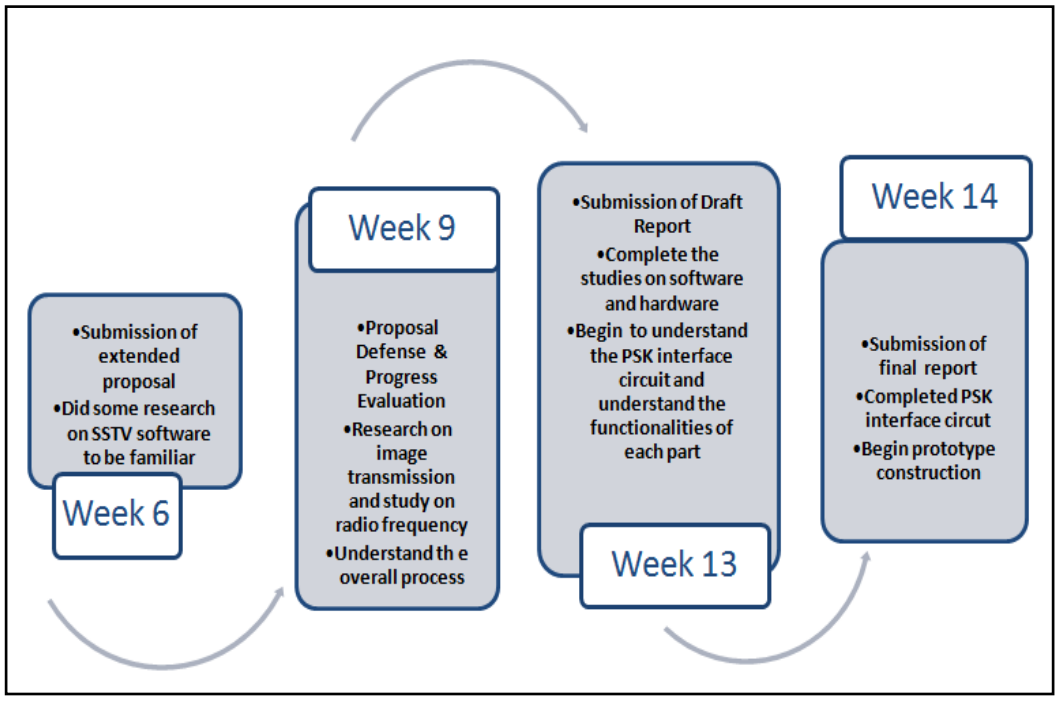


FIGURE3.12. Key milestone

3.5 Tools

3.5.1 Hardware

3.5.1.1Transceiver Module

A handset is a gadget that incorporates of both beneficiary and a transmitter. The handset fills in as a transmitter of the information furthermore portrayed as a recipient of the information. The beneficiary and transmitter consolidated and had the same hardware in a solitary lodging. The handset module utilized as a part of this undertaking is handie-talkie or understood as walkie-talkie. The walkie-talkie can be likewise portrayed as handheld, compact radios. This is on the grounds that they convey remotely utilizing radio waves on a solitary, shared recurrence band. Transmitter/beneficiary and radio wire incorporates into every battery-controlled unit. There is an amplifier that regularly bends over as receiver works when we talk into it and a catch that we "push-to-talk" (PTT). The sort of walkie-talkie utilized as a part of this venture is Kenwood TK-1118. The determinations of the walkie-talkie are appeared in table beneath.

TABLE3.4: Specifications of walkie-talkie

BAND	UHF
Frequency Range	350 – 370MHz
Power Output	2.5W
Channel Number	100
Communication Range	5-15km (on broad area)
Spurious Radiation	Better than 60db
Sensitivity	Better than 0.20 V
Standby Current	40Ma
Transmitting Current	1.2A
Operation Voltage	6.0V

3.5.1.2 Soundcard Properties

Normally, the functions of sound card:

- The simple to-advanced converter (ADC), which makes it conceivable to make computerized recordings from simple sound inputs.
- The advanced to-simple converter (DAC), which makes it conceivable to change over computerized information to simple sound.
- An interface to unite with the motherboard, commonly utilizing Peripheral Component Interconnect (PCI)
- Input and yield connectors so can connect to speakers, earphones or a receiver. Numerous PC frameworks have speakers and mouthpiece constructed in, yet connectors permit you to utilize higher quality outer gadgets to play or record

3.5.1.3 PTT Interface Circuit

PTT interface is the equipment in this undertaking. The red LED demonstrates the information transmitting and green LED when the collector got the information. In outlining and development for the circuit, selecting components and segmentis critical to get a correct output. The interface requires no outside force and is worked by the PC's serial port. This interface gives two fundamental capacities, first to unite the PC with the handset, and second, to control the PTT (push to talk) capacity.

3.5.1.4 Personal computer (PC)

PC is one important tools used in this project. SSTV software is downloaded in the pc. Furthermore, we need the soundcard in the pc or laptop to the conversion of data signals.

3.5.2 Software

3.5.2.1 Slow Scan TelevisionSoftware (SSTV)

Analog frequency modulation is used by SSTV software in which every different value of brightness in the image gets a different audio frequency. Slow Scan Television System (SSTV) is the prime software needed inthis project. SSTV software is chosen for the project due to some supporting reasons:

- Personal computers are being very common and universal these days, especially among the ham radio fraternity
- The availability of computer-to-transceiver and simpler task for the radio ham to receive and send many other digital modes such as RTTY, PSK, Domino, Olivia and Throb to name but a few.
- Suitable software for digital and analog SSTV, as well as the other digital modes.
- Allow the transmission of images within a bandwidth of 500Hz, as compared to 2500Hz required by the more traditional wideband modes like Scottie and Martin.
- SSTV software introduces many new digital SSTV modes.

Analog frequency modulation is used by SSTV software in which every different value of brightness in the image gets a different audio frequency.

3.5.2.2 MATLAB

Matlab software is used to analysis the test performance results by finding the Peak Signal Noise Ratio (PSNR). Peak Signal Noise Ratio (PSNR) will measure the reconstruction level of the images. Higher value of PSNR indicates the image is in good quality with less noise error while lower PSNR value indicates the image contain too much error thus degrading the quality of image [20]. Analysis in Matlab has been carried out in two main factors the influence the image transmission. The factors are volume of handie talkie and distance range between transmitter and receiver.

Chapter 4

Results and Analysis

4.0 Overall Prototype

This complete project consists of hardware and software implementation. PC is used for its soundcard acts as a modem. Soundcard is used for the translation of anolog and digital information while walkie talkies are used as a transmitter and receiver. Moreover, PTT interface circuit is used to control Push to Talk button transmitter. Hand phone is used to display received image. For the software part, SSTV is used to generate audio tones for transmission via RF. The complete project design for image transmission analysis is shown in FIGURE 4.1:

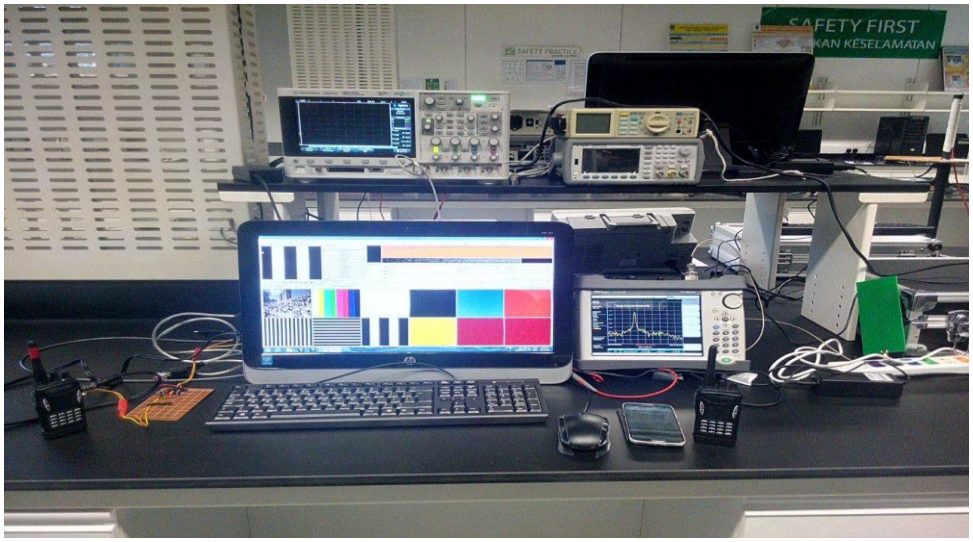


FIGURE 4.1. Complete project design for the analysis

4.1 SSTV

Slow-scan television (SSTV) can be recognised as a communication medium for image transfer. SSTV can be transmitted via voice signals with a standard SSB transceiver on all radio amateur frequency bands. SSTV is suitable software for utilising short waves signal in communication through radio frequency

SSTV software is using single-sideband (SSB) amplitude modulation with a transceiver. In this project the transceiver will be the handie talkie. The allocated frequency range for SSTV to transfer an image is between 1500 Hz (black) to 2300 Hz (white). Frequency values above 2500 Hz are strongly suppressed, so the frequency of white colour to be the maximal level of SSTV signals.

SSTV signals are transmitted via frequency modulation of audio signal. In order to get a clear image, the transmission should avoid any phase shift and drift. To avoid these errors, the spectrum of video signal is modulated on the auxiliary carrier frequency of 1900 Hz called sub-carrier. This modulation is SSTV is called Sub-carrier frequency modulation (SFCM). Furthermore, the bandwidth range used in the SSTV is 1.0 to 3.2 KHz and it also depends on modes used in transmission of image. The FIGURE shown below is the comparison graph between two images when transmitting. The graph shows different images needed different amplitude and frequency modulation when transmitting depending on SSTV mode, image content and also the transmission speed.

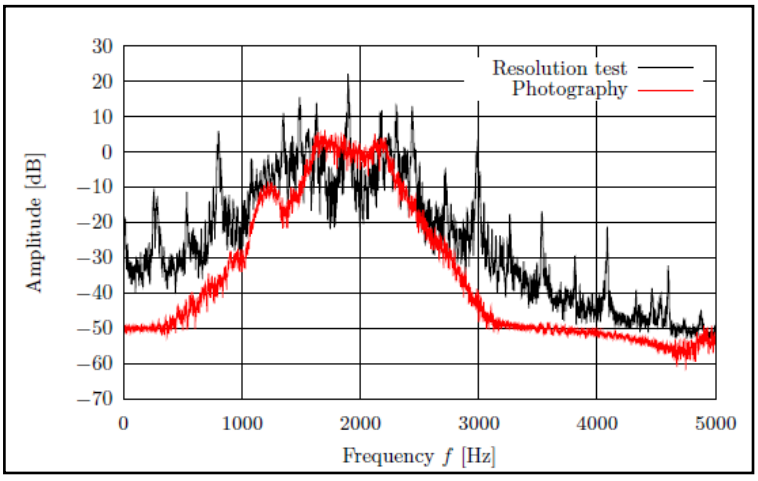


FIGURE 4.2. SSTV frequency spectre for two different images transmitted

The pictures received from SSTV software will be not exactly the same astransmitted. This is because SSTV is an analog mode and it cannot transfer image without loss. Even if the image transmitted from an empty space without any noise or interference, the image received still distorted due to limited bandwidth and speed of transmission. The image received will more distort if the transmission speed is keep increasing. The transmission modes in SSTV are not defined by horizontal and vertical scan rates, but in the number of lines transmitted in one minute. Most modes in SSTV carry images with 240 lines and image will be shown in a 4:3 aspect ratio on screen. Each mode in SSTV have different rate of transmission speed lines. For example, if the picture in high quality with colour image of (320x240), it takes nearly five minutes for the receiver to receiver. The comparison with the modes is shown below:

The frequency range to transmit information is from 1500 Hz to 2300 as mentioned above. Each frequency from that transmission scale defines specific brightness. FIGURE below shows the scan line differentiates according the image colour.

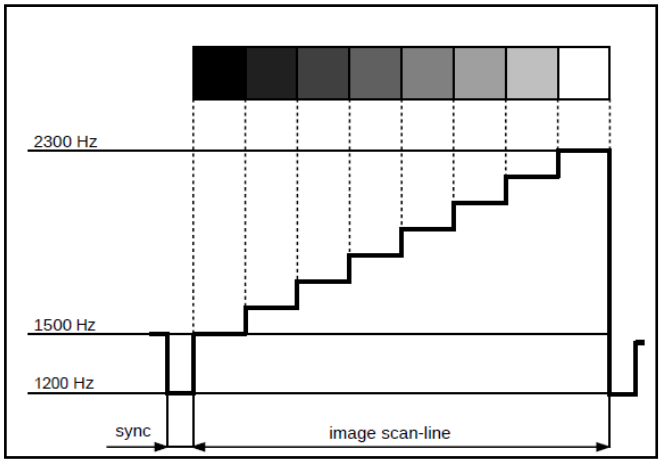


FIGURE4.3. Scan line of the image

4.2 Computer Operations

The connection between the transceiver and the computer or laptop just can be made by a connection cable called serial 9 pin USB cable. Before operate the SSTV software, there are a few things must be known for the transmission. The basic functions are:

- To configure a suitable sampling frequency for reception and transmission
- To use the tuning indicator
- To switch different modes in transmission
- To write or add text into transmitted images
- To save and load images in normal formats
- Creating a gallery store to save images for transmission
- Adjusting volume level of sound card in computer or laptop

4.2.1 Sound card as a modem

Sound card in PC plays a vital role in the transmission. Nowadays, sound card become the standard PC tools. Soundcard plays many roles as it can use for music player, games and recording. The sound card will be using as MODEM – Modulator/ Demodulator in this project. It allows information from PC to be transmitted and received over physical media like radio waves or telephone lines. Basically in a simple term, the modem is used for translation of digital signals to analog signal and vice versa. The modem is important for any communication because, it allows the PC to work with any sound or audio signals for the data processing.

4.2.2 Sampling

The digital conversion of images started with sampling. Sampling technique will scan the current value of the analog signal periodically. The sampling rate depends on the type of sound card used. The normal range of sampling frequency in the sound card is from 8 kHz up to 96 kHz. The higher rate of frequency is for big scale purpose such as recording studios.

Shannon's theorem is the suitable explanation for the sampling frequency using in the conversion of images. The theorem defines that the signal continuous in time including spectral components with highest frequency (f max). The highest frequency can be reconstructed from a sequence of evenly spaced samples with a sampling frequency greater than double fmax. Figure 4.3 show the conversion process of signals.

$$f_s > 2f_{max}$$

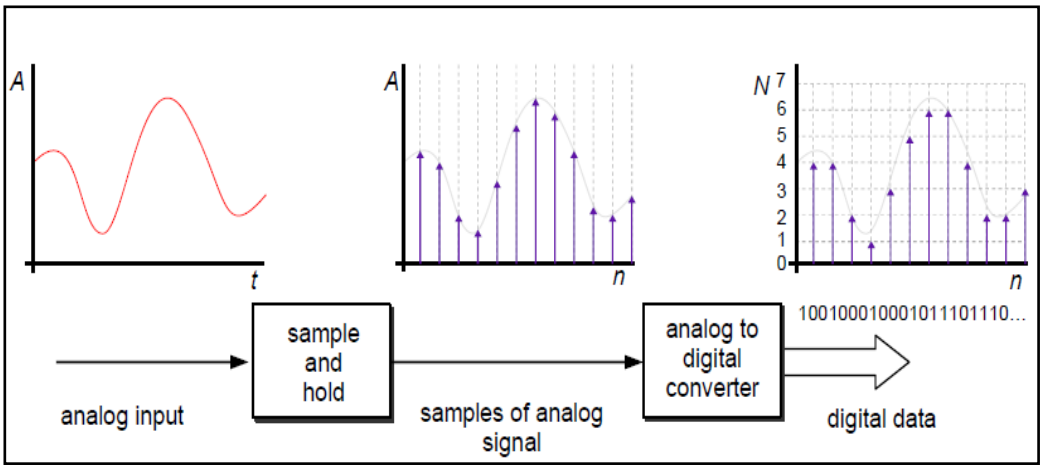


Figure 4.3. The conversion of analog signal to digital data

The condition shown above must be satisfied for explicit signal reconstruction. An error called aliasing might occur if the sampling frequency is lower than the maximum frequency.

4.2.3 Interface between transceiver and PC

In this project, the interface is consists of and 3.5mm jack plugs and shielded cables. The connection must be correct to before start operating. Firstly, the sound card input LINE IN must be connected with a reception cable to the transceiver output or speaker port. This connection can be labelled as AF OUT with impedance around 10k ohm which gives maximum output of 100Mv.

While, the Line out or the speaker output from PC or laptop is connected to the microphone input of transceiver. This connection is labelled as PATCH IN. Last thing to do is, setting up the audio levels of received and transmitting signal. This step can be done in system tools. The setting for transmitted signal should be around 2/3 of maximum. This is to prevent the transmitting signal from being over-excited or attenuated and distorted.

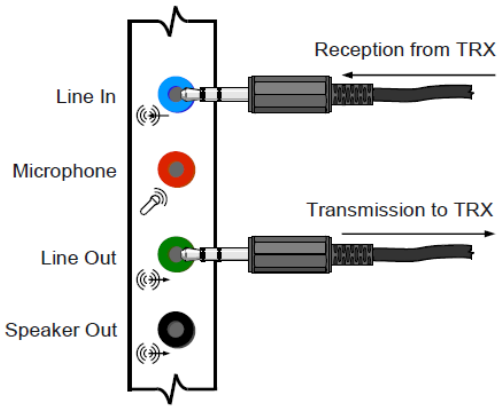


Figure 4.4. Basic interface between transceiver and sound card

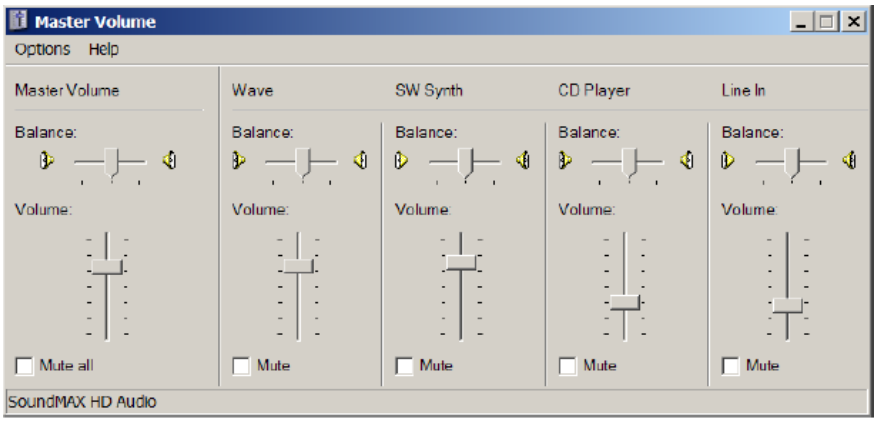


Figure 4.5. Volume settings

4.3 PTT Control

The push to talk (PTT) button is switching from reception and transmission. Manual PTT switching is not very recommended way to control PTT but for early testing purposes the PTT can be controlled manually when each time transmitting. The best solution is automatic switching. It can provide transceiver with VOX feature, when it detect signal in the input. But there are some disadvantages of this automatic switching. First is, the reaction might not be immediate, in the case when digital mode in beginning transmission can be lost. Furthermore, the system operating in this image transmission process can produce disturbance noises when keying the transmitter in this case.

Moreover, SSTV software supports PTT to control over a simple serial port called (RS-232) circuit. The control signal is connected to RTS pin number 7 while ground is on pin number 5 at dB9 connector.

4.3.1 Noise Reduction

Direct connection from PC to transceiver is not recommended as it can cause noise in communication channel. Furthermore, PC and transceiver can have slightly different electrical potential and it causes errors in transmission.

4.4 Transmission and reception of images

There are few important operations must be followed for the transmission and reception of images:

1. The images selected for the transmission will be processed to set the resolution and compression. Then, the images will be translated into audio signal in the SSTV, to be sent for radio transmission. Basically, the time consume for the complete transmission is depends on the input file size and also computer configuration. Usually, it consumes a second or two for faster CPUs and around several minutes on slower systems.
2. Next, the audio file is played and transmitted. The audio signal from transmitter will be recorded and plays in the receiver through RF.
3. Then the audio signals from the receiver will be captured by the decoder software in hand phone. Robot 36 software will reconstruct the original file. The time for the receiver to reconstructs the original signal is depends on volume of data and processor speed.

4.4.1 Waterfall Images

The term waterfall in SSTV software is known for the spectrogram moving down when the transmission of images started. The principle of "waterfall images" is based on Fourier transformation. In a simple explanation, it shows the signals compiled from a big amount of harmonic waves. The principle of waterfall process is shown in the Figure 4.6:

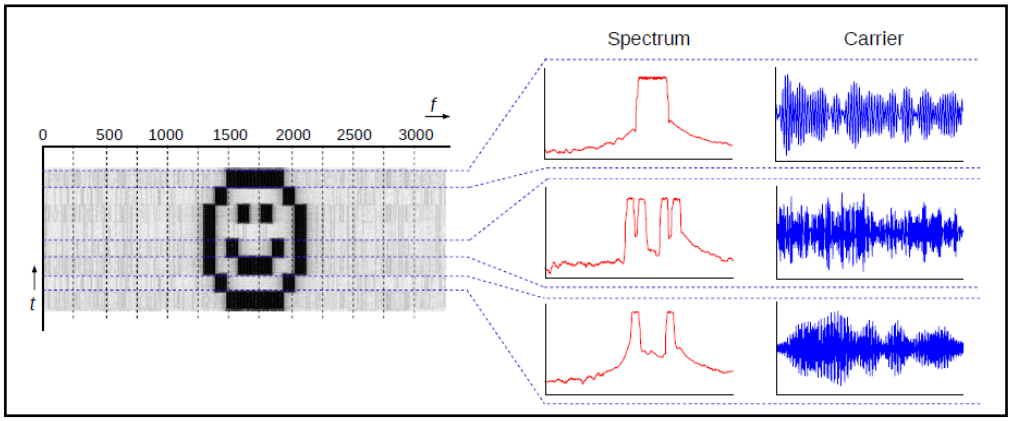


FIGURE4.6. Principle of waterfall image display

4.5 Transmission Process

MMSSTV software will transmit the image via audio tones. The process flow of converting picture data to sound data is shown below:

Picture data →LPF (ON/OFF) → VCO (ON/OFF) → D/A → Sound data

LPF and BPF are used to limit the frequency of the digital output as insurance. If the CPU load is too high for transmit, LPF AND BPF just can be turned off. LPF is the filter that smoothes the signal translations from image data to the frequency domain. As a result, the frequency bandwidth is substantially limited and horizontal resolution of the TX image is slightly sacrificed. Moreover, BPF is a filter that limits the bandwidth of the TX signal. It is useful to limit the spectrum spread. The received images will be better quality by setting the cut-off frequency higher and increase the sampling frequency in the PPL decoders and zero-cross.

4.5.1 Clock Calibration

The clock calibration is very crucial in the transmission via SSTV. The discrimination of the clock appears as a slanted image. The calibration of clock in SSTV can be done by following the steps below:

1) Go Option, Setup, Misc page, and push Adj button

2) Receive standard radio wave
3) Tune into the tick sound
4) Continue listening the sound for few second and observe the vertical line
5) Click the upper point of the line
6) Click the lower point of the line

If the PC soundcard have different clock sampling frequencies fro TX and RX, then should adjust the offset frequency by following the procedure:

1) Adjust the slant in RX.

2) Go Option, Setup, and TX page. Select External in the Loopback.

3) Connect the Line-out to the Line-in of your soundcard.

4) Transmit an image with Martin 1.

5) You should have an image through the external feedback.

6) After completing the image receive, go Sync page and adjust the slant.

- You could use the High-accuracy slant adjustment.

- Do not push the Mem button

7) Push the TX (TX offset) button in the sync page.

8) Make sure that you have no slant in the TX. If you still have slant, repeat from (6).

If the TX image is greatly slanted, the solution will be changing the soundcard modes either to monaural or stereo

4.6 Circuit Analysis

The circuit used in this project is called as PTT interface. The main purpose of this circuit is to connect ham radios or any other audio set up or devices to be isolated from sharing audio common ground to laptop or PC. PTT interface circuit is

controlled by USB interface. Basically, the connection to PC is done through RS232 9 pin serial connector as shown below.

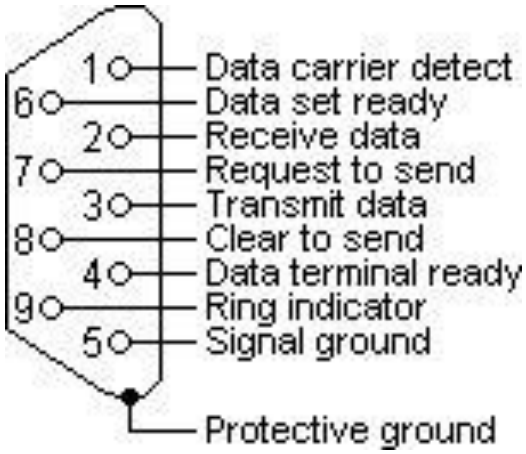


FIGURE4.7. RS 232 Connection pin

Moreover, the selection of pin in RS 232 to connect is very important. The pin chosen to be connected in this project is pin Request To Send (RTS) and Ground (GND). RTS is on pin number 7 and the pin number 5 will be Ground.

4.6.1 Circuit Operation

The working operation of PTT interface circuit is not too complicated. First of all, the control for Pin RS232 has to be done in SSTV software to be HIGH if it transmits. The red LED will lights up and turns on the BC 548 transistor. This action will lead to PTT interface circuit to be grounded. When the PTT button of handie talkie is not triggered, the shield cable is not connected to direct current, where by the 0.1uf capacitor keep the alternating current audio to be grounded. There two colours of LED is used in this project. The red LED is to show the transmitting process whereas the green LED will lights up after transmitting.

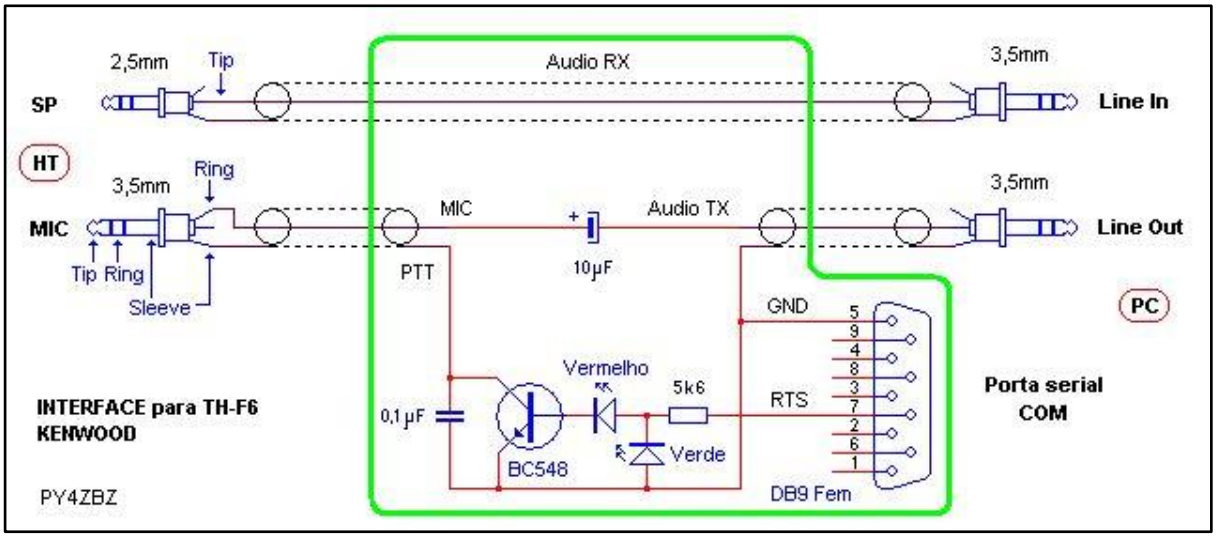


FIGURE4.8. Schematic diagram of PTT interface circuit

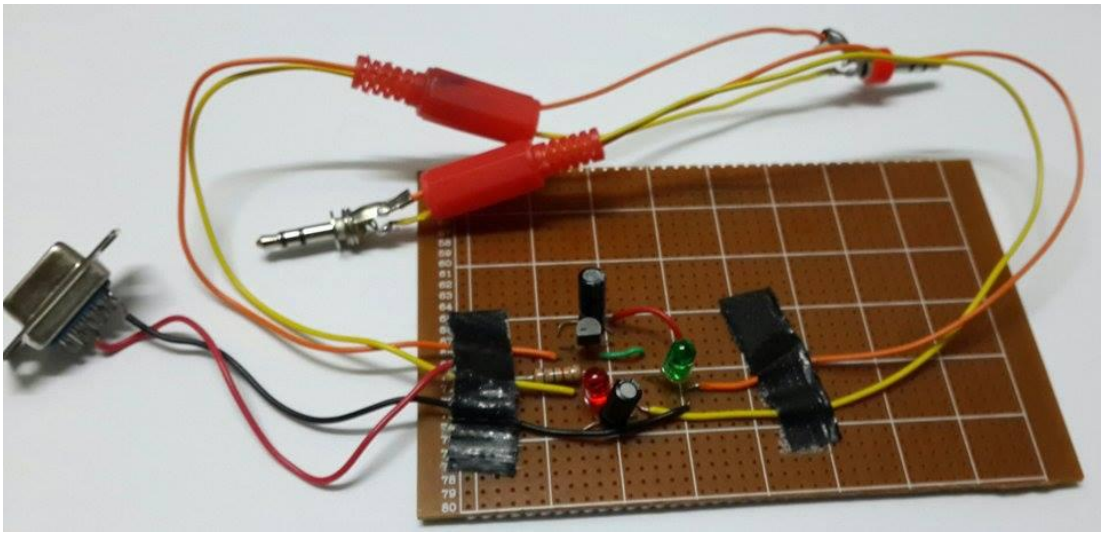


FIGURE 4.9. PTT Interface circuit

The working behaviour of the circuit is tested in communication lab with the oscilloscope analyser spectrum. The results of testing shows that the SSTV software takes around 0.026s delay to transmit the data after PTT is controlled to allow the transmission by the interface circuit. The result from testing is shown below. The red is analyser for PTT operation. It will move down from up right after TX button is selected to transmit. The blue analyser in oscilloscope is the audio signal from SSTV software. The main purpose of this PTT circuit is to consume battery power of walkie talkie. If it continuously transmitting signal, the battery charge will drainquickly. This will cause the battery of the walkie talkie to failure easily. Other

than that, this circuit also prevent from unwanted noise or signal from the transmission.

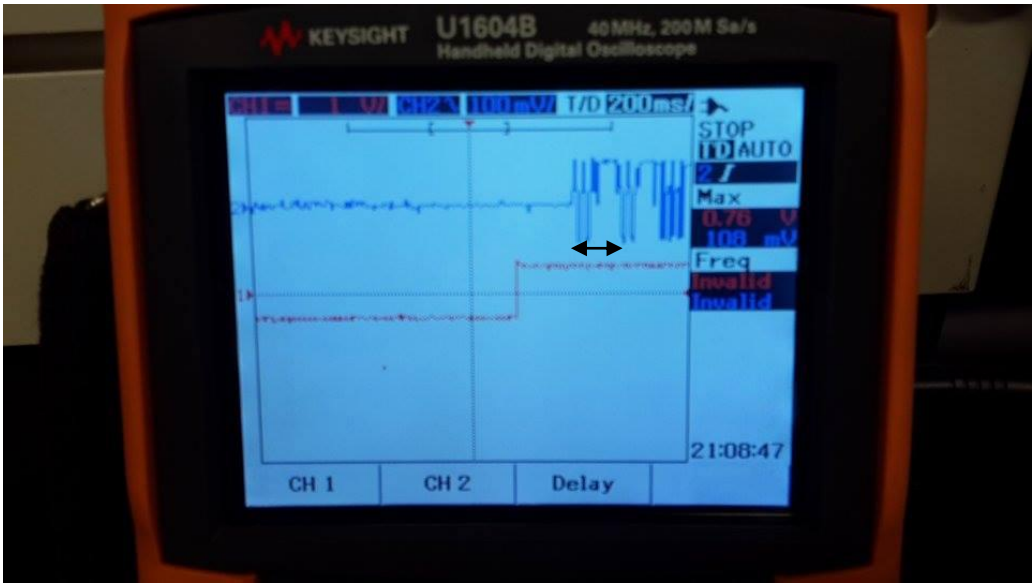


FIGURE4.10.PTT circuit output

4.7 Radio frequency operation

Basically, radio waves use modulation technique to carry information. Radio waves can be called as carrier signal as it carry information to the receiver. To receive the image or data transmitted, the receiver must be able to demodulate the carrier signal for the user to get the accurate data. For that, the receiver must know the type of modulation technique used by transceiver during the transmission into Radio operation is relies on the radiation of energy. The radio wave is a form of radiation of energy from a transmitting antenna. The radio waves travel similar to the speed of light at 300,000km/sec or 186,000 miles/sec. In the antenna part, a small electrical voltage is produces when the waves arrive at a receiving antenna. This small voltage will amplified in a suitable voltage for the radio waves to retrieve the information contain into a understandable form from the output (loudspeaker). Furthermore, there will be oscillator in every transmitter. Electrical signal are produced from the oscillator of a given frequency. This voltage produces is amplified several thousand times, to be the radio-frequency carrier. Frequency modulation is the technique used to modulate the carrier by varying the frequency. The frequency

of the carrier signal will be increasing gradually during the positive portion and decrease during the negative period of the carrier frequency. Moreover, the frequency of the audio signal will determined the carrier signal of the transmission.

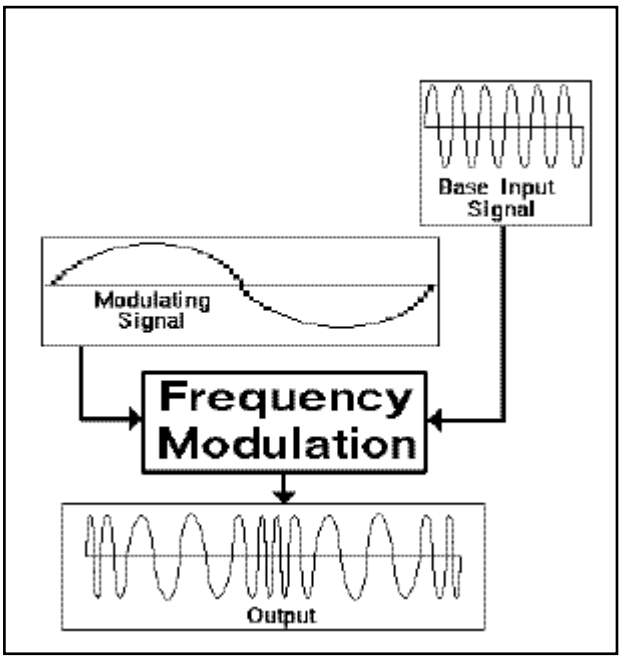


FIGURE 4.11. Frequency modulation

4.8 SSTV software analysis

Slow can television (SSTV) software is used to receive and transmit still picture via amateur radios in color or monochrome. SSTV can operate on maximum bandwidth of 3 kHz. There are several types of modes in SSTV software can be used to transmit a picture. The time taken to receive a picture from SSTV transmission is depends on the modes used. Several modes take shorter time to transmit image whereas some takes longer time to transmit the image. SSTV will scan the pictures uploaded and convert the pictures colours into different frequencies of audio tones. In a simple term, the signal frequency oscillates up or down depending on the brightness of the picture's pixel. The testing was carried out to show the different type of colour have different value of frequencies thus giving different audio tones. The testing is carried out using oscilloscope in the communication lab. The result is shown in the following TABLE 4.1

TABLE 4.1 below shows the output of frequency values for different colour images used in the SSTV transmission. The measurement of white, black, red, blue and green colours give resonant frequency values of 2300 Hz, 1500 Hz, 1660 Hz, 1980 Hz, 1820 Hz and 2118 Hz respectively. Each colours give different frequency values thus giving different audio tones through SSTV software. The frequency values are measured using digital oscillator by connecting to the output audio jack of PC. The audio tone generated by SSTV software is varies for each colour transmitted, thus giving different values of frequency in oscilloscope. The output frequency for white colour is shown in the FIGURE 4.11.

TABLE 4.1. Frequency oscillation for different colours

Colour	**Frequency(Hz)**
White	2300
Black	1500
Red	1660
Blue	1980
Green	1820
Yellow	2118

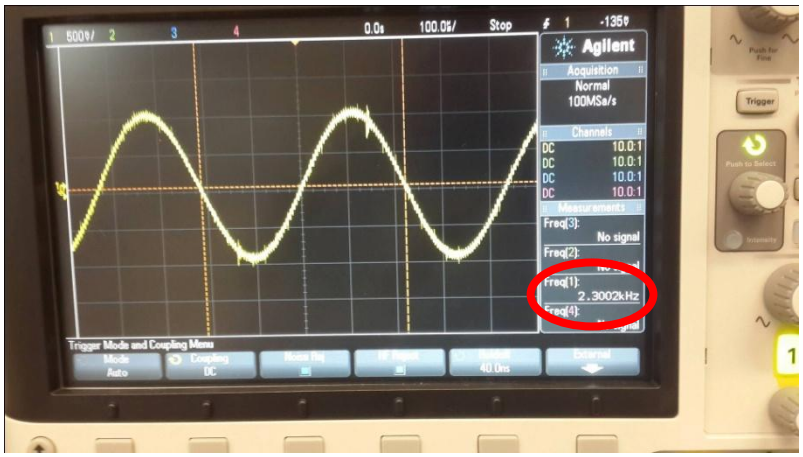


FIGURE4.12. Frequency value for white colour

Furthermore, the transmission of image is also been carried out using 6 different types of transmission modes. There transmission modes selected to be analysed are Martin 1, Martin 2, Robot 36, Robot 72, Scottie 1 and Scottie 2. The duration for complete image transmission is different for each transmission mode as shown in TABLE 4.2:

TABLE4.2: Transmission time by each Mode

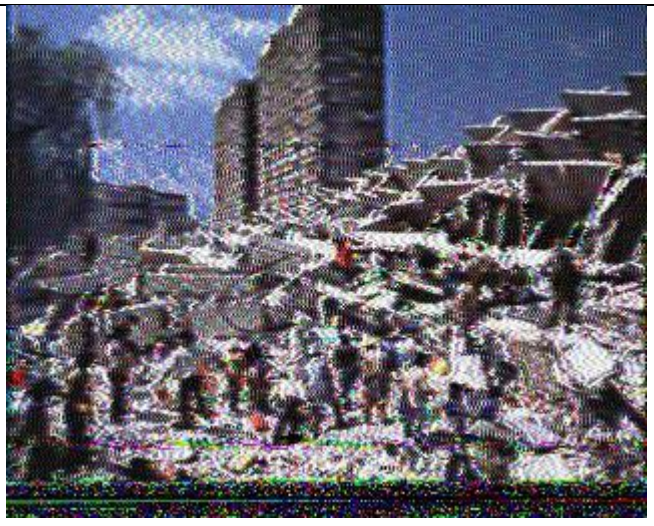
Mode	Transmission time (s)
Martin 1	114.3
Martin 2	58.06
Robot 36	36
Robot 72	72
Scottie 1	109.6
Scottie 2	71.1

It can be concluded that, modes which have more samples per scan line in transmission produce more detailed images and thus takes longer time for the

transmission. Thus, image transmission which utilising Martin 1 and Scottie 1 mode give more detailed image than the Robot 36 and Robot 72 modes. The mode analysis results are shown in TABLE 4.3:

TABLE4.3: SSTV Modes analysis

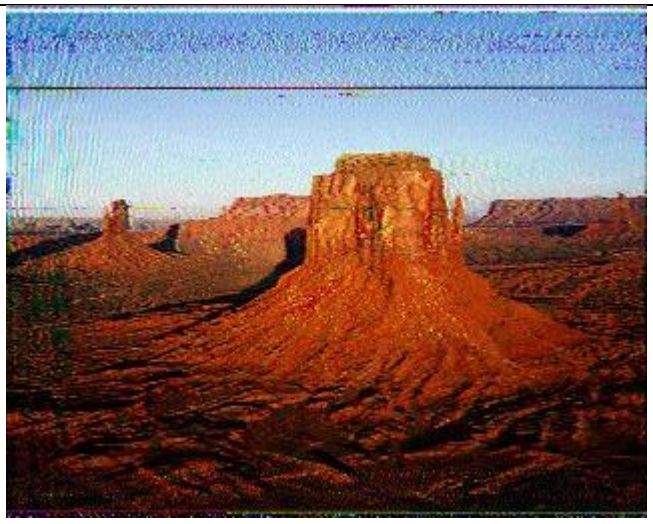
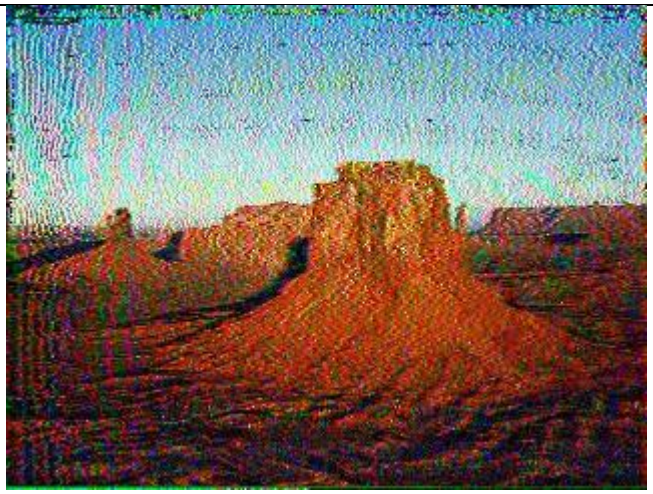
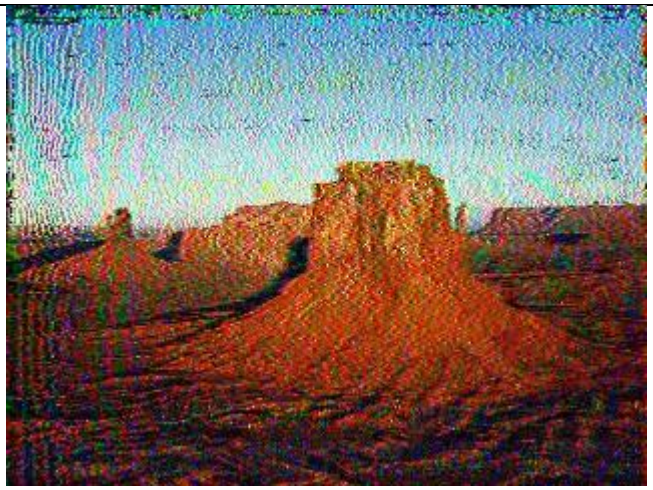
	• Original image transmitted • No noise • Very detailed image • Perfect colour details
	• Martin 1 • Transmission time : 114.3s • Received image mostly similar as the original image • Every detail of image can be seen

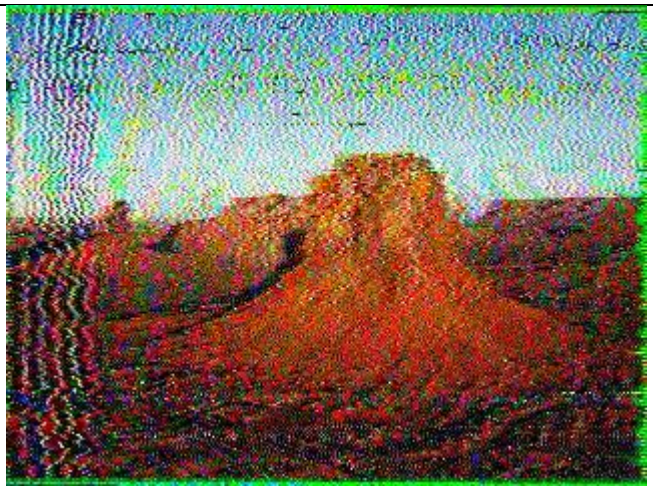
	• Scottie 1 • Transmission time : 109.6s • Received image almost similar to original image.The image is slightly dull compared to original image
	• Robot 72 • Transmission time : 72s • Image is dull compared to original image • Got some noise and error in transmission
	• Scottie 2 • Transmission time : 71.1s • Image consists quite alot of noise and error • Some details of images are missing but still mostly are present

	• Martin 2 • Transmission time : 58.06s • Image is very dull compared to original image • Colour is very much fade
	• Robot 36 • Transmission time : 36s • Image is very much pale and dull compared to original image • Image is not stable • Some details from image are hard to see

The analysis is also carried out in two main factors that influence the transmission image. The factors are distance and volume. For the distance, the transmitter and receiver is kept for different distance range to each other. The distance ranges are 5m, 15m, 25m, and 30m. From the results analysis, it is concluded that, the more the distance from the transmitter from the receiver, the lower the quality of the picture received. This may be caused by several factors. The longer transmission range will cause more error and noise in the middle of transmission, thus causing the quality of pictures received is not very clear. Other than that, it also can be caused by the natural factors such as lightning, raining. These factors can causes interruption to the transmission signals. Noise from human such as working noise, human voice also can make disturbances to the transmission. The results based on distance are shown in the TABLE 4.4:

TABLE 4.4 Results analysis based on distance range

	• Distance is 5m • Transmission mode : Scottie 1 • Transmission time :108.6s • Very less noise in transmission • Picture is clear with very less error
	• Distance is 15m • Transmission mode : Scottie 1 • Transmission time : 108.6s • Picture is not clear and have some error • Picture is blur and not stable
	• Distance is 25m • Transmission mode : Scottie 1 • Transmission time : 108.6s • Picture is not stable and having alot of errors

	• Distance is 30m • Transmission mode : Scottie 1 • Transmission time : 108.6s • Picture consists alot of noise and very hard to see the details on the image

Furthermore, the analysis is continued towards the next factor, volume. The volume of walkie talkie is adjusted to 25%, 50% and 100% of the maximum volume of walkie talkie. While the distance between transmitter and receiver is maintained the same for volume testing. The results of the transmission of image with various volume levels is analysed and shown in the Table 4.5:

TABLE4.5: Results analysis based on volume percentage

	• 25% of max volume • Image received was not clear and have some signal loss during transmission • Details in image is not clear

	• 50% of maximum volume • A very less signal loss during transmission • Details in image still can be detected
	• 100% volume of walkie talkie • Image was very clear • Have very less bit error • No details in image lost during transmission

4.9 Data Analysis of Results

The results from volume test and distance test is recorded and analysed. The results are analysed using Matlab software. Matlab software is chosen to analyse the noise in images received by the transmission using Peak Signal Noise Ratio (PSNR). PSNR is an expression for the ratio between the maximum possible value (power) of a signaland the power of distorting noise that affects the quality of the image.PSNR values are calculated in decibel. The Peak Signal Noise Ratio is defined as shown in FIGURE 4.11:

$$PSNR = 20 \log_{10} \left(\frac{MAX_f}{\sqrt{MSE}} \right)$$

FIGURE 4.13: Equation of PSNR

MAX_f ,is the maximum signal value that exists in our original image while **MSE**is Mean Squared Error .The PSNR analysis is carried out for parameters of distance and magnitude of volume. The Matlab software is used to get the Peak Signal Noise Ratio of each images received from different specification in the transmission as shown in TABLE 4.5 above. The PSNR values of the image and graph plotted from the volume test is shown below:

TABLE4.6: Values of PSNR from volume analysis

Number of image	Volume Percentage (%)	PSNR Value (dB)
1	25	8.7300
2	50	8.7445
3	100	8.8308

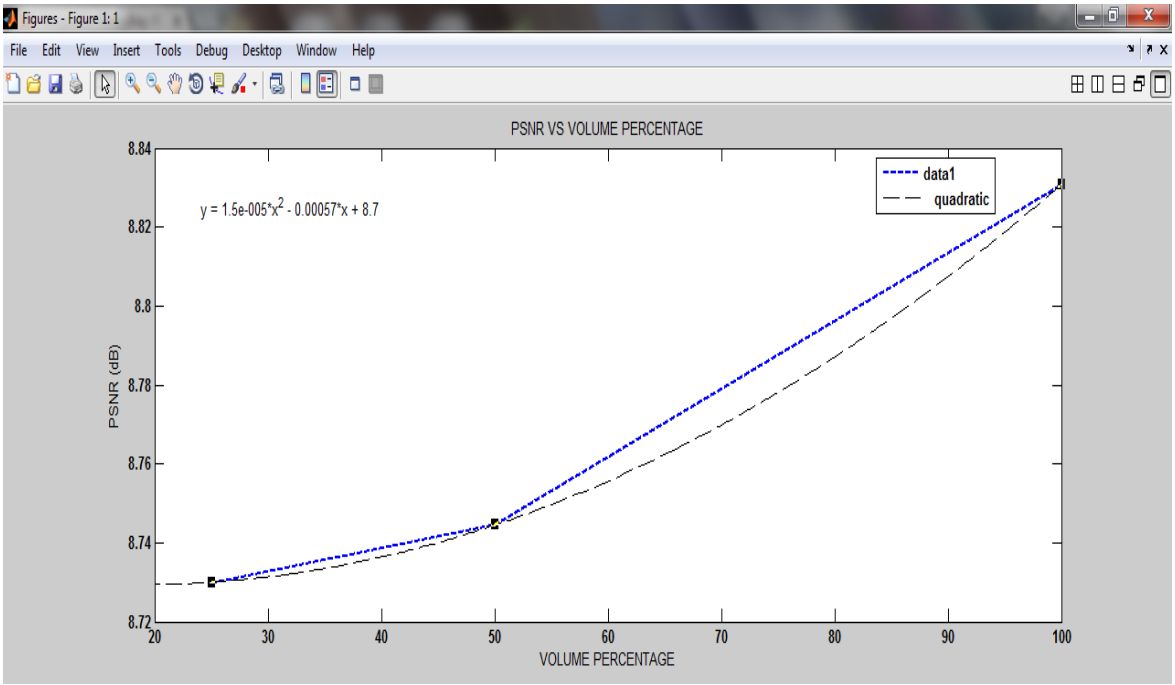


FIGURE4.14. Graph of PSNR vs Volume Percentage

FIGURE 4.14 shows the plot of PSNR versus the magnitude of volume for the transmission of VHF radio. The analysis above shows that higher volume percentagegives more detailed images with less noise, thus giving higher PSNR value. It is shown in FIGURE4.12, that the value of PSNR is increasing when the magnitude of volume is increased.

Besides that, another analysis have been carried out to find PSNR value of each images received from different distance range of transmitter and receiver. The images received from distance test results are shown in TABLE 4.4. The PSNR values and the graph plotted based on values is shown in FIGURE 4.15:

TABLE4.7: Value of PSNR in distance analysis

Distance (m)	PSNR Value (dB)
5	8.0123
15	7.9994
25	7.9651
30	7.9241

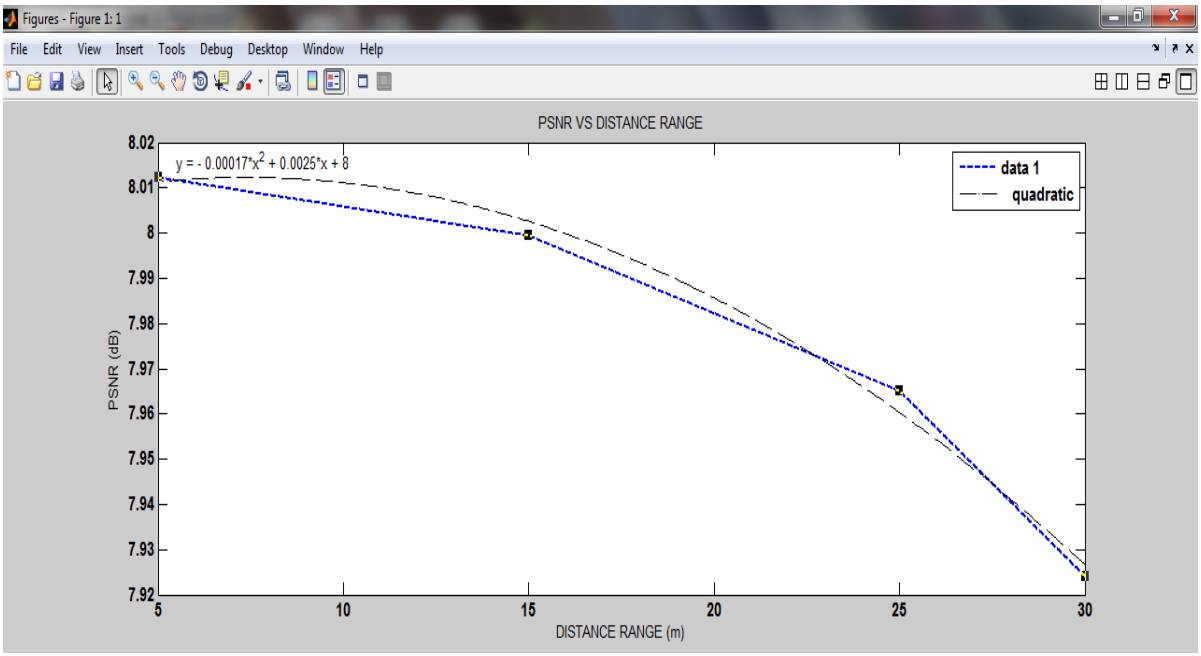


FIGURE4.15. Graph of PSNR vs Distance range

The x-axis is the distance range between transmitter and receiver while the y-axis is the PSNR value. The average PSNR value calculated in the distance range transmission analysis is 7.9649 dB. Thus it is concluded that, longer distance transmission cause more distortion to the image quality compared to the nearer distance image transmission. This is influenced by several factors such as human voice, industrial noise and also natural cause such as raining, lightning and so on.

RECOMMENDATION

There are plenty of future modifications and development can be made on the current project. Therefore, it is very recommended to any dedicated candidate or student to take this project to continue and made more useful modifications. First of all, most of us want to transmit images and received those transmitted images with less error and noise. Thus, can design a effective walkie talkie antenna that reduces noise when receiving the voice signal.

Furthermore, few elements can be reduced to simplify the communication in the efficient way. For example, the use of PC as interface medium to the transceiver can be avoided with built-in camera in the walkie talkie. Thus, can transmit image immediately by taking picture on the spot using the walkie talkie camera and received in the receiver walkie talkie camera.

In addition, the distance limitation for the transmission can be extended more even can receive images from satellite. But for that implementation, the amateur radio must be registered and most importantly the person handling the radio must have the license from Federal Communications Commission (FCC). For that reason, handie talkie was used to analysis image transmission system via RF.

Basically, all the user wants to receive a picture with perfect quality as the original image transmitted even though in the bad communication condition. Thus, the dedicated candidate who willing to take the challenge may work for the future development recommended or by implementing any own mind-blowing ideas for the betterment of project.

CONCLUSION

An alternative communication medium via radio frequency using image transmission method was successfully investigated and analysed in the Final Year Project. This project describes a powerful, yet low cost communication medium using RF. This method of image transmission communication brings very important role whenever there is no line coverage for the mobile line, Bluetooth, Infrared. This is because, handie talkie operates using its own antenna and not depending on local antenna. Thus whenever, there is a disaster happens in a specific place, this image communication method can be implemented to overcome the communication lost and seek for outside help. SSTV software is used to decode and encode images for the successful transmission.

For Final Year Project 1, the initial stage in the project, building a Push to Talk (PTT) interface circuit, testing, trouble shooting has been successfully done. Building PTT interface circuit has been very challenging task where it cannot control the PTT button of the walkie talkie when it is transmitting. PTT interface circuit have to be implementing especially for the power consumption of handie talkie.

Most important stage in this project is integrating all the sub-elements together for a successful image transmission. At the end, the main objective of this project to transmit image via RF has been successfully achieved. The complete processes of image transmission from SSTV to transmitter and then to receiver is clearly understood. The analysis has been carried out from the test performance of the image transmission using Matlab software. The two factors been analysed in this project is distance between transmitter and receiver and volume of walkie talkie set to transmit the audio signal which carries image data. The images received from test performances and Matlab analysis is shown in this report.

In a nutshell, recommendation and ideas for future development is given for next researcher who willing to take this project to the next level. As mentioned, this project is very beneficial for all especially in emergency time such as disaster occasions. As mentioned, this project can be commercialized to the market because it is provide all time communication for people, thus gives profit to the developer.

REFERENCES

1. J. Yang, M. H. Lee, M. Q. Jiang, and J. Y. Park, "Robust wireless image transmission based on turbo-coded OFDM," IEEE Trans. Consumer Electronics, vol. 48, no. 3, pp. 724 – 731, Aug. 2002.

2. H. A. Rahim, N. S. Murthy, F. A. Malek, R. B. Ahmad, A. S. M. Zain, "Design and simulation of Orthogonal Frequency Division Multiplexing transceiver system using Differential Phase Shift Keying (DPSK) for Wireless Local Area Network," *International Conference on Computer and Communication Engineering (ICCCE),* 2010.

3. C. McDonald "Introduction to RF & Wireless Communication System-Developer Zone," National Instruments, April 5,2011.

4. R. C. Gonzalez & R. E. Woods, "Digital Image Processing," Addison-Wesley, 2002.

5. K.K. Sarma, "A digital phase locked loop based Signal and Symbol Recovery System for Wireless Channel, Signal and Communication Techonology,"*IEEE*, 2009

6. H. A. Rahim, N. S. Murthy, F. A. Malek, R. B. Ahmad, A. S. M. Zain, "Design and simulation of Orthogonal Frequency Division Multiplexing transceiver system using Differential Phase Shift Keying (DPSK) for Wireless Local Area Network," *International Conference on Computer and Communication Engineering (ICCCE),* 2010.

7. D. G. Sachs, R. Anand and K. Ramchandran, "Wireless Image Transmission Using Multiple-Description Based Concatenated Codes," March 2000.

8. W. Hong and S. Li, "Improve the Effectiveness of Wireless Image Transmission using Wavelet Transform," *Pro. IEEE Int. Symposium on Microwave, Antenna,Propagation and EMC Technologies for Wireless Communication*, pp. 1295 – 1298, Aug. 2007.

9. J. R. Schueckler, "A Digital Image Processing System for Slow Scan Television, Department of Electrical Engineering College of Engineering Rochester Institute of Technology Rochester, New York May, 1981.

10. Behzad, Arya Reza, " The implementation of a High Speed Experimental Transceiver Module with an Emphasis on CDMaApllications. Berkeley, Calif. : Electronics Research Laboratory, College of Engineering, U of California, 1995.

11. M. Nagao, T. Matsuyama, H. Mori, "An Interactive Picture Processing System on a Minicomputer, " Department of Electrical Engineering KyotoUniversity

Japan, *Proceedings International Conference on Pattern Recognition and Image Processing.*200

12. A. G. Huda & A. Reza, " An E-learning interactive source for teaching digital image processing at the undergraduate level in engineering. " Published in Interactive Collaborative Learning (ICL) 2012 15TH International Conference, September 2012.

13. Guo, Y. J. , "Antenna and RF technologies for future wireless communications systems, " in *and Propagation (APCAP), 2012 IEEE Asia-Pacific on,* vol., pp. 77-75, 27-29 Aug. 2012.

14. Haykin, Simon S., and Michael Moher. *Modern Wireless Communications*. Upper Saddle River, N.J.: Pearson/Prentice Hall, 2005. 560.

15. *Evaluation of Slow Scan Television for Traffic Condition Monitoring* (Vol. 398). (2011). Northwestern University, Texas: Texas Transportation Institute, Texas A&M University System, 1985.

16. Ingram, Dave. *The Complete Handbook of Slow-scan TV*. Vol. 859. Blue Ridge Summit, Pa.: G/L Tab, 1977.

17. Morais, D. (2004). *Fixed broadband wireless communications: Principles and practical applications* (p. 384 pages). Upper Saddle River, N.J.: Prentice Hall/Professional Technical Reference.

18. *WCNC : 1999 IEEE Wireless Communications and Networking Conference, [21 - 24 September 1999, New Orleans, USA; conference record]* (p. 1580). (1999). Piscataway, NJ, University of Michigan: IEEE Operations Center.

19. Tomasi, Wayne. "Psk Modulation." *Advanced Electronic Communications Systems*. 5th ed. Upper Saddle River, N.J.: Pearson Education, Limited, 2013, 2001. 616 Pages.

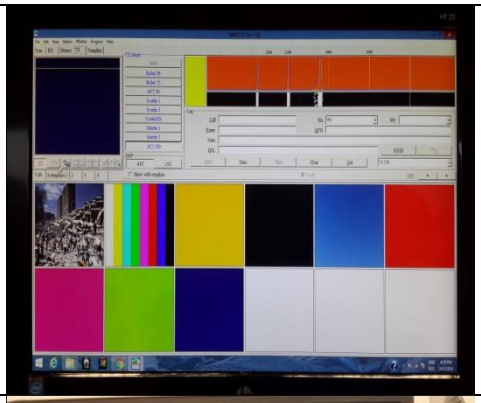
20. J. Pavlovi, M. Moko& J. P. Milan, "Detection of Transmission Errors n Block Coded Images," Journal of Electrical Engineering, Vol.56,2005.

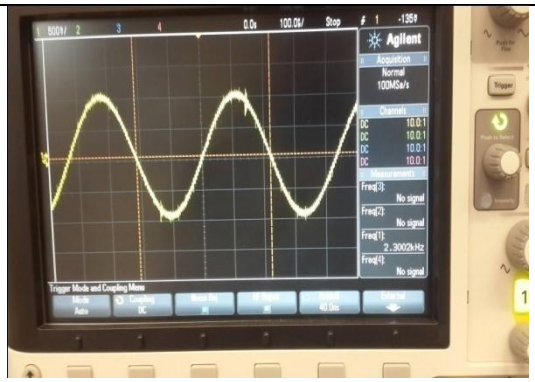
APPENDICES

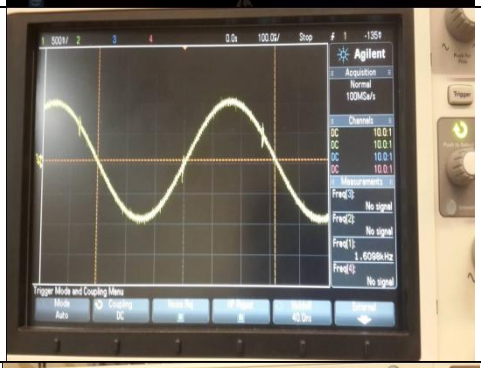
APPENDIX 1: Final Year Project Cost

NO	HARDWARE	QUANTITY	PRICE (RM)	TOTAL (RM)
1	Resistor 1/4W	8	0.05	0.4
2	Transistor BC 548	2	0.4	0.8
3	E-cap 0.1u	4	0.2	0.8
4	LED Blue and Yellow	4	0.6	2.4
5	Veraboard small	2	1.5	3
6	3.5 audio jack	4	0.5	2
7	3.5 to 2.5 audio adapter	2	9	18
8	Box	2	5	10
9	2 meter wire	1	2	2
10	Walkie-talkie	2	140	280
11	9 pin to USB Cable	2	12	24
				RM 343.4

APPENDIX 2: Testing Colour Frequency Output







APPENDIX 3: Presentation Poster