DESIGN AND CONSTRUCTION OF A

WIRELESS AUDIO/VIDEOS

TRANSMITTER

BY

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2004/18752EE

DEPARTMENT OF

ELECTRICAL/COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY

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A thesis submitted to the department of Electrical and Computer Engineering, Federal University of Technology Minna, in partial fulfillment of the requirements for an award of Bachelor in Engineering (B. Eng.)

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Dedication

I dedicate this work to my late mum Mrs. Victoria, whose soul goes matching on. She believed so much that I will make great achievements in life, that has inspired me greatly and today I see her dreams come true.

ATTESTATION/DECLARATION

I MANSHIK NANMAN GWAMZHI, hereby declare that this project work was carried out by me and has never been presented elsewhere in any form for the award of a degree. All information derived from published work was duly acknowledged. I also, hereby relinquish the copy right to Federal University of Technology Minna.

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09/03/10

Signature and date

Acknowledgement

First, my profound gratitude to God Almighty for his grace, without which this work would not have been possible.

Also, in no little measure I appreciate my father, Chief Manshik Gwamzhi for being the financial pillar and for the confidence he has in me. I will equally not forget my project supervisor Engr. J.G Kolo and my project technical supervisor Mallam Umar for their guidance and constructive criticism through every stage of this project. Also I shall not fail to appreciate my brother Barr. Nandang Gwamzhi and his wife Aunty Vero for the important role they played in my life. God bless you all.

ABSTRACT

This project work is based on the design and construction of a wireless Video/Audio transmitter that allows the transfer of a Video/Audio signal over a certain distance. This project consists of six different modules namely: Power Supply Unit, Oscillation/Modulation Unit, Input Amplification Unit, Power Amplification Unit and Antenna Unit. The design is done such that we have the video input and audio input and the two signals were processed separately then combine and transferred to a single antenna. The aim of this project was achieved since the constructed circuit is capable of transmitting Video/Audio signals over a certain distance.

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CHAPTER ONE

1.1 INTRODUCTION

With the fast growing technology in our world today, there is little time for inconveniences and a greater need for portability. The idea for a Video /Audio transmitter comes from this need. A video transmitter creates an infinite number of possibilities, for instance it would allow you to set up security cameras around your house which would send video/audio signals directly to a television or VCR that is tuned to the same frequency. In addition there would be no need to deal with cumbersome wires and cables.

The purpose of communication systems is to transmit information from a source to a receiver. This project is to provide a means, by which video/audio signal can be distributed through a wireless mode which would provide more convenience, and it is obvious that this project compared to one using wire transmission, will be more economical, easily managed and maintained.

Video/audio transmission however is a branch of communication which involves the sending, processing and reception of signals. A basic block diagram of a communication system is as shown below.

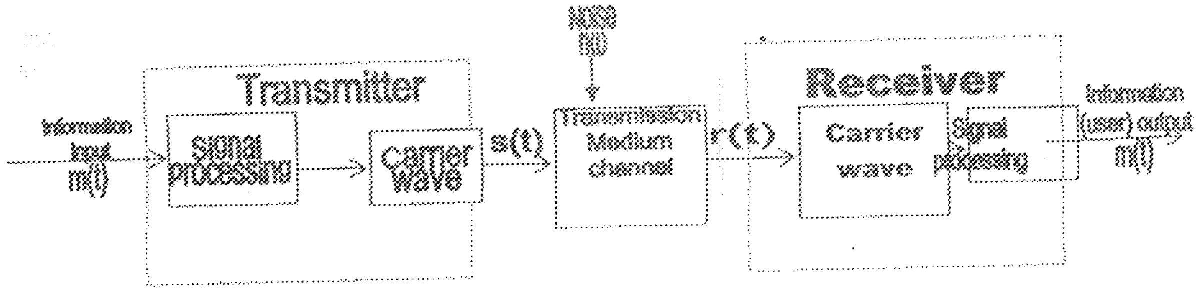


fig1.1 Block diagram of a communication system

The transmitter carrier circuit converts the processed baseband signal into a frequency band that is appropriate for the transmission medium of the channel. The input transducer could be a video camera, VCR receiver which serves as the base band signal source to the transmitter

1.2 OBJECTIVES

J. Ward a principal lecturer at university Columbus Ohio stated in applied digital electronics (1997) that the first step in designing any circuit is to take time to spell out exactly what you want the circuit to do for you. Hence this project is aim at achieving the following:

1. To process and transmit video/audio signals via a wireless link.
2. Transmission and reception of the electric signals
3. To design a video sender that is of low power requirement.

1.3 METHODOLOGY

A group of carefully selected components forming sub circuit of the final circuit were assembled for the design and construction of this project putting the following into consideration

1. The design was tested on a breadboard.

2. The design is permanently constructed and soldered on a Vero board

3. The prototype is packaged in a wood work design.

1.4 PROJET LAYOUT

This project writes up runs into five chapters. Chapter one is the introduction and objectives of the project. Chapter two is literature review. Chapter three forms the body of the project; it is a detailed discussion of the design and construction as well as the working principle of this project. Chapter four highlights the problems encountered, test and results. Recommendation and conclusion forms chapter five.

1.5 LIMITATION

1. Spectrum limitation

2. The non availability of component altered the original design as

Equivalent components were used.

3. The range of coverage is limited

CHAPTER TWO

2.1 LITERATURE REVIEW

Wireless communication is one of the big engineering success stories of the last twenty years, not only from a scientific point of view, where the progress has been phenomenal, but also in terms of market size and impact on society, unlike in the ancient time when communication over long distance was a challenge.[1]

Modern communication began in the 1800s with the discovery that electricity can be used to transmit signals. For the first time, a signal could be sent faster than any mode of transportation. The first practical telecommunication device to make use of this discovery is the telegraph. [2]

Telecommunication in general has been developing in step with mans progress. This is every bit true of television as a form of communication, it has travelled a long road from unrealized projects through mechanical systems to all electronics television as we know it today. [3]

The scientific foundation for television has been laid by the remarkable discoveries made in many countries. The advent of the first motion picture projectors followed the invention of the incandescent lamp by A N Ladyguin of Russia in 1873 and the accidental discovery of the properties of selenium by
W Smith and L May in the same year. These two discoveries enabled electric energy to be converted to light and back. [4]

Basing himself on these two discoveries, J.Kerry of the United State came up in 1875 with a system for the transmission of moving images. He was the first to propose that the image should be analyzed into elements. In Kerry's system, all of the picture elements were to be transmitted in parallel, and this called for a great number of communication channels-as many as there would be picture elements. The idea was obviously practical. It limitations were avoided in what are known as sequential television system using only one communication channel over which the picture element are transmitted in turn. Systems based on this principle were proposed in a variety of designs by A. de Paiva (1878) of Portugal, the Russian physiologist P.I. Bakhmetyev (1880), S. Bidwell of Britain (1881), and Seneca of France (1881), the details and techniques have of course changed since then, but the basic principle of sequential transmission has survived. [5]

The idea of wireless radio communication in the mid 1800 from the theories of two English physicists, Michael Faraday and James C. Maxwell predicted the existence of electromagnetic waves that made broadcasting possible. [6]

In 1884, N. Nipkow, a Polish working in Germany, invented his mechanical analyzer, now known as the nipkow disc, which ushered in the era of mechanical television systems. Mechanical television was able to show something for the effort put into it in 1925 when J.L. Baird in Britain and C. Jenkins in the United States first demonstrated the transmission of moving silhouettes over a distance. In the Soviet Union, a mechanical TV system was shown in early1931. The first broadcast TV system used the Nipkow disc, but mechanical television was inherent unable to improve definition and sensitivity, to display the picture on a large viewing screen and so on.[5]

In 1988 the German physicist applied the theory of the existence of electromagnetic waves to construct a spark gap transmitter, a device that generated radio waves from electric spark. [4]

The step towards electronic television was made by B.L. Rosing of Russia in 1907 when he proposed an improved version of the Brown tube instead of the Nipkow disc at the receiving end. The idea of an all-electronic television system was advanced for the first time by Cambell-Swinton of Britain in 1908.

In 1895, Italian electrical engineer Marconi extended the range of that transmission and adapted a technology that later resulted in wireless radio that could transmit actual voice and music. [7]

In 1901, Marconi built the first trans-oceanic telegraph transmitter, which had 3400km (2100miles) from England to Sean John`s new found land. An English physicist and engineer Sir John Ambrose Fleming and American inventor Lee De Forest made it possible to modulate and amplify wireless signals to send voice transmission. The range and clarity of voice transmission increased as advancement in technology were made, in 1951 the American telephone company transmitted a voice message by radio between the United States and France. [8]

By 1930s small two way radio transmitters were in common use among law enforcement and civil emergency authorities. Improvement in technology has made two way communication systems smaller and lighter, with extended range and capabilities. [2]

Televisions got its start as mass communication media shortly after the World War II (1939-1945). Television broadcasting boom began just after the war in 1946 and the industry grew rapidly from mechanical systems to all electronic system. [5]

Color TV has been an important milestone in the history of broadcast TV. Regular color telecasts in the USSR began in 1967. The event came as the climax of a good deal of research and development. In fact, color TV travelled the same road as mechanical and black-and-white electronic television. Because of its complexity, however, it lagged behind. At first, a mechanical color TV system based, as was the case with the black-and-white television, on the use of the Nipkow disc supplemented with tri color filters was proposed by I.A Adamain in the Soviet Union in 1925. The idea was followed up by Baird of Britain who demonstrated a sequential color television system in 1928. Similar experiments were made by Bell Television Laboratories in the United States, using a three-channel sequential color system. Subsequent work was mainly concentrated on sequential (mechanical-electronic) systems as less expensive and more technically feasible. Sequential color TV was adopted for telecasting by the United States in 1951 and by the Soviet Union in 1953. They were in operation for a year and were later removed. [3]

Since they were incompatible with black-and-white television, the early sequential color TV systems failed to find their way into telecasting practice. This set scientist looking for compatible color TV systems. The first compatible parallel color TV system was developed and adopted in the United States in 1953 and is now known as the NTSC (National Television System Community) system. Several compatible color TV systems have been proposed in Europe, including the Soviet Union. [9]

2.2 THEORETICAL BACKGROUND

By the process of modulation, the base band signals are made suitable for transmission over a transmission media. Modulation occurs in the transmitter, the transmitter also ensure sufficient RF (radio frequency) power is supplied to the transmitting antenna by amplification of the band pass signal at the final stage of the transmitter. [7]

2.2.1 MODULATION IN TV TRANSMITTERS

Both amplitude modulation (AM) and frequency modulation (FM) are used in processing of the base band signals for TV broadcast. The audio signal is frequency modulated forming the audio sub carrier that is 4.5 MHz higher than the video carrier frequency. The video signal is amplitude modulated unto the RF carrier, at this point the double side band AM signal is generated.[4]

Transmitting DSBAM (double side band amplitude modulation) does not make efficient use of transmitting power and bandwidth. The base in power economy and bandwidth economy is the SSBSC (sing side band suppressed carrier) amplitude modulation but this is not applicable in TV transmission since side band signals extend down to lower frequencies. It is impossible to suppress the whole of the undesired band signal without affecting the low frequency component in the wanted side band. This leads to what is known as the vestigal side band modulation, which is use in TV broadcasting. [2]

2.2.2 FM THEORY

Given the expressions below:

$V_c = A\cos\Phi(t)$ 2.1

$\Phi(t) = 2\pi fct + \alpha$ 2.2

Where:

V_c =carrier voltage

$\Phi(t)$ =carrier angle

$\hat{A}$=carrier amplitude

f_c=carrier frequency

α=carrier phase

Angle modulation varies the angle of the carrier by an amount proportional to information signal amplitude. Angle modulation can be broken into two, Frequency Modulation and Phase Modulation.

2.2.3 FREQUENCY MODULATION (FM)

FM is an angle modulation in which the frequency of a sine wave carrier is caused to depart from the carrier frequency f_c by an amount proportional to instantaneous value of the modulating or intelligence waves.

2.2.4 DERIVATION OF THE FM VOLTAGE EQUATION

V_{fm}=ACos ω (t) 2.3

$f=f_c + \Delta f$ 2.4

$\Delta F=k_o \times V_m$ 2.5

Equation (2.3) to (2.5) governs the output of a voltage controlled oscillator (VCO). F is the frequency of the modulated output.

$\omega=d\Theta/dt=2\pi f$ 2.6

That is, taking the derivative of angle from equation (i) give the angular velocity of the output.

But,

$f = f_c + \Delta f$

Hence substituting equation (2.3) in equation (2.5)

$\omega = d\Theta/dt = 2\pi (f_c + \Delta f)$ 2.7

Taking the integral of both sides

$\Theta(t) = 2\pi ft + 2\pi k_o \int Vm(t)\, dt$ 2.8

Where $\Delta f = K_o V_m$

But ,

$V_m(t) = Cos(2\pi fmt)$ 2.9

Hence

$\Theta(t) = 2\pi fct + K_o V_m (Sin 2\pi fmt)/fm$ 2.10

By substituting equation (2.10) in (2.1)

Finally the FM voltage equation is given by

$V_{fm} = ACos\{2\pi fct + K_o V_m (Sin 2\pi fmt)/fm\}$ 2.11

$V_{fm} = ACos\{2\pi fct + \beta (Sin 2\pi fmt)\}$ 2.12

Where:

$\beta = K_o Vm/fm = \Delta f/fm$ 2.13

The equation (2.13) above represents the standard equation for frequency modulation and β is a variable of the equation called the modulation index. K_o is a parameter of the circuit a miller capacitance of the transistor.

2.2.5 FREQUENCY MODULATION GRAPHS

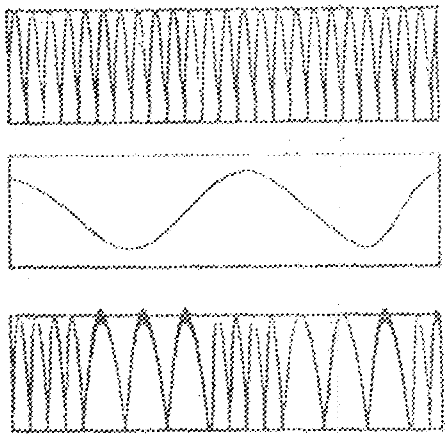


Fig2.1 frequency modulation graphs (carrier, modulating and modulated wave forms)

2.2.6 FM SPECTRUM AND BAND WIDTH: A frequency modulated wave consist of an infinite number of frequency components called side frequencies each containing a fraction of the message signal bandwidth that is required for its transmission However, in practice an approximate value is reasonably taken about the bandwidth

Carrier

fc-3fm fc-3fm fc-fm fc fc+fm fc+2fm fc+3fm

Fig2.2 FM Spectrum

The approximate estimate of the transmission bandwidth in FM systems is given by the Carson's Formula

$B=2(\Delta F+F_m)=2f_m(\beta+1)$ 2.14

Where:

B=transmission bandwidth

ΔF=Frequency Deviation

ΔF_m=Modulating Signal Frequency

β=Modulation Index

2.3 AM THEORY

Amplitude modulation varies with the amplitude of the carrier by an amount proportional to the amplitude modulating or information signal. This can be stated mathematically as:

$V_{am}(t) = V_c + KV_m(t)$ 2.15

Given that

$V_m(t) = V_m \cos\omega_m t$ 2.16

Therefore,

$V_{am}(t) = V_c + KV_m \cos\omega_m t$

But $V_{am} = V_{am} \cos\omega_c t$

$V_{am} = (V_c + KV_m \cos\omega_m t) \cos\omega_c t$

$V_{am} = V_c (1 + KV_m/V_c \cos\omega_m t) \cos\omega_c t$

$V_{am} = V_c (1 + M \cos\omega_m t) \cos\omega_c t$

Where $M = KV_m/V_c$ implies modulation index of an AM signal, its value ranges between zero and one. The modulation depth is expressed in percentage.

Modulation depth=$M \times 100$

2.3.1 AMPLITUDE MODULATION GRAPHS

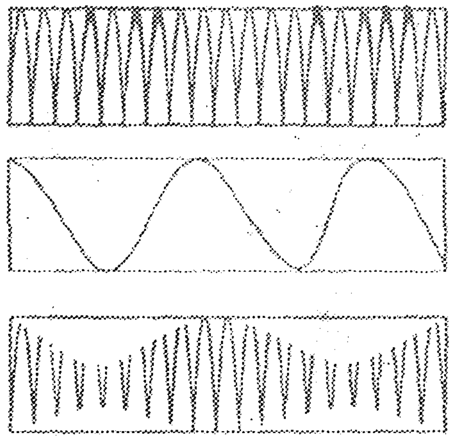


Fig2.3 Amplitude modulation graphs (carrier, modulating and modulated waveforms)

2.3.2 SPECTRUM AND BANDWIDTH

A simple AM signal contains three frequency components

(i) The carrier signal frequency, fc

(ii) The lower side frequency, fc-fm

(iii) The upper side frequency, fc+fm

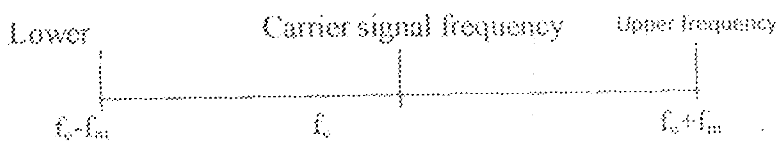


fig2.4 frequency spectrum of an AM spectrum

In other to transmit an AM signal. The entire frequency component must be taken into consideration β (transmission bandwidth) is given by:

$$\beta = (f_c + f_m) - (f_c - f_m) = 2f_m$$

This implies that the bandwidth for the transmission of AM signal is twice modulating signal bandwidth.

2.3.3 VESTIGIAL SIDEBAND MODULATION

A conventional AM signal i.e. A double side band AM signal is first generated and this is then applied to a filter having a transmission bandwidth between its stop and pass band that is skew symmetrically about the carrier frequency.

The total transmission bandwidth is given by:

$$\beta = Fv + W$$

Where W is the signal bandwidth and Fv is width of the vestigial side band for example W is 5.5MHZ for a 625 line television signal while Fv is 1.25MHZ. this gives a transmission bandwidth of about 6.75MHZ

2.3.4 THE ELECTROMAGNETIC SPECTRUM

Table 2.1 the electromagnetic spectrum classification and application

FREQUENCY BANDS	CLASSIFICATION	APPLICATION
3-30KHz	Very low frequency (VLF)	Long range navigation sonar
30-300KHz	Low frequency(LF)	Navigation aids
03-3MHz	Medium frequency (MF)	Commercial AM broadcasting
30-300MHz	Very high frequency (VHF)	VHF TV Broadcasting, and air traffic control
0.3-3GHz	Ultra high frequency (UHF)	UHF TV Broadcasting, Radar and satellite communication.
3-30GHz	Supper High frequency (SHF)	Micro wave links and land mobile communication
30-300MHz	Extra High frequency (EHF)	Rail road service Radar and landing systems.

The portion of the electromagnetic spectrum of interest is the UHF and VHF band of frequencies (ultra high frequency/very high frequency); which is used in TV broadcast. This is however due to the fact that electromagnetic waves experience negligible refraction in the atmosphere at this frequencies resulting in high quality signal reception

2.3.5 TV BROADCAST FREQUENCY BANDS

Broadcast television operates on a total of 52 RF channels which are accommodated between five frequency bands as follows.

Band I 48.5-66MHz (r.f channels 1 and 2)

Band II 76-100MHz (r.f channels 3-5)

Band III 174-230MHz (r.f channels 6-12)

Band IV 470-582MHz (r.f channels 21-34)

Band V582-790 MHz (r.f channels 35-65)

CHAPTER THREE

Design, Analysis and Constructions of a wireless video/audio sender

The project design was carried out in modules to ease the construction process and for easy assessment. It consists of six modules namely: the power supply unit, oscillation/ modulation unit, Audio input amplification unit, power amplification unit and Antenna.

The interconnection of these units is shown in the figure below.

For further elaboration the modules were discussed separately, pointing out what happened at each stage of the construction, thus:

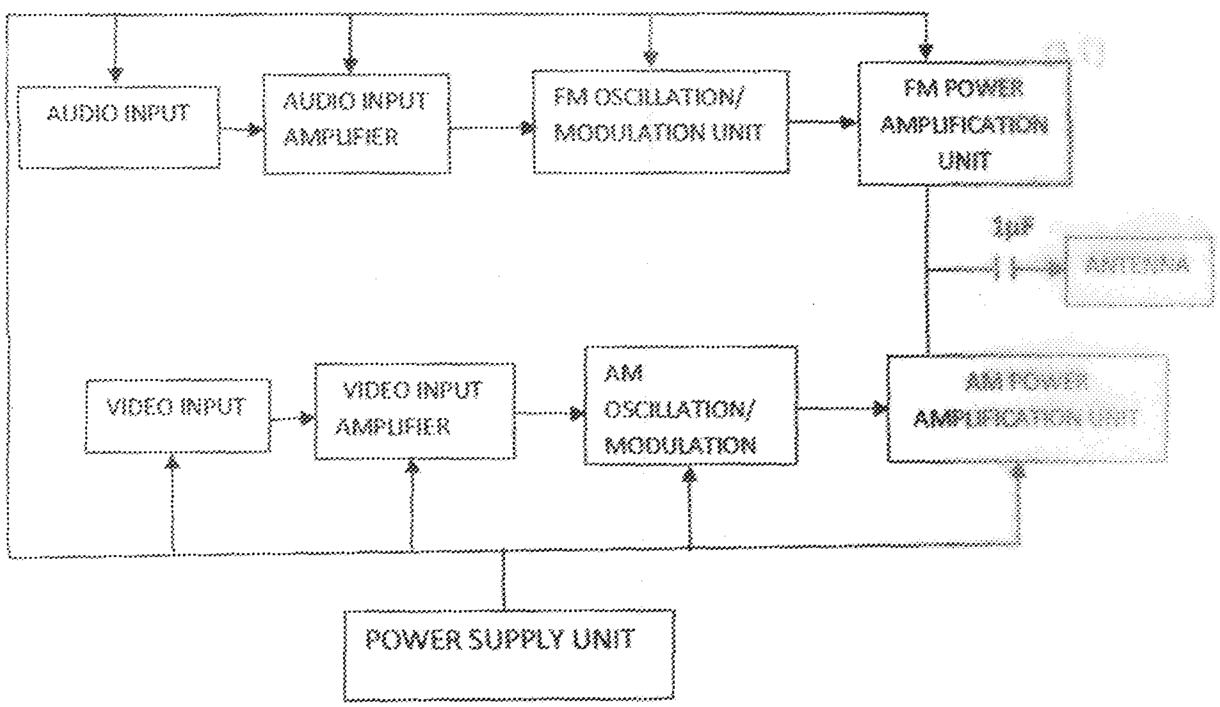


Fig 3.1 simplified block diagram of video/ audio transmitter

3.1 The power supply unit.

The power supply distribution in Nigeria is 240V 50Hz sinusoidal voltage (ac) and most electronic components and circuits require low direct (dc) voltages of about 5-15V. A regulated 12V D.C supply is therefore used in this design. A centre tapped $240V_{rms}$ step down transformer was used to obtain a 25V supply and rectified to regulate the voltage to a dc supply.

The design of a power supply source consists of a full bridge rectifier, which is made up of four silicon diodes, (two of which conduct during the negative half cycle). The output of the rectifier is a full wave rectified voltage Vo.

By calculation we have

$$V_o = \frac{2V_s\sqrt{2}}{\pi} \qquad (3.1)$$

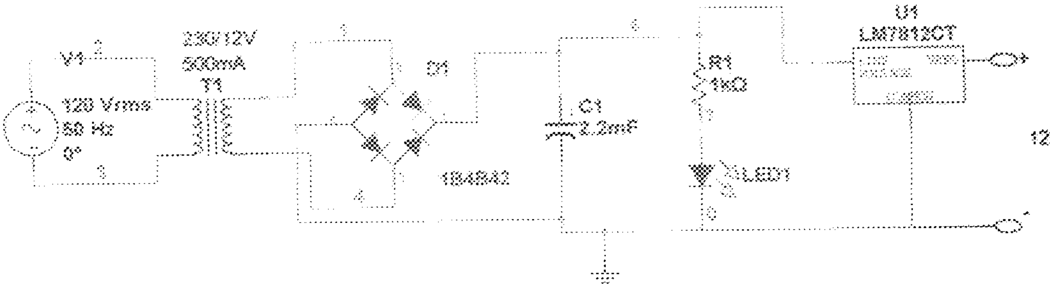
Where V_o = Average DC voltage value

V_s = Instantaneous or peak value

$$V_o = \frac{2\times 12\sqrt{2}}{\pi}$$

$$= \frac{2\times 16.97}{\pi}$$

$$V_o = 10.80V$$



The resulting voltage produced after rectification still has some ripples which is not needed in the circuit they are therefore removed by means of filtration. Filtration is the process of removing unwanted ripples and pulses and to achieve this purpose a capacitor is used to produce the necessary smoothing.

A light emitting diode (LED) is connected to the output as power output indicator. To obtain the value of the current limiting resistor for the LED we have

$$R = \frac{Vo - Vr}{I} \tag{3.2}$$

But for the LED

$V_r = 2V$, $I = 20mA$

$$R = \frac{12-2}{20 \times 10^{-3}}$$

$R = 500\Omega$

A 1KΩ resistor was used.

An LM7812 voltage regulator was used to regulate the rectified DC voltage to 12V. This regulation is necessary for steady voltage supply, because supply voltage is always varying and the DC voltage is directly proportional in magnitude to the value of AC supply [12].

3.2 STANDARD FOR BAND ALLOCATION TO CHANNELS

The table below shows a typical industry standard for band allocation to channels that might, help shade some light on this project.

Table 3.1 standard band allocation to channels

BAND	CHANNELS	FREQUENCY
Low –band VHF	2 through 6	(54-72 MHz and 76-88 MHz)
High-band VHF	7 through 13	(174- 216 MHz)
UHF	14 through 69	(470-806 MHz)
UHF	70 through 83	(8062890 MHz)

3.3 VIDEO INPUT SIGNAL AMPLIFIER UNIT

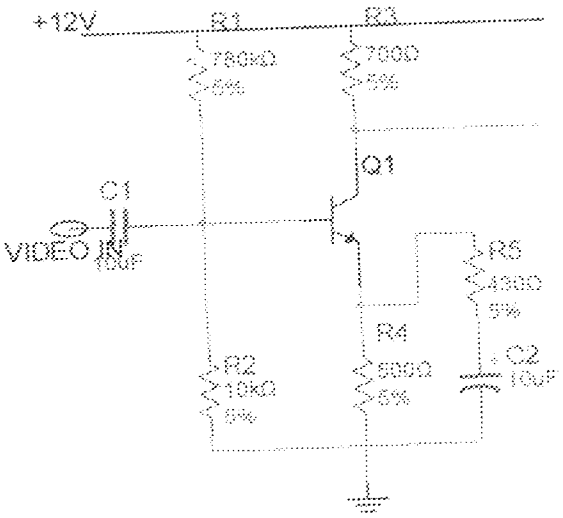


Fig3.3 circuit diagram of video input signal amplifier

For the common emitter amplifier circuit with Q1, the input signal video is amplified as required.

From the data sheet of Q1 (BC548) I_C =0.5mA

$V_c = V_{cc} - R_c I_c$

$R_c = \frac{Vcc - Vc}{Ic}$

$V_c = 0.5\ V_{cc} = 0.5 \times 12 = 6V$

$R_c = \frac{6}{0.5} \times 10^3 = 5K\Omega$

R_e= 500Ω was chosen

$V_e = I_e R_e = 500 \times 0.5 \times 10^{-3} = 0.25V$

V_b= 0.25 + 0.6= 0.15V

For the ratio R_1:R_2 to put V_b= 0.85V

V_{cc}- V_b= 12-0.15= 11.85 volts

$$\frac{R1}{R2} = \frac{11.85}{0.15} = 79k\Omega$$

R_2= 10K was chosen

R_1 = 79 × 10K = 790KΩ

For a gain of 10

$$Av = \frac{Rc}{Re + R_1//R_3}$$

$$10 = \frac{12000}{500 + 780e^3//R3}$$

$$R_3 = \frac{546e6}{779300}$$

R_3= 700Ω

The emitter base voltage (V_{be}) for silicon is ≈ 0.6V

3. 4 AM OSCILLATION/ MODULATION UNIT

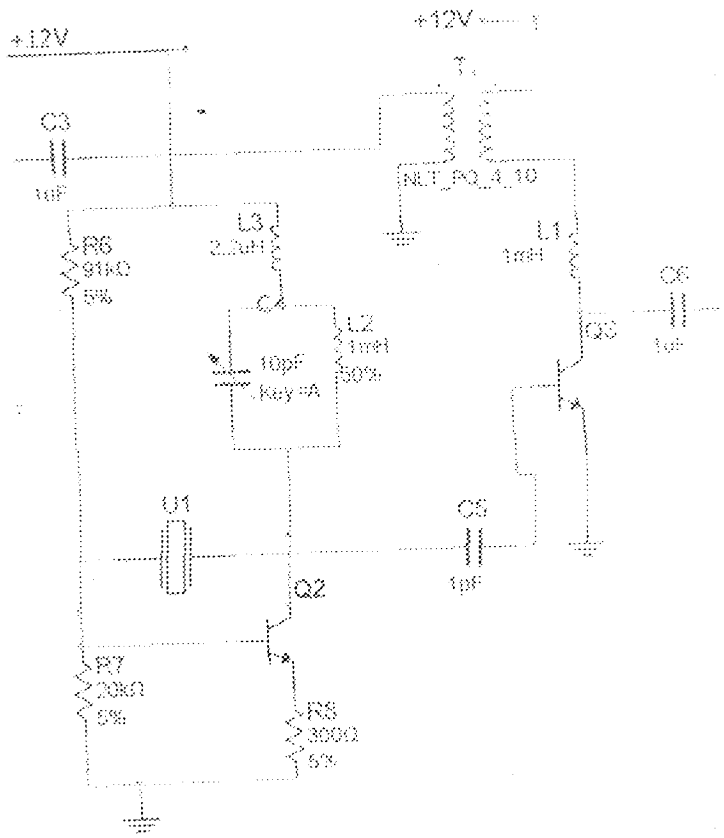


Fig3.4 Circuit diagram of AM oscillation/ modulation unit

The circuit Q2 is a crystal oscillator circuit that generates the carrier frequency of 175.25MHZ, while the LC tank circuit is tuned to the same frequency. Matching the carrier frequency with the LC tank gives a good stability. For the LC tank

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

F_0= 175.25MHZ

LC= $\frac{1}{(2\sqrt{f0})^2}$

= 8.25×10^{-19}

L is fixed at 1mH

C= $\frac{8.25\times10^{-19}}{1\times10^{-3}}$

C= 8.25pF

Hence the variable capacitor chosen was within this range of value, a 10pF variable capacitor was chosen.

C1 allows easy passage of the AM signal and provide good filtration.

The bandwidth of an AM signal BW= $2F_m$

Video signal range: O-5MHZ = F_m

Maximum bandwidth (BW) = 2×5= 10MHZ

3.5 FM OSCILLATION/MODULLATION UNIT

The amplified message (audio) signal and a carrier frequency locally generated by the collpits oscillator network are joined together in the circuit. The varactor diodes do the mixing by providing the means of altering the resonant frequency of the tank circuit, hence the modulation. The positive feedback provides sustenance of oscillations.

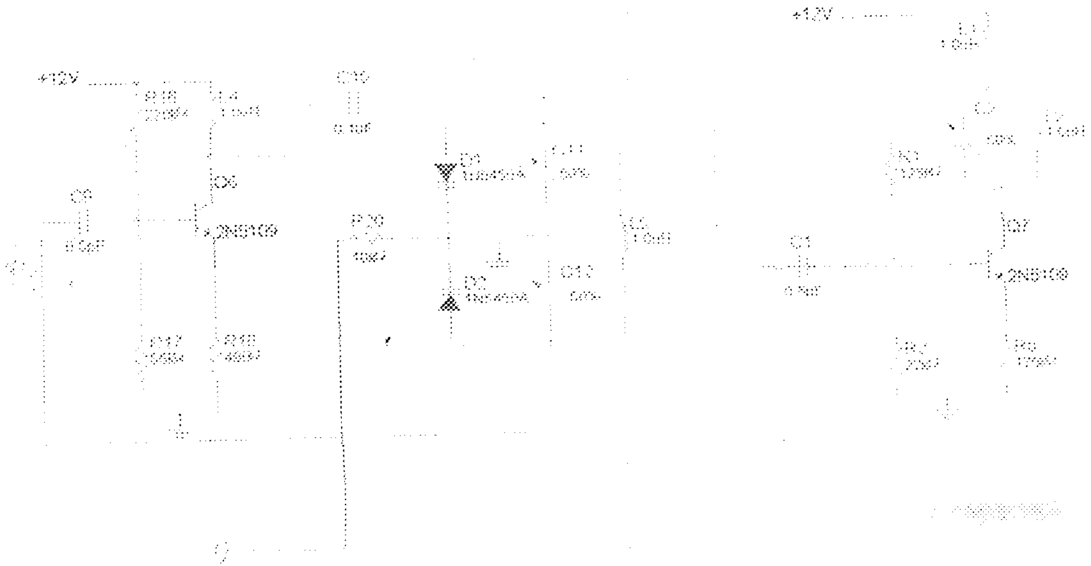


Fig3.5 Circuit diagram of FM oscillation/ modulation unit

The network with Q7 fixes the FM signal because the FM signal obtained at the stage before it is susceptible to differential changes based on changes on amplitude of the input message signal.

3. 6 AUDIO INPUT SIGNAL AMPLIFIER

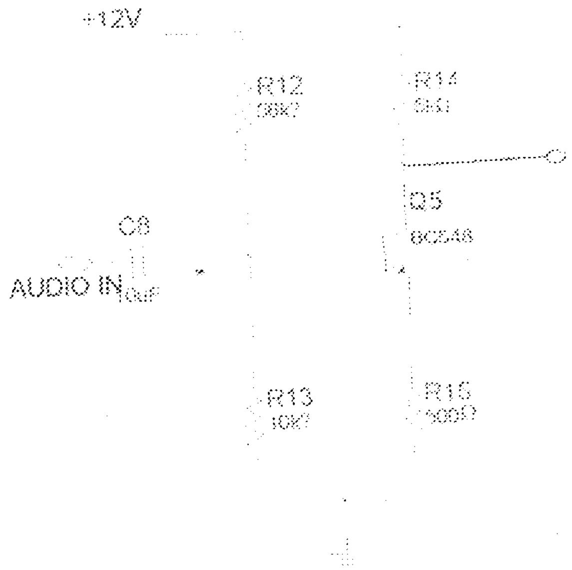


Fig3.6 circuit diagram of audio input signal amplifier.

The network Q5 is a common-emitter amplifier circuit which amplifies the input audio signal.

From the data sheet of the transistor Q_5(BC548) , I_c = 0.5mA

$$V_{cc} = V_c + I_c R_c \quad (3.3)$$

$$R_c = \frac{V_{cc} - V_c}{I_c} \quad (3.4)$$

$V_c = 0.5\ V_{cc} = 0.5 \times 12 = 6V$

$R_c = \frac{12-6e^{3}}{0.5} = 5k\Omega$

R_e = 500Ω is chosen

$V_e = I_eR_e$ (3.5)

$= 330 \times 0.5 \times 10^{-3}$

$= 0.25V$

$V_B = 0.25 + 0.6$

$= 0.85V$

For ratio R_1: R2 , putting V_b =0.85V

$V_{cc} - V_b = 12 - 0.85$

$= 11.15V$

$\frac{R1}{R2} = \frac{11.15}{0.85} => \frac{R1}{R2} = 13.1$

$R_1 = 13.1\ R_2$

R_2 = 10KΩ is chosen; R_1= 13.1 × 10k = 55.3kΩ

$R_e = \frac{25}{Ic}$

$R_e = \frac{25}{0.5}$ =50Ω at I_c= 0.5mA

A gain of 50 is chosen (this gain is greater than that chosen for the **video signal amplification** because generally, for signals from AV ports, the audio signals are **far smaller than those of** video).

$A_v = \frac{R_c}{R_e} + (R_c//R_3)A$ (3.6)

$50 = 5000/(50 + R3)$ (The effect of R_e is negligible)

$2500 + 50 R_e = 500$; $R_3 = (5000 - 2500)/50 = 2500/50 = 50\Omega$

The amplifier circuit incorporates a high pass fitter and has to pass **signal from 20Hz – 20** KHz (Audio). This implies passing frequencies from 20Hz.

The relevant resistance is $R_3 + R_e = 50 + 500 = 550\Omega$

$f = \frac{1}{2}\pi R_{in}C$; (3.7)

$C = \frac{1}{2}\pi f R_{in}$ (3.8)

$R_{in}(bias)/hfe(R_e + R_3)$ (3.9)

$R_{in}(bias) \approx R_2 = 10K\Omega$

$R_{in} = 10^3//(100 \times 100)$

$= 10^3//10^4$

$= 909.09\Omega$

$C = \frac{1}{2}\pi \times 20 \times 909.09$

$= 8.75 \times 10^{6}$

A 10nF capacitor is preferred.

C in combination with R_2 therefore forms a high pass fitter suitable for **passing audio signals.**

For the Colpitts Oscillator, operating frequency, we have

$$F_0 = \frac{1}{2}\pi\sqrt{LC_0} \qquad (3.10)$$

$$C_0 = \frac{C_1 C_2}{C_1 + C_2} \qquad (3.11)$$

C_o from the circuit diagrams of figure 2.4 is a ganged capacitor

$$LC_0 = \frac{1}{(2\pi f_0)^2} \qquad (3.12)$$

F_0 is set at 181MHz instead of 180.75MHz of the carrier since **the output will depend on the** amplitude of the message signal.

$$LC_0 = 1/(2\pi \times 181 \times 10^{6})^2$$

$$= 7.73 \times 10^{-19}$$

L is fixed at 0.1μH: $C_0 = 7.73pF$

$$\frac{C_1 C_2}{C_1 + C_2} = 7.73pF \qquad (3.13)$$

C_0 is chosen to be around this vicinity. **A 10pF- ganged capacitor is therefore chosen.**

Let RFC (2.7μH) = L, then **Reactance at f_o = 181MHz, $X_L = 2\pi f_o L$**

$= 2\pi \times 181 \times 10^6 \times 2.7 \times 10^6$

$= 3.07\ K\Omega$

Feedback fraction= $\frac{drop\ access\ C2}{drop\ access\ C1} = \frac{1X_{C2}}{1X_{C1}} = \frac{C_1}{C_2}$ (3.14)

From simulations, this was found to be = 0.16

Minimum gain to sustain Oscillations

$A_v\ (min) = \frac{1}{feedback\ fraction} = \frac{1}{0.16}$ (3.15)

$A_V \approx R_c/R_E$, therefore R_C/Re ; X_1 represent $R_c = 3.07K\Omega$

$R_E = 3.07\times10^3/6.25$

$= 0.49 \times 10^3$

$= 490\Omega$

To obtain theoretical values of C_1 and C_2 at the instance when **181MHz is tuned.**

From equation (3.13)

$C_1C_2 = 7.73\ (C_1 + C_2)$ (3.16)

From equation (3.14)

$C_1 = 0.16C_2$ (3.17)

Substituting (3.17) into (3.16)

$0.16\,C_2 \times C_2 = 7.73\,(0.16C_2 + C_2)$

$0.16C_22 = 8.97C_2$

$C_2 = 56.04pF$

Substituting C_2 back into (3.16)

$56.04C_1 = 7.73\,(C_1 + 56.04)$

$7.25C_1 = C_1 + 56.04$

$6.25C_1 = 56.04$

$C_1 = 56.04/6.25$

$= 8.97pF$

$V_c = 0.5V_{CC} = 0.5 \times 12 = 6V$

Therefore $I_C = \frac{VCC - VC}{RC} = \frac{12-6}{3.07 \times 1000}$

Therefore $V_E = I_E R_E$; $I_E = I_C$

Therefore $V_e = 1.95 \times 10^{-3} \times 500$

$= 0.97V$

$V_B = 0.97 + 0.6 = 1.57V$

For the ratio R_1, R_2

$V_{CC} - V_B = 12 - 1.57 = 10.43V$

$R_1/R_2 = 10.4/1.57 \Rightarrow R_1 = 10.4R_2$

$R_2 = 55K\Omega$ is chosen, therefore $R_1 = 55 \times 10.4 = 572K\Omega$

The LC tank of Q7 fixes the desired FM frequency (180.75MHz)

$f_0 = \frac{1}{2}\pi\sqrt{LC}$, $f_0 = 180.75MHz$

$$LC = \frac{1}{(2\pi f0)^2} = \frac{1}{(2\pi f0 \times 180.75 \times 10^6)^2} = 7.75 \times 10^{-19}$$

L is fixed at $0.1\mu H$: $C = \frac{7.75 \times 10^{-19}}{0.1 \times 10^{-6}} = 7.75pF$

The capacitor should be around this vicinity. A 10pF variable capacitor is chosen. The resulting FM signal is considered a narrow band FM. Since long distance transmissions are not required, this is quite sufficient. In this case therefore, Bandwidth of FM signal

BW = 2FM

Audio signal range: 20Hz – 20 KHz

Therefore Maximum BW = 2 × 20 KHz = 40 KHz

Modulation index β for this type of FM is known not to exceed 0.02

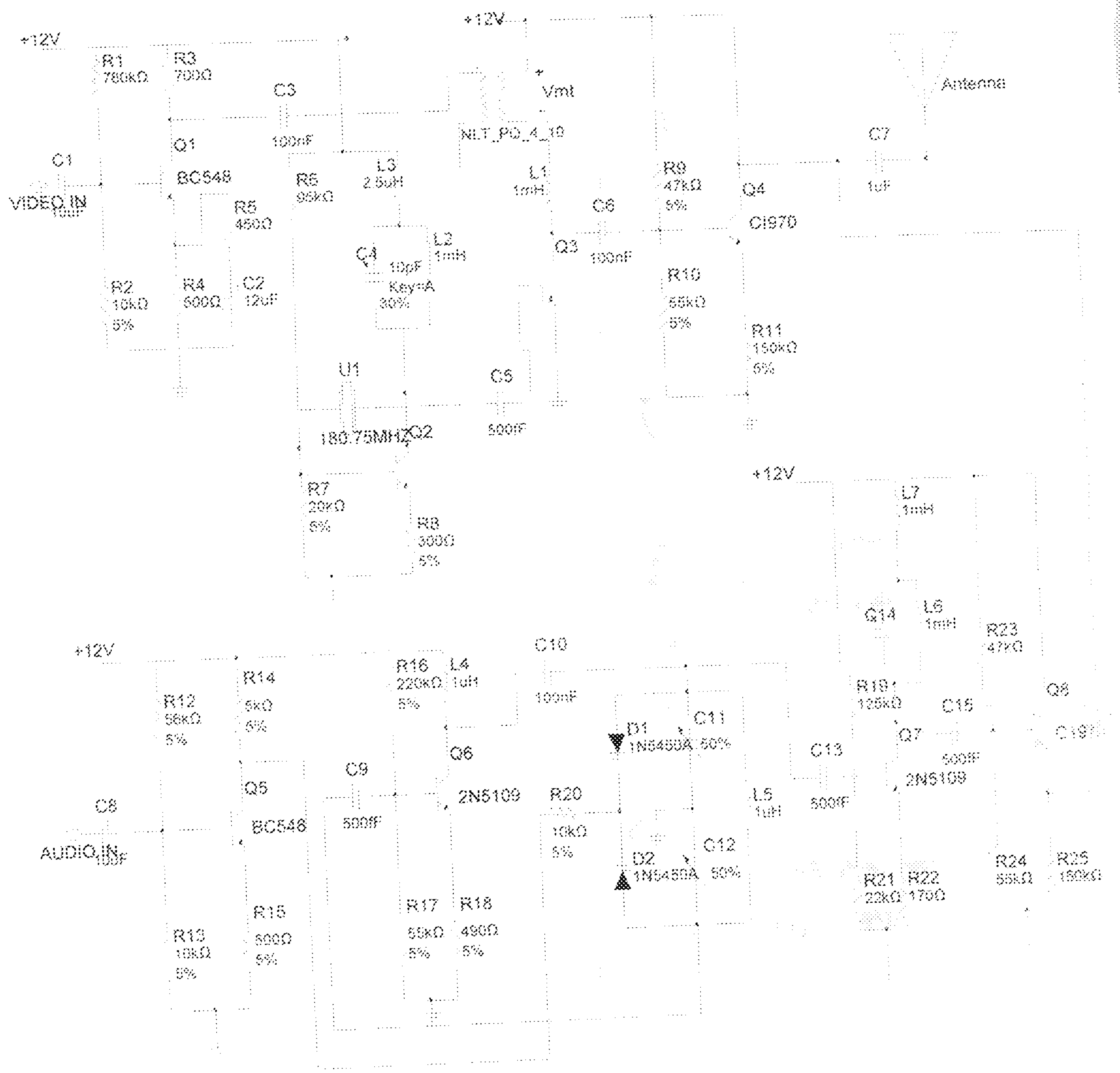


Fig 3.9 a complete circuit diagram of wireless video/audio transmitter

CHAPTER FOUR

4.1 Test, Results and Discussion

Series of test were made during assembling of various devices to ensure that it works optimally. All the components used, were tested to avoid the use of faulty components, measuring the outputs of the various blocks if their output results conforms to the expected results.

The following equipments were used to test the construction.

- A TV set
- 12 Dc power source supply
- A DVD player which serves as a base band source.

The testing was done by setting up the TV set and tuned to an unused channel. It's antenna fixed in position. Then the potentiometer was adjusted for video gain, the bias used adjusted for proper switching and amplification, a 12 volt DC power supply provided the 100mA of current needed. Then the DVD video and audio source was connected to the corresponding video and audio jack respectively. At a frequency of about 500MHz signal from the DVD player was transmitted to the television which serves as a receiver but as the position of the television was taken further away the transmitter picture and audio sound began to diminish until the disappears at a certain distance that was not determine due to lack of proper measuring tools.

The design specification of each component of this project was followed strictly except in cases of non availability of components, equivalent components were used. The different components were build according to design on bread board and tested okay for each module before it was transferred to the Vero board. The performance of the transmitter was tested and found to be working. Hence the primary aim of this project was achieved.

CHAPTER FIVE

5.1 Conclusion and summary.

Generally, I learned a great deal about RF signals relative to how much I knew before embarking on this project design

The aim of this project was achieved. The objective was to be able to transfer video/audio signal over a certain distance. The project have been constructed and tested and is capable of transmitting Audio/video signal to television within a workable radius of coverage. The project was quite tasking because of the extra care that had to be taken in working with frequencies. availability of components pose a little challenge as equivalent components were used in some case. With respect to the objectives spelt out in carrying out this project, the required result was obtained.

5.2 Recommendation

This project can be greatly improved on, by those interested in RF transmission design which most people take for granted. For further work on this project, some control means can be included in the design to take care of issues regarding unwanted reception.

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