DESIGN AND CONSTRUCTION OF ULTRASONIC CAR IMMOBILIZER SECURITY SYSTEM

BY

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DEDICATION

This project is dedicated to my parent, Alhaji Ibrahim Suleiman and Halima Ibrahim Suleiman, and the entire family of Alhaji Ibrahim Suleiman.

DECLARATION

I hereby declare that this work is carried out by me under the supervision of Mr. J. Ajiboye in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.Eng).

....

Ibrahim Mansur **Date**

APPROVAL

This is to certify that this project was carried out by **IBRAHIM MANSUR** of the department of Electrical/Computer Engineering. Federal University of Technology, Minna. Niger state

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ACKNOWLEDGEMENT

My profound gratitude to Almighty God Who in His infinite mercy gives me good health and guides me throughout my study in the university and also gives the wisdom to carry out this project.

To my parents, Alhaji Ibrahim Suleiman and Halima Ibrahim Suleiman I will forever acknowledge their effort throughout my entire life for their enormous support and the love and caring they have for me right from my day one in this earth and also for their patience to put up with my absent. I will always remember you.

I will always acknowledge my darling sisters Dr. Mrs. Khadija Ibrahim Abdul Rasheed and Mrs. Hindatu Ibrahim and my big brothers Engr. Shehu Ibrahim Suleiman and Engr. Nurudeen Ibrahim Suleiman for their enormous contribution throughout my study. I also appreciate the support from the rest of my siblings and the entire family of Alhaji Ibrahim Suleiman for their love and caring.

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This acknowledgement will not be completed without recognizing the support from my friend as well my class mate, who had been my counselor and motivator in my academic study in the university. I also appreciate all my friends and class mates in the department, who contributed one way or the other to my success in the school

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ABSTRACT

The project represents the concept of the design of ultrasonic car demobilizer system. The ultrasonic car demobilizer consists of a transmitter that constantly sends out beam of ultrasonic signal and a receiver that continuously monitors the beam of the signal from the transmitter. This transmitter and the receiver are fixed to the two doors of a car such they point to each other. At anytime an intruder comes within the vicinity of this signal between the transmitter and the receiver or tries to open the door of the car, the signal is distorted and the receiver detects this change. The receiver responds to this new change by triggering the alarm system and at the same time deactivates the ignition circuit of the car thereby rendering the car immobile

CHAPTER ONE

INTRODUCTION

1.0 General Introduction

Report from media, law enforcement agencies coupled with past records of complain from colleagues and neighbors, have revealed that car theft has steadily been on the increase. In addition, criminals are now well organized and fortified in this act of car stealing and executing their operation according to well planned techniques which the law enforcement agencies find occasionally difficult to diffuse. Therefore, a means of discouraging this act must be devised as a way of combating this criminal act and reducing the occurrence to the barest minimum.

Due to this inevitable need to combat this menace, various ways of providing an efficient, dynamic and highly sophisticated means of car security system have been devised. And again, more research is being carried out daily to improve on existing system as the perpetrators also try to study how to bypass the system.

Surprisingly they usually faced new challenges posed by new design, hence designers also are trying to produce complicated design, integrating various phases of car system such that if one aspect is beaten the other can still save guard the car from been theft and ensure security of life of the car owner.

Car security system, like other alarm system, is in two categories:

- Remote alarm system
- Contact operated alarm system.

The Remote alarm system involves the transmission of signal from transmitter to a receiver. The system is triggered when there is any interference in the transmitted signal between this transmitter and receiver. The contact operated alarms are alarm system that are activated by opening or closing of set of switches or contacts, which could take a form of a pressure pad, simple push-buttons switch etc.

This work is targeted at designing a remote alarm system, using ultrasonic signal, with a view to apply it in safeguarding cars from thieves and arm robbers. The system is activated by any interference of the beam signal between the transmitter and the receiver. Once there is frequency change in the signal received by the receiver, it detects the change and thereby activates the alarm system. An LED comes ON and buzzer gives a short beep. If the reset button is pushed, the LED will go off, indicating that the alarm has been reset. A failure to reset the system within a specified period time will caused the relay to activate which in turn cut-out the car engine.

The block diagram in fig.1.1 below summarizes the function of the system in block stages.

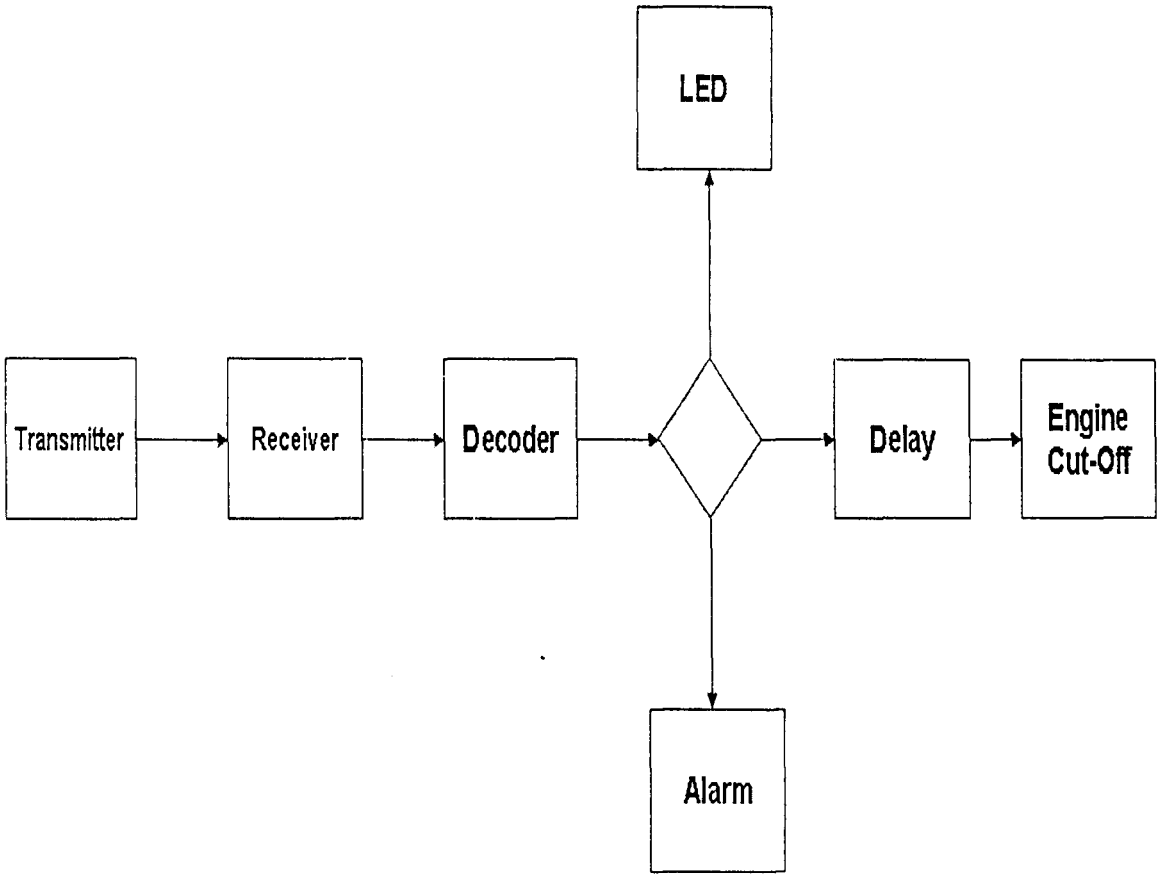

Fig. 1.1 Block diagram of the car demobilizer

1.2 AIM OF THE PROJECT

To develop a simple low cost device aimed at easing the prevailing financial difficulty face by car owners in the security of their cars.

1.3 OBJECTIVE

The objective of the project is to reduce the rate of car theft in the country to the barest minimum, if not completely wiped out.

Also to reduce the resources spent on importing similar and more expensive product form other countries, thereby enhance our foreign reserves.

CHAPTER TWO

LITERATURE REVIEW / THEORICAL BACKGROUND

2.1 LITERATURE REVIEW

According to research and consultation from books and project reports, security system and protection devices are very necessary in vehicles, houses, offices, warehouses, hospitals and stores against intruders and buglers. It is also used at airports and public buildings to detect weapons, explosives and contraband. Government agencies use highly sophisticated electronics security equipment to detect various means of espionage, sabotage and to prevent a surprise attacks.

The origin of security system is obscure but technique of protecting the household, such as the use of locks and bared windows, is very ancient. As civilization increased the distinction between passive and active security system was recognized. The responsibility for active security measure was vested on police and similar public services. Inability of community police and other security agencies to provide all the security desired by some individuals and organization led to supplemented efforts by private groups which is exactly what is done in this project. Presidential building for instance, employs some form of bugler alarm system to detect the presence of an intruder, the alarm may be an audible bell, horn, siren, or a visible light such flood lights and strobe lights. Some security systems are silent and secretly transmit a signal either to a police station or to a special alarm service that monitors the alarm system of its subscribers. [8]

Burglar alarm may be used to detect intruder in a number of ways. For instance, space protection alarm is designed to detect movement within a certain area. Modern space protection alarms system may use Photoelectric, Passive-infrared, Ultrasound and microwave devices to detect intruder or any bridge of security.

The photoelectric alarm or "electric eye" is a fairly common alarm today as security system. It consists of a transmitter and receiver. The transmitter sends light to the receiver, and if the beam is interrupted for a second, the receiver recognizes it and sounds the alarm. The photoelectric unit may be a transmitter and a receiver that oppose each other that is placed opposite to each other, or the transmitter and the receiver may be housed together in one unit while utilizing a reflector at the other end of the room. The old type of unit, which is still seen in some places, uses ordinary white light. The major set back of this type of system is that the signal produce from the source is usually visible especially at night. And it is simply defeated by shining a flashlight into the receiver. The Passive Infra-Red alarms or PIRs are so called because they do not emit Infra-Red energy, but merely detect a change in it. A PIR probes its monitoring area, and if any changes are detected in Infra-Red (heat), it sounds an alarm. A PIR records the ambient room temperature so it will notice any changes, such as that produces by the human body. Slow temperature changes, such as thermostatically controlled heating systems, will not interfere with the PIR's duties. The PIR is often called a thermal detector; however such heat detectors are used primarily for fire prevention. The PIR is immediately recognizable due to its common design and dark-red lens. Due to the nature of a PIR, they are usually placed in a very conspicuous location, such as in the corner of a room. This system can be bypass easily by walking slowly around

the area of consideration. And also it is not efficient if the area of consideration is small.

The microwave alarm system is another transmitter/receiver motion detector, and is unquestionably the most difficult to successfully bypass. The system emits a beam of ultra-high RF (Radio Frequency) energy, generally 10.525 GHz, and detects intruders by observing any change in that RF energy.

Microwave systems are extremely versatile in that one unit may be used to monitor an 80m by 80m room or a 10m by 300m hallway. The primary disadvantage of a microwave system is that it has a propensity to penetrate the boundaries of the building it is protecting. In other words, microwave energy that is used to guard a business sometimes reaches out into the parking lot, which understandably causes many false alarms. And also it is expensive to setup. [9]

The system I employ in this project is the ultrasonic alarm detector. The ultrasonic system consists of a transmitter and receiver. The transmitter emits beam signal of frequency of about 20-45 KHz. This frequency lies above the human threshold of hearing, so cannot be detected by human ear. The receiver monitors the incoming frequency from the transmitter. The entire system is may be a self-contained in one unit, although occasionally on transmitter is used with several receivers.

The sound waves that emanate from the transmitter follow an elliptical (resembling an elongated oval) pattern, and ultimately return to the receiver. If those waves are somehow altered during their elliptical journey the receiver will know it, and the alarm will sound. Therefore the theory is that if an intruder enters the guarded area, the ultrasonic frequency will be altered by his presence, thus alerting the receiver to an intrusion.

The ultrasonic system is very effective, and the range is generally about 40-50 feet. The advantage this system has over the other security system techniques mention above is that the presence of ultrasonic signal is not easily detected as the sound is not audible to human ear. This makes bypassing this kind of system very difficult as the intruder does not have a prior knowledge of presence of the signal. And ultimately the ultrasonic alarm is cheap to install especially in car security system.

A determined thief can steal almost any vehicle, however well protected but few will risk the difficulties and delay of stealing a thief-protected car. There are two main types of anti-thief devices use in a car; an intrusion detection and deterrent security system. The intrusion detection systems warn that someone is trying to enter the car. Any attempt to enter the car while the system is active causes a switch to be earthed, thus sounds a horn and other alarm and will sometimes flash the headlights. [10]

The deterrent system prevents the car from being driven away. That is making the car immobile anytime the system detects intruder. This may be operated electrically by disconnecting the ignition system on battery or mechanically by locking the gear lever, steering wheel clutch or foot brake. Some ignitions immobilize and sound an alarm warning if someone tries to start the car. Another type of immobilizer cut out the fuel supply and the ignition. A lockable top with a pipe connection at each side in fitted into the fuel pipe between the tank and carburetor it is also wired to the coil. Once the device is locked, fuel cannot flow and the ignition system is cut out. Some systems combined all the actions: cutting out fuel and ignition system and sound the alarm.

2.2 THEORETICAL BACKGROUND

2.2.1 THE 555 TIMER

The 555 timer is a versatile, low cost IC that is specifically designed for precision timing applications, but which can also be applied in variety of Mono stable, Abstable and Schmitt-Trigger applications. This specific device was originally introduced by Signetics, but is now available under the 555 designation from many other manufacturers.

The 555 timer can process innumerable attractive features. It does operate from supply Voltage, which is between the rage of 4.5V and 16V.Its output is capable of sourcing any load current that is up to a maximum of 200mA. Hence, it can drive certain load such as low power lamps, LED, Relays and also high impedance speakers. When use in timing mode, it can readily produce accurate timing periods which can be varied from a very few microseconds to several hundreds through a single R-C network. The timing periods of the IC are independent of the actual supply rail voltage. The 555 timer has temperature coefficient of only 0.005% °C.

The circuit symbol for a 555 is a box with the pins arranged to suit the circuit diagram: For example 555 pin 8 at the top for the +Vs supply, 555 pin 3 output on the right.

Fig 2.1 shows the 555 symbol and the pin connection.

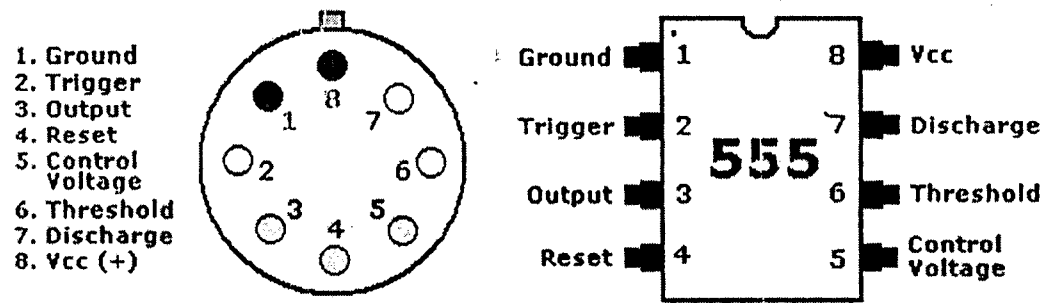

Fig 2.1 555 timer with pin connection

2.2.2 ASTABLE MULTIVIBRATOR

Astable circuit produces a 'square wave,' this is a digital waveform with high transition between low (0V) and high (+Vs). Note that the durations of the low and high states may be different. The circuit is said to be an Astable because it is not stable in any state: the output is continually changing between 'low' and 'high'. The time period (T) of the square wave is the time for one complete cycle, but it is usually better to consider frequency (f) which is the number of cycles per second.

$$T = 0.7 \times (R_1 + 2R_2) \times C_1 \qquad (1.0)$$

$$f = \frac{1.44}{(R_1 + 2R_2) \times C_1} \qquad (1.1)$$

T = time period in seconds (s)

f = frequency in hertz (Hz)

R_1 = resistance in ohms (ohm)

R_2 = resistance in ohms (ohm)

C_1 = capacitance in farads (F)

The time period can be split into two parts:

$$T = T_m + T_s \tag{1.2}$$

Mark time (output high):

$$T_m = 0.7 \times (R_1 + R_2) \times C_1 \tag{1.3}$$

Space time (output low):

$$T_s = 0.7 \times R_2 \times C_1 \tag{1.4}$$

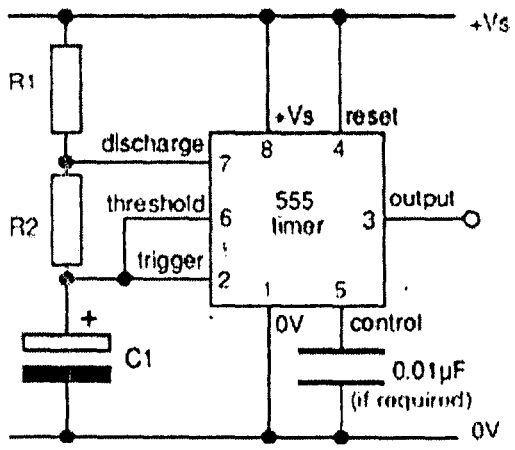

Fig 2.2a Astable Multi-Vibrator circuit

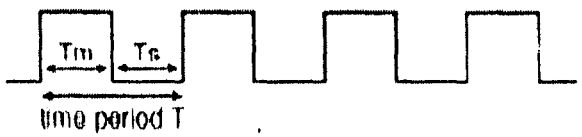

Fig 2.2b Astable output square wave

2.2.3 MONOSTABLE MULTIVIBRATOR

A monostable circuit produces a single output pulse when triggered. It is called a Monostable because it is stable in just one state: 'output low'. The 'output high' state is temporary. The duration of the pulse is called the time period (T) and this is determined by resistor R1 and capacitor C1:

Time period:

$T = 1.1 \times R_1 \times C_1$

T = Time period in seconds(s)

R_1 = resistance in ohms (Ω)

C_1 = capacitance in farads (F)

The maximum reliable time period is about 10 minutes.

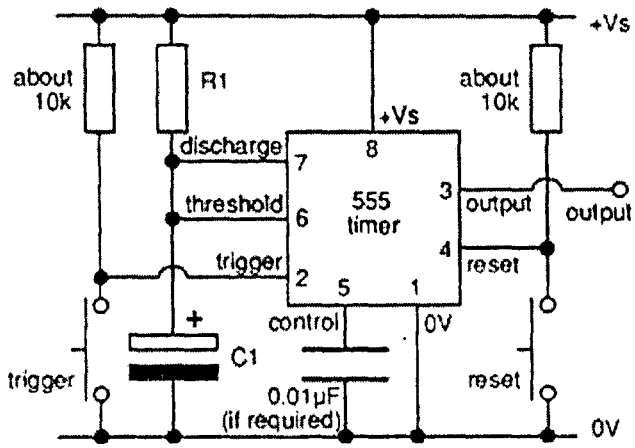

Fig 2.3a Monostable circuit with manual trigger

Fig 2.3b Monostable output, a single pulse

2.2.4 BISTABLE MULTIVIBRATOR

The circuit is called a Bistable because it is stable in two states: output high and output low. It is also known as a 'flip-flop'.

It has two inputs:

Trigger (555 pin 2) makes the output high.

Trigger is 'active low', it functions when $< {}^{1}/_{3}$ Vs.

Reset (555 pin 4) makes the output low.

Reset is 'active low', it resets when < 0.7V.

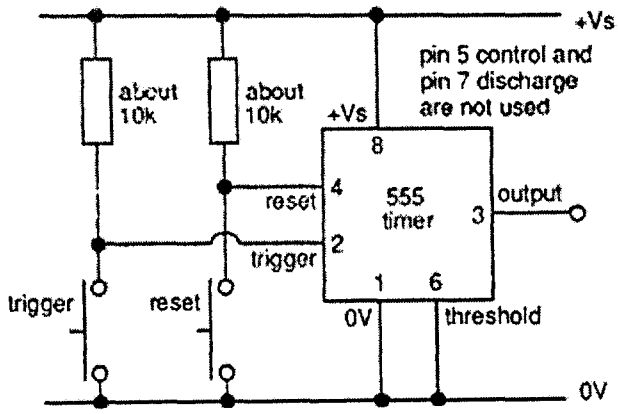

Fig 2.4 Bistable circuit

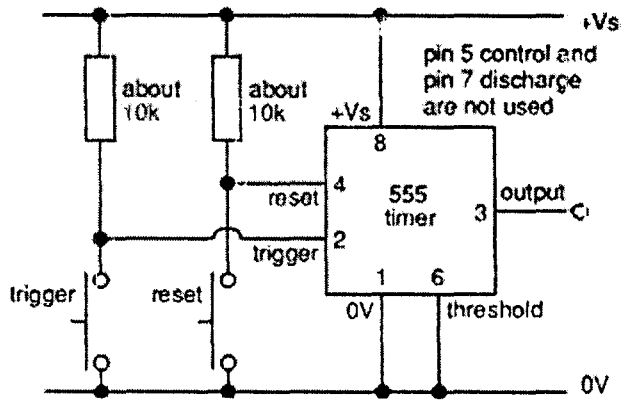

Fig 2.4 Bistable circuit

2.2.5 OPERATIONAL AMPLIFIER

An operational amplifier is an integrated circuit amplifier with a very large voltage gain, high input impedance and low output impedance. They are available in hundreds of different types, the most general group being the DC-coupled differential voltage amplifiers, inverting and non-inverting inputs and a single-ended output. The symbolic diagram is shown below

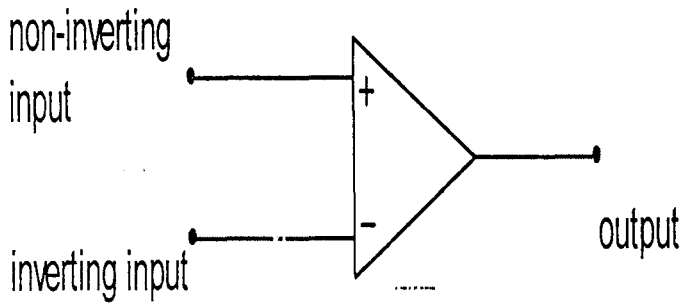

Figure 2.5a Operational amplifier

The output is an amplified version of the difference between the two inputs (the output goes to positive when the non-inverting input is greater than the inverting input). Only a very small difference in potential is required between the two inputs to cause a large output-voltage swing. The voltage gain is large and unpredictable, and the device is never used as an amplifier without negative feedback being applied. They are designed in such ways that can open-loop gain of several million to be reduced to one-tenth of the gain by the application of negative feedback.

The voltage gain, Av of the amplifier is the ratio of the output voltage to input voltage with understated conditions for source resistance and load resistance. The ideal op-amp has infinite input impedance, zero output impedance, infinite voltage gain, infinite bandwidth and zero output voltage when the two input voltages are equal.

Unfortunately, this device would also have infinite cost. The basic inverting and non-inverting amplifier circuits are shown below.

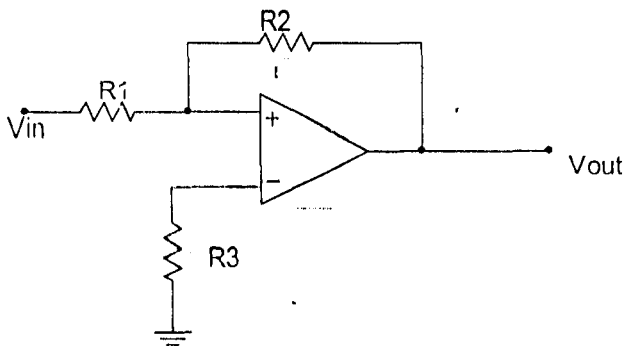

Figure 2.5b inverting amplifier

The amplifier Gain:

$$A_v = V_{out}/V_{in} = -R_2/R_1 \qquad (1.6)$$

Amplifier input impedance

$Z_{in} = R_1$; (1.7)

Z_{out} = fraction of an ohm

$R_3 = R_1 // R_2$ (1.8)

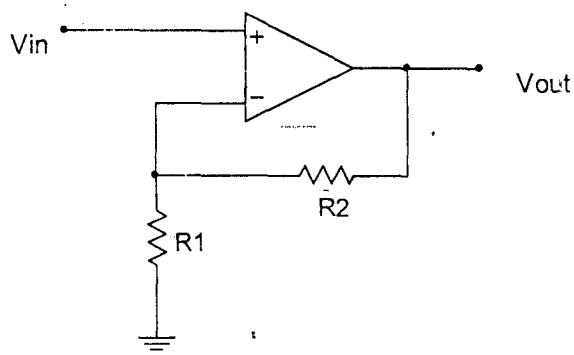

Figure 2.5c non-inverting amplifier

Amplifier gain:

$A_V = V_{out}/V_{in} = 1 + R_2/R_1$ (1.9)

Amplifier impedance:

Z_{out} = fraction of an ohm

In the construction of this project we decided to use the LM358N, a bipolar op-amp. This is a dual low-power op-amp designed specifically to operate from a single supply rail of 3 to 30 v dc with a quiescent current of 500A.

The 741 features an input common mode that includes ground and an output voltage that can swing to ground. This op-amp is ideally suited for direct operation from a standard +Vdc supply and is compatible with all forms of logic.

2.2.6 ULTRASONIC TRANDUCERS

An ultrasonic transducer is a special device used in converting high acoustic wave into electrical signal or convert electrical signal into acoustic wave.

For this project, the following characteristics as specified by the manufacturer were considered for the proper functioning and efficiency of the transducer.

Table 2.1 characteristic of ultrasonic transducer

	SCG-401T	SCM-401R
	Transmitter	Receiver
Sensitivity	106dB	-65dB
Resonant frequency	40 ± 1KHZ	40 ± 1KHZ
Pulse rise time	2msec	0.5msec
Max input voltage	20Vrms	----------
Impedance	500Ω	30K Ω
Operating temperature	-20 °C to +60 °C	-20 °C to +60 °C
Capacitance	1100pF	1100pF

2.3 PROJECT OVERVIEW

The ultrasonic signal is used in the system to detect any intruder by responding to unusual state detected by the receiver. The ultrasonic alarm is more effective as compared to other form of security system as described above. This is because the presence of the

signal is not easily detected and even if detected, it can not be disabled without the circuit responding by triggering on the system.

This project is designed to combine both the intrusion and deterrent system feature to provide effective car security system.

CHAPTER THREE

3.0 DESIGN ANALYSIS

The design of the car immobilizer was first implement on a computer system using Multisim Software. The output of the various stage of the circuit is analyzed on the computer by computer simulation.

The entire circuit was designed on the computer in two stages. The first stage, which is the transmitter, consists of signal generator that produces an audio signal of frequency of about 40K Hz. The second stage comprises the receiver, amplifier, detection circuit and comparator circuit. Ultrasonic signal of frequency of about 40K Hz is required or intended to be transmitted through the input transducer and the transmission channel to the receiver. This is achieved with 555 timer IC. The transmitted ultrasonic signal is received at the receiver but with much attenuation. This signal is amplified using the amplifier circuit to compensate for the attenuation along the transmission channel. The next action is to detect the presence or absence of the signal at any time. To do that detection circuit is designed to perform the specified operation. A comparator circuit is designed to respond, to the presence or absence of the signal by operating the activation circuit

3.1 FREQUENCY GENERATOR

The circuit in fig3.1 depicts the circuit to make oscillate the ultrasonic frequency of 40KHz. Oscillation's operation is same as IC1 and makes oscillate at the frequency of about 40 KHz. It makes RB>RA to bring the duty (Ratio of ON/OFF) of the oscillation wave close to 50%.

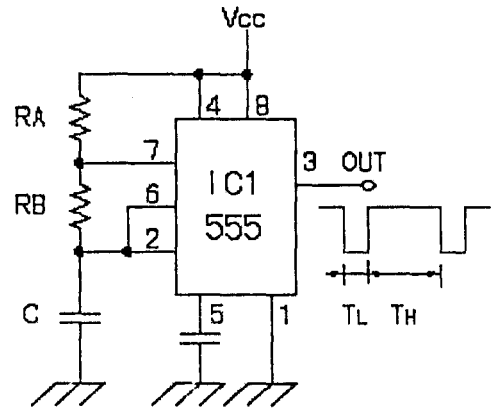

Fig3.1 Frequency generator

The frequency of the ultrasonic must be adjusted to the resonant frequency of the ultrasonic sensor. Therefore, I am made to be able to adjust the oscillation frequency by making the RB the variable resistor. The IC1 works as the oscillator of frequency 40 KHz. The ultrasonic of 40 KHz is sent out for the 10 millisecond and pauses for the 11 milliseconds. The calculation example of the frequency is shown below.

The condition: RA = 1.5K-ohm, RB = 15K-ohm. C = 1000pF

T_L = 0.69 x RB x C

= 0.69 x 15 x 103 x 1000 x 10^{-12}

= 10.35 x 10^{-6}

= 10 µsec

T_H = 0.69 x (RA + RB) x C

= 0.69 x 16.5 x 10^3 x 1000 x 10^{-12}

= 11.39×10^{-6}

= 11 µsec

$$f = \frac{1}{(T_L + T_H)} \qquad (2.0)$$

$$= \frac{1}{\left[(10.35 + 11.39) \times 10^{-6}\right]}$$

$= 46 \times 10^3$

= 46.0 KHz

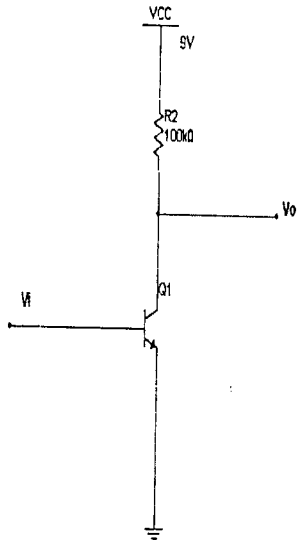

Fig3.3a Pre-amplifier Stage

$$V_{CC} = I_C + V_{CE} \tag{2.1}$$

$$V_B = V_B - V_{BE} \tag{2.2}$$

Voltage gain:

$$A = R_C / R_E = 400 \tag{2.3}$$

Power gain:

$$G = -g_m R_C = -R_C / r_e = -R_C \times I_C(mA)/25 \tag{2.4}$$

Input impedance:

$$Z_{in} = h_{fe} \times r_e = 25h_{fe} / I(mA) \tag{2.5}$$

This increased the quiescent current. Although if the input signal is high there will be non-linearity at the output.

The second stage amplifier is also a common emitter amplifier, but the emitter is grounded through a emitter resistor R_E. The output of the first stage serves as the input to the second stage.

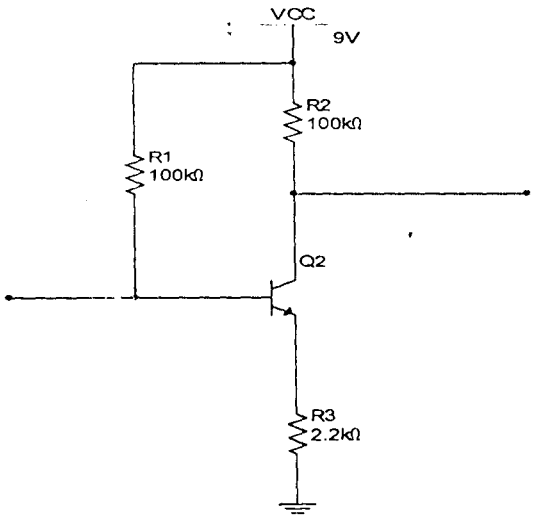

Fig.3.3b Amplifier circuit

$$V_{CC} = -I_C R_2 + V_{CE} \tag{2.6}$$

$$I_B = (V_{CE} - V_{BE})/R_1 \tag{2.7}$$

The voltage gain:

$$A_V = V_{out}/V_{in} = -R_C/R_E \tag{2.8}$$

3.3 SIGNAL DETECTION

The detection circuit detects the received amplified ultrasonic signal. It is a half- wave rectification and a low pass filter. The circuit converts the square pulse train at the input to a D.C voltage level.

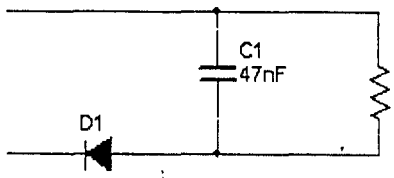

Fig. 3.4 Detection Circuit

The resistor causes the capacitor to discharge somewhat between cycles.

Assume the load current stays constant.

Ripple voltage:

$$\Delta V = 1/C\,\Delta t \qquad (2.9)$$

$$\Delta V = I_{Load} / fC \qquad (3.0)$$

3.4 COMPARATOR AND CALCULATION

The comparator circuit is the circuit that detects the presence or absence of the signal at the receiver. The comparator circuit is operation amplifier of the single power supply. The operation amplifier amplifies the output difference between the positive and negative input. Generally, the op amp has ten of thousand of multiplication factor. So when the

positive input becomes higher than the negative, the output difference is ten of thousand amplified and output becomes the same as the power supply. Oppositely, when the positive input becomes lower a little than the negative input, the difference is ten of thousand of times amplified and output becomes 0V.

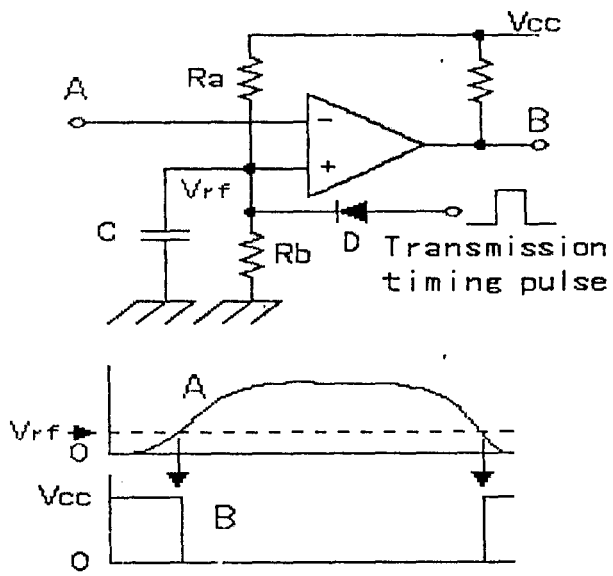

Fig.3.4 Comparator circuit and.it output

The reference voltage:

$$V_{rf} = (R_b \times V_{CC})/(R_a + R_b) \qquad (3.1)$$

$= (100K\Omega \text{ x } 9V)/ (1M\Omega + 100K\Omega)$

$= 0.81V$

So when the rectified ultrasonic signal becomes more than 0.81V, the output of the signal detector becomes low and vise versa.

3.5 DESIGN OVERVIEW OF THE WHOLE CIRCUIT

The signal generator generates pulse train signal of about 40 KHz and this signal is converted to a signal that can be transmitted through air medium, by the output transducer, TX. The input transducer, RX at the other end received the transmitted signal coming from the TX and then amplified it with the amplifier circuit to improve on the signal strength. The signal detector then circuit detects the signal received by the RX at any time.

The presence or absence of the signal at the RX at anytime is determined by the operational amplifier (comparator) which in turn activates the mono stable multivibrator accordingly.

The figure 3.5 depict the comprehensive schematic diagram of the car demobilizer System

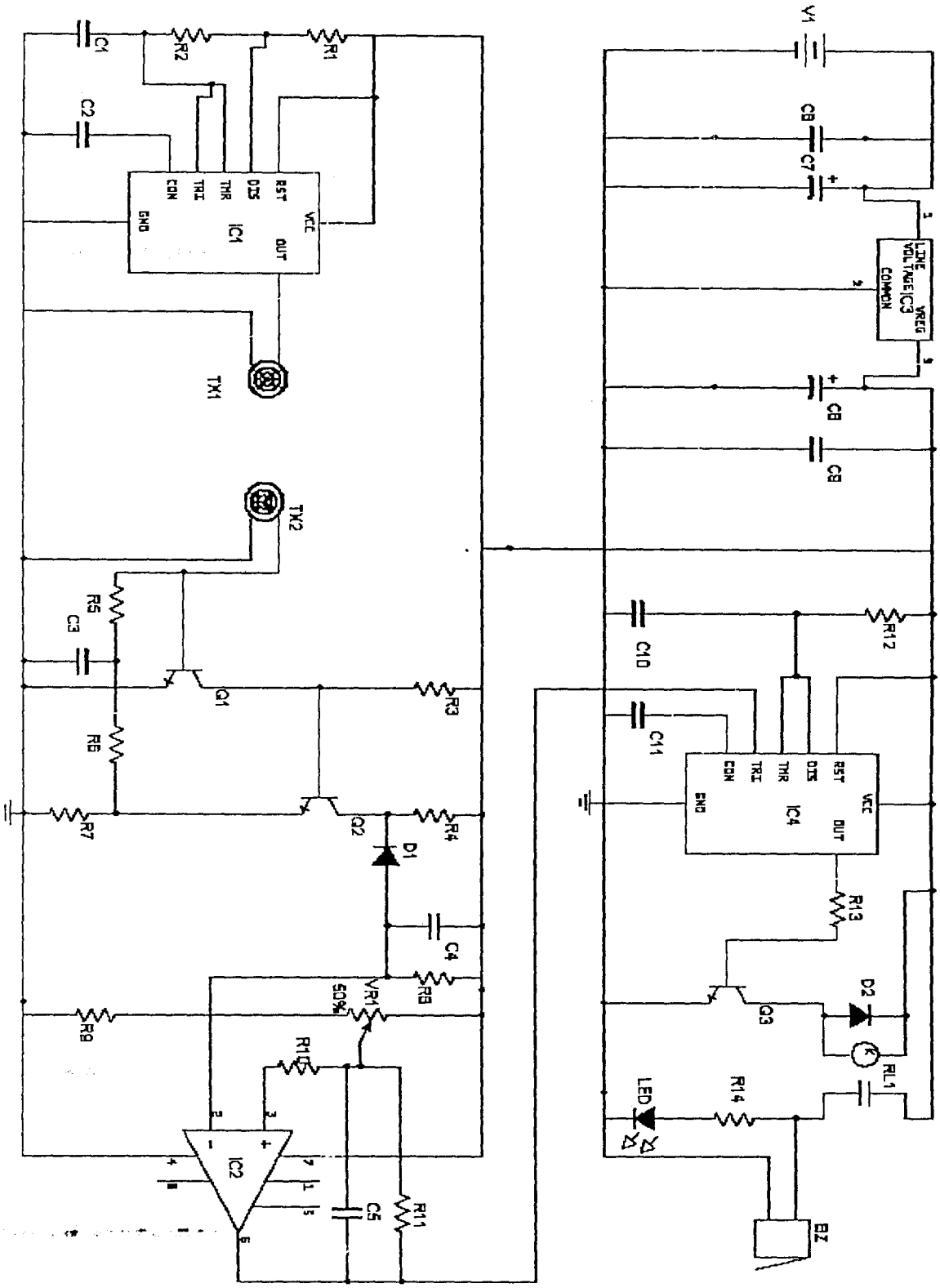

Fig 3.5 Schematic Diagram of car demobilzer

CHAPTER FOUR

4.0 IMPLEMENTATION AND TESTING

4.1 IMPLEMENTATION

The circuit is first implemented on a computer using the Multisim software simulation. The output of the various stages of the system, such as the signal generation, reception circuit, amplifier circuit, detection and activation of a delay circuit, is analyzed to determine voltages and the types of waveform. The circuit is then constructed on a bread board to carry out the testing measure and analyzed the working and performance of the circuit. And finally the circuit is transferred to Vero board for permanent soldering.

4.2 TESTING AND ANALYSING THE SIGNAL GENARATOR

On the signal generator, the waveform is observed at the output of the 555 timer (pin 3) with the aid of oscilloscope meter. The waveform is a pulse train wave of magnitude voltage about 9V and period T of 25μs. the duty cycle is measured to be 50%. The fig 4.1 below shows the output waveform as captured form the virtual oscilloscope.

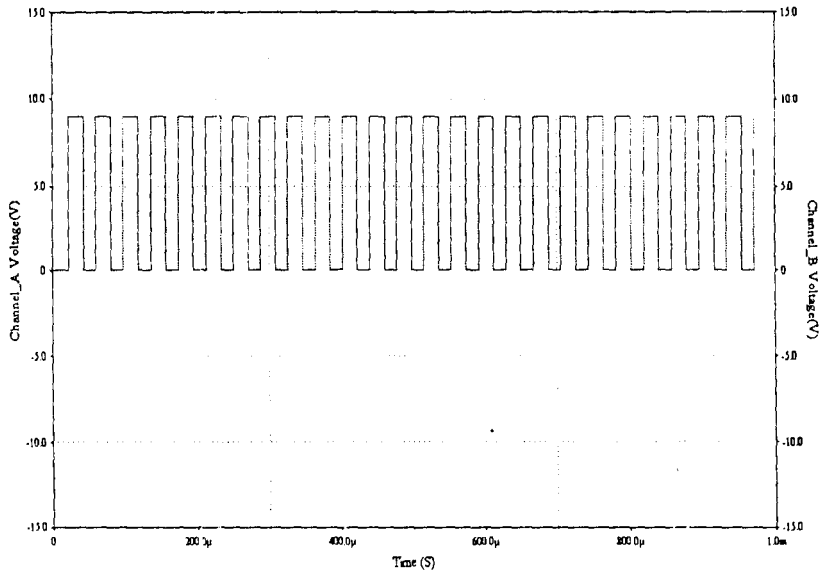

Fig.4.1 waveform of the signal generator

From fig 4.1:

$V_{peak} = 9.0\,\text{V}$

$T \approx 25\,\mu\text{s}$

Duty cycle $\approx 52\%$

4.3 THE SIGNAL AMPLIFIER

At the input stage the weak ultrasonic signal from the receiver is input or fed to the input of the amplifier circuit to compensate for the loss in the signal strength during transmission.

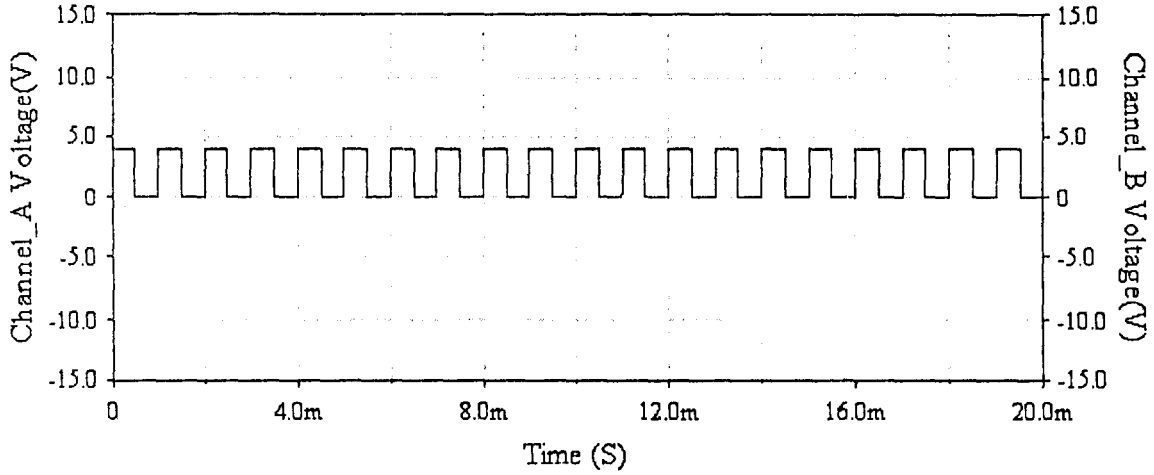

Fig 4.1 Input signal of the amplifier

The figure 4.1 above depicts the input signal waveform at the input of the amplifier and the corresponding output wave form .The voltage across the Rc of the amplifier circuit is measured using digital multi-meter. The potential difference at one particular time gives 3.644V

4.4 DETECTION OF THE SIGANAL

The figure 4.3 below is the detection circuit of the ultrasonic signal. The signal is fed from the output of the amplifier to the input terminal of the detection circuit.

The input signal, when observed on the oscilloscope meter, is more of a square wave than as compare to the output that is gives a D.C level signal.

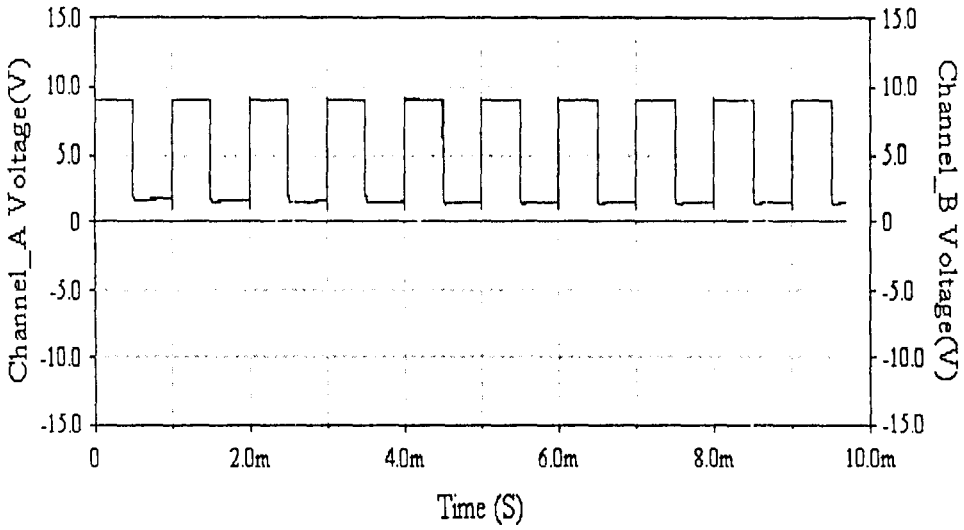

Fig 4.2a Signal at the input of detection circuit

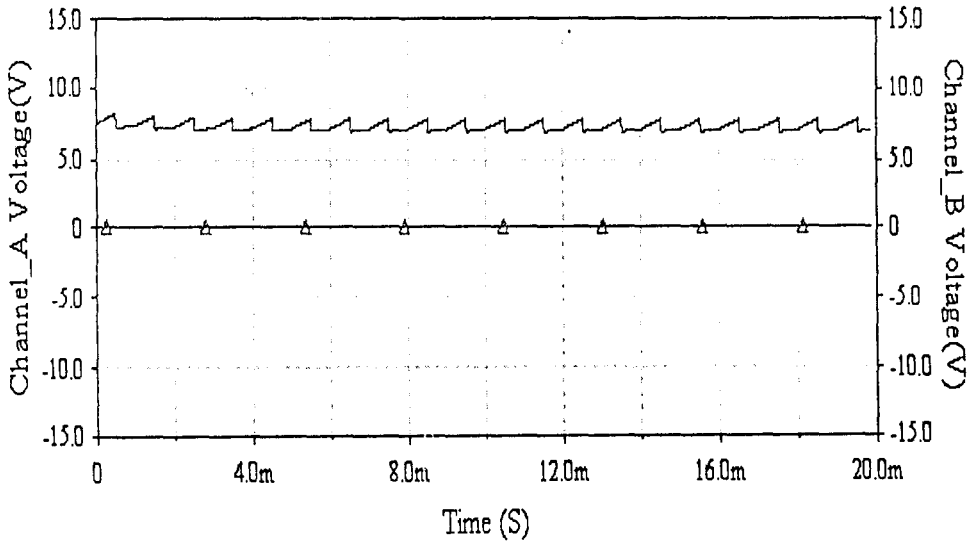

Fig4.2b Output signal of the detection

The output of the low pass filter is D.C but with little ripple alternating signal

The voltage at the output of the circuit is measured.

$V_{peak} \approx 7.8V$

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

It can be deduced from the foregoing report that the design of the ultrasonic security system like any other electronic system needs careful planning and implementation.

There are various intruder and deterrent alarm security systems but this particular one is unique because of its mode of operation –the means of intrusion detection is precise. Ultrasonic system has a number of applications but I decided to use it my own way car security system.

5.2 RECOMMENDATION

This circuit if properly researched and developed will become a replacement for many alarm systems that are not fool proof because it has the tendency of being almost 100% fool proof.

Therefore, I recommend that the department and the school authority should embark on further development and commercialization of this system.

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APPENDIX A

LIST OF COMPONENTS USED

COMPONENTS	VALUES
R1	1.5KΩ
R2	15KΩ
R3	100KΩ
R4	10KΩ
R5	10KΩ
R6	100Ω
R7	2.2KΩ
R8	100KΩ
R9	68KΩ
R10	100KΩ
R11	1MΩ
R12	1MΩ
R13	1KΩ
R14	10KΩ
VR1	10KΩ
VR2	50KΩ
C1	1000pF
C2	0.1μF
C3	1μF
C4	0.047μF

C5	10μF
C6	0.1μF
C7	100μF
C8	100μF
C9	0.1μF
C10	330μF
C11	0.1μF
D1	IN4001
D2	1N4001
Q1	BC109
Q2	BC107
Q3	BFY50
IC1	555
IC2	301A
IC3	78L09
IC4	555
RL1	RELAY
BZ	BUZZER
TX	OUTPUT TRANSDUCER
RX	OUTOUT TRANSDUCER