DESIGN AND CONSTRUCTION OF AUTOMATIC CAR PARKING AID MAKING USE OF AN INFRA – RED AS MOTION DETECTOR

BY

IFON ANIEKAN STEPHEN

98/7000EE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA.

NOVEMBER, 2004.

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

ELECTRICAL AND COMPUTER ENGINEERING

DESIGN AND CONSTRUCTION OF AN AUTOMATIC CAR PARKING AID MAKING USE OF AN INFRA - RED AS MOTION DETECTOR

BY

IFON ANIEKAN STEPHEN

98/7000EE

A PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELOR OF ENGINEERING [B. ENG.]

AT

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA.

NOVEMBER, 2004.

TABLE OF CONTENTS

CERTIFICATION

This is to certify that this project titled " Design And Construction Of An Automatic Car Packing Aid" was carried out by Ifon Aniekan Stehpen under the supprevission of Engr. S. N. Rumala and submitted to the Electrical Computer Engineering Department, Federal University Of Technology. Minna in partial fulfillment of the requirement for the award of Bachelor of Engineering (B. Engr.) Degree in Electrical Computer Engineering

Engr. S. N. Rumala
Project Supervisor

Date / Signature

Engr. M. D Abdulahim
Head of Department

Date / Signature

....
External Supervisor

....
Date / Signature

DECLARATION

I Ifon Aniekan Stephen hereby declare that this project was written by me and that the contents are results of my own design and calculation. Information obtained from published and unpublished works of others have been acknowledged by means of reference.

Signed

....

Ifon Aniekan Stephen

06/12/04
....

Date

DEDICATION

This project is dedicated to my parents Lt. Col. And Mrs. Ifon, Mrs. Imeh Moses Umoh for all they have done for me and for enabling me to come far in my endeavors.

To my brothers, sisters and friends whose prayer, support and encouragement have been of tremendous help to me.

Above all, I will like to dedicate this project to God almighty for his grace, favour and faithfulness.

ACKNOWLEDGEMENT

I express my profound gratitude to God almighty for the strength, wisdom, knowledge and understanding he has given me to complete my program " To God be the glory, honour and praise.

I sincerely express my appreciation and gratitude to my parents Lt. Col. S.J. Ifon., my grand mother Mrs. Bassey J., Mrs. Imeh M. Umoh, Mr. And Mrs. Ifon, Edwin Ifon, Col. Ifon, my brothers and sisters, jimmy Ifon, Dorathy Iifon, Unyime Ifon, Hope, Stephen, Udeme, Charle, Akaninyene, Rose, Ine. Thanks for your supports, encouragements, love and care, may God continue to bless and renew your strength.

I will like to thank Mr. Romala (Supervisor) for his intelligent and valuable suggestions coupled with his objection and contributions through out the period of this work. Iam highly grateful to all members and staffs of the department, for the numerous ways in which they have been of help to me during my course of study. My special depth of gratitude goes to Engr. M.D. Abdulahim (my head of department) for his advice and understanding, God bless you all.

In complete will this be if I fail to acknowledge Pastor Kayode Olufoki, Mrs. Moses and all members of the living faith Church, Minna and all my friends both in Minna and abroad, I say may posterity never fail to all your good will to mankind.

TABLE OF CONTENTS

CHAPTER ONE

.1 INTRODUCTION

Our contributions to the society are most times fuelled by personal experience complemented by the knowledge of a particular field of study.

Electronic system refine, extend or supplement human facilities and abilities to observe, perceive, communicate, remember, calculate, or reason. Electronics systems are clarified as either analogue or digital.

Analogue system change their signal output linearly with the input and can be represented on a scale by means of a pointer. In the other hand, digital instruments or circuit, represent their output as two discrete level ('1' or '0') and could show their output in a digital display either numerically or alphabetically.

This project comprise both analogue circuit and digital circuits. The opto sensing stage is an inferred transceiver at the base of the garage door which has a projected infrared beam to an infrared require on their opposite side of the garage door the projected beam is broken by any car entering or approaching the door once broken the infra-red receiver stage given an output which is amplified by the Op-Amps. The input of the first to the metering terminals of the individual op-amps and gives an output to indicate the closeness of the car R. The garage parking area with the aid of L.E.D. The application of this project and the electrical application cannot be other emphasized. Optical interruption, electronic timing functions and belong circuits. The project has both security application and injury. It is more comfortable and easy if the emoting of the garage is done automatically. The project could be above and implemented on the building of the school or department car parking space.

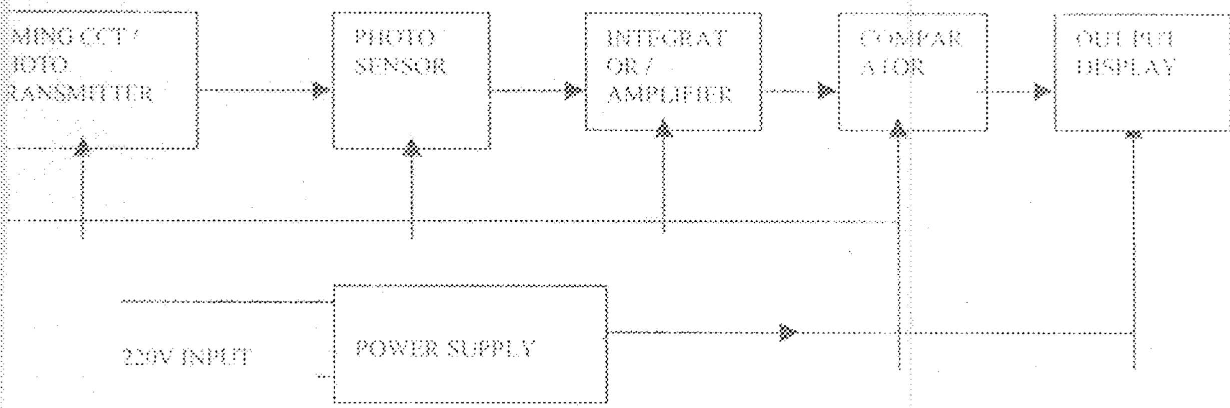


FIG 1.1: GENERALISED BLOCK DIAGRAM

1.2 DESIGN SPECIFICATIONS

INPUT VOLTAGE: 220V AC mains

SUPPLY VOLTAGE: +12V dc

INFRARED RANGE: IM (approx.)

PHYSICAL TYPE OF PHOTO TYPE GARAGE: 200 x 500mm

CHAPTER TWO

LITERATURE REVIEW

.0 LITERATURE REVIEW

This project is basically divided into two main system the sending end and the receiving end. The IR sense a car which is near the gate. These systems are refereed to as passive and active IR detector. In the passive system, a sensor containing an IR sensitive photodiode is fixed at one side of the garage or gate. Circuit with in the sensor detect the IR radiation reflected by the car and activity the LED. Today, the newer sensor are designed. They are two IR sestina device which are focussed to activate the same LED. Or eplities different LED within a specified building. Logic with in the sensor circuit switches on the LED only when the system are activated in sequences as would occur if a car reflects the IR beam.

In the active system each sensor consist of two housing: one housing contains on IR LED and an IR sensitive photodiode. The other housing contain are IR reflector. When positioned in front of the garage, the sensor system are more reliable then the possible system but they required careful alignment when installed and can cause false switching if there is any mechanical shifting. For the purpose of this project, IR rays which form the basis of this work will be generated using pulses and received using photodiode.

2.1 OP - AMPS AND COMPARATORS

An operational amplifiers is a differential amplifier with an extremely high open voltage gain. Negative feed back circuit are employed in op - amps to control the gain when precise gain values are needed. The comparator is an operational amplifier without a feed back. Hence, it is controlled by the open hoop voltage gain. The op - amp was originally developed for use with analogue computers but now they found place in almost all aspect of electronics. The op-amp has the following ideal characteristics:

Infinite voltage gain

Infinite input impedance

Infinite band with.

In practice however there are deviation from ideal conditions due to manufacturing process and other physical conditions the various components might be subjected to which make up the op-amps

2.2.0 OPTO-DEVICES

Opto devices convert light energy from one form to another. They are used for transmission of infra red rays, emission of light in different colours. (i.e. LED's), sensing of light rays of different intensity (LDRs, photodiodes and photo transistors), and for the conversion light to different electrical quantities like current, voltage of about 1.7v d.c. forward current. The symbol for the infra-red emitter is shown in fig. 2.0 a below.

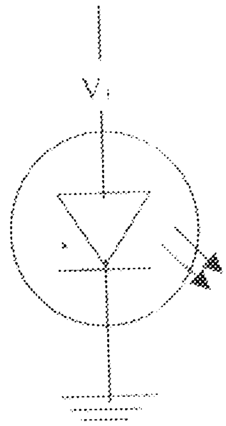


Fig. 2.1a shows the schematic representation.

2.22 THE PHOTO-TRANSISTORS

The photo-transistor is a semi conductor device, which gives current amplification due to transistor action. Some are molded in transparent plastic cases with top convex to act as a lens focusing light on the transistor. As a result, extra minority carriers are liberated at the reverse bias collector base junction. This allows amplification of the leakage current produced. When used in this way, no connection to the base is required. The photo-transistor is one of the most sensitive photo devices comparatively.

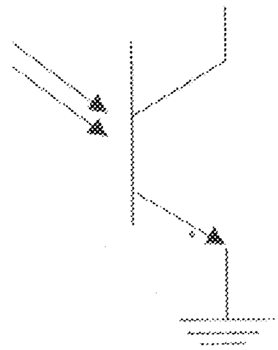


Fig. 2.1a: A schematic representation for photo transistor

2.23 THE PHOTO-DIODE

The photo-diode consists of a normal P-N junction with a transparent window through which light can enter. A photo-diode is usually operated in reverse bias and leakage current increases in proportion to the amount of light falling on the junction. This effect is due to the semi-conductor and producing electrons and holes.Photo-diodes find application in counter circuits, scanners for discs, remote control receivers, etc. The schematic symbol is shown in fig. 2.2

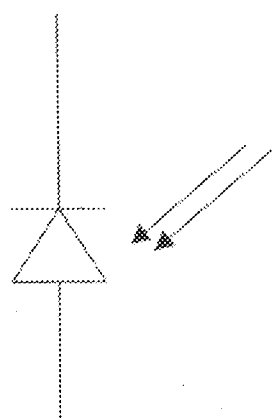


Fig. 2.2: A schematic symbol for photo-diode.

2.3 TRANSISTORS

Transistors are active components used basically as amplifiers and switches. The two main types of transistors are: The bipolar transistors whose operation depends on the flow of both minority and majority carriers, and the unipolar or field effect transistors (called FETs) in which current is due to majority carriers only (either electrons or holes). The transistor as a switch operates in class A mode. In this mode of bias the circuit is designed such that current flows without any signal present. The value of bias current is either increased or decreased about its mean value by the input signal (if operated as an amplifier) or ON and OFF by the input signal if operated as a switch.

Fig. 2.3: shows the transistor as a switch.

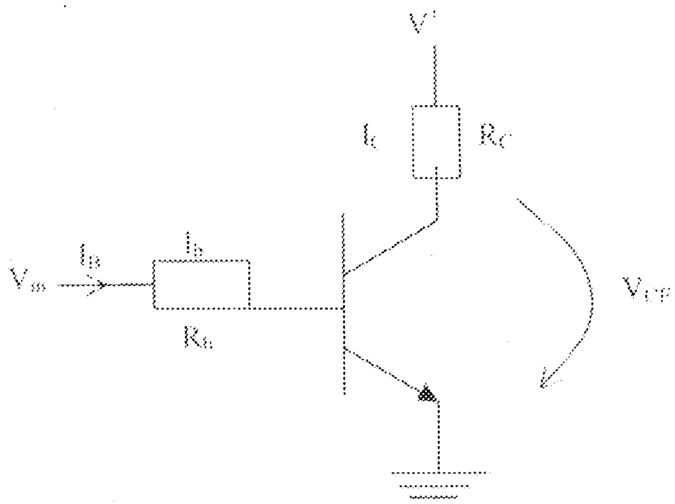


Fig. 2.3: Transistor as a Switch.

For the transistor configuration, since the transistor is biased to saturation. $V_{ce} = 0$, when the transistor is ON. Which implies that,

$V_1 = IcRc + Vce$ ....(2)

$Vin = I_B R_B + V_{BE}$ ....(3)

$I_C / I_B = hfe$ ....(4)

$R_B = \frac{V_{in} - V_{BE}}{I_B}$ ....(5)

where,

I_c = collector current

I_B = base current

V_{in} = input voltage

V^+ = Supply voltage

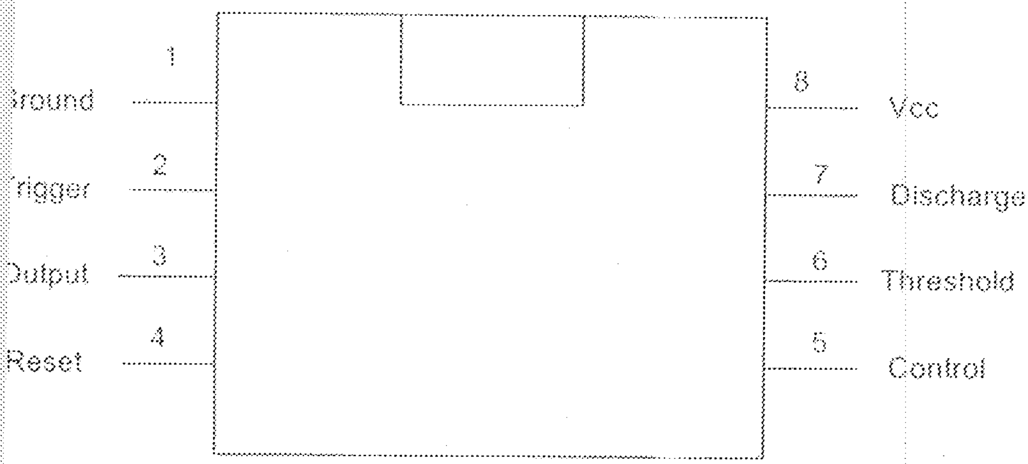
V_{ce} = Collector-emitter voltage

hfe = current gain

2.3 IC TIMERS

The emanation of IC timers eliminated a wide range of mechanical and electromechanical timing devices. It also helped in the generation of clock and oscillator circuits.

Timing circuits are those, which will provide an output charge after a predetermined time interval. This is of course, the action of the monostable multivabrator, which will give time delay after a fraction of a second to several minutes.



Pin 5: This is the control voltage input. A voltage applied to this pin allows the timing variations independently of the external timing network. Control voltage may be varied from between 45 to 90 of the V_{cc} value in monostable mode. In astable mode the variation is from 1.7 to the full value of supply voltage. This pin is connected to the internal voltage divider so that the voltage measurement from here to ground should read $^2/_3$ of the voltage applied to pin 8. If this pin is not used it should be bypassed to ground, typically use a 10µf capacitor. This helps to maintain immunity from noise. The CMOS Ics for most applications will not require the controlled voltage to be decoupled and it should be left unconnected

Pin 6: This is the threshold input. It resets the flip-flop and hence drives the output low if the applied voltage arises above two-third of the voltage applied to pin 8. Additionally, a current of minimum value of 0.1A must be supplied to this pin since this determines the maximum value of resistance that can be connected between the positive side of the supply and this pin. For a 15V supply the maximum value of resistance is 20m.

Pin 7: This is the discharge pin. It is connected to the collector of an NPN transistor while the emitter is grounded. Thus the transistor is turned on and pin 7 is effectively grounded. Usually the external timing capacitor is connected between pin 7 and ground and is thus discharged when the transistor goes on.

Pin 8: This is the power supply pin and is connected to the positive of the supply. The voltage applied may vary from 4.5V to 16V though devices, which operates up to 18V are available.

2.5 RELAYS

The objective of many electromechanical system is to control a simple output device. This device might be as simple as light, relay or electric motor in this project, a head light is switch on by a relay.

A relay is an excellent method of isolating a logic device from high-voltage circuit. Fig. 2.5 shows a relay can be switch on by switches on a transistor. When the output of the transistor goes HIGH, i.e. the transistor is turned ON, the relay is activated. When activated, the normally open (NO) contacts of the relay close as the armature clicks downward. When the transistor is turned OFF, the relay is deactivated. The armature springs upward to its normally open (NO) position.

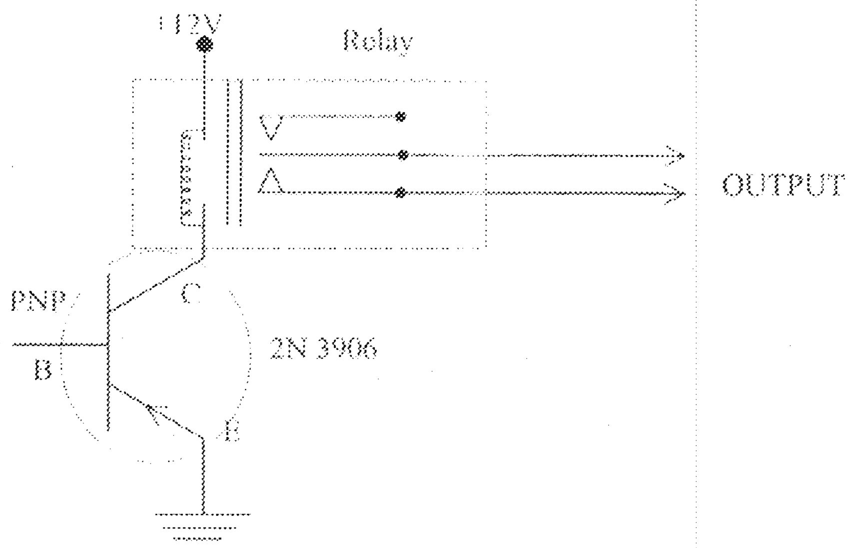


Fig. 2.5: Transistor and relay connection.

2.6 OTHER PASSIVE COMPONENTS

Positive components are components, which cannot amplify passive and require an external power source to operate. They include resistors, capacitors, diode, indicators and transformers, etc. Their application range from potential dividers to control of (as in resistors) filtration of ripples voltages and blocking of unwanted D.C. voltages (as in capacitors). They form the elements of the network circuit oscillator stages and are also used generally for signal conditioning in circuits. Their schematic diagrams and symbols are shown in fig. 2.6 below.

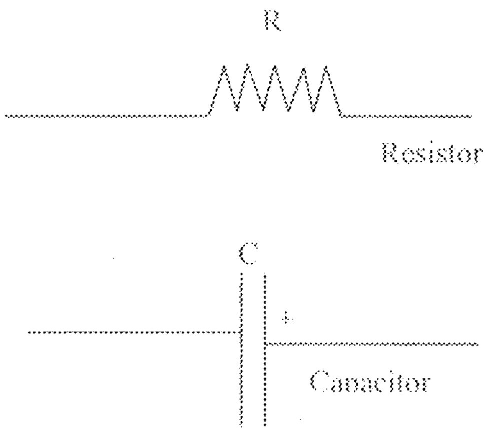


Fig. 2.6: Schematic representation for passive components.

CHAPTER THREE

DESIGN AND CONSTRUCTION

3.0 PRINCIPLE OF OPERATION

The operation of the LEDs are controlled by breaking a projected infra-red beam from one side of the garage or door to another. The infra-red beam transmitted using an infra-red transmitter is received by a photo diode. The photo diode is connected to the negative or the inverting terminal of the op-amp. When the beam is broken, the photodiode resistance changes there by changing the voltage drop across it. The change in potential difference is integrated by the integrator arrangement of the op-amp. The output of the integrator is fed to the comparator's inverting terminals through a potential divider with a fixed resistor. The changes in potential difference is detected by the comparators, which compares this drop with a fixed voltage and gives an output which is "high" or "low".

The comparator output goes low when the beam is broken and lights the LED responsible for the low cathode input voltage. When the cathode is low as compared with the input voltage or the supply voltage (+12V), the LED comes on depending on the closeness of the car to the garage in the car parking space.

The system is designed with a voltage level supply of +12V d.c. to power the electronic circuits in the project. The system gets power from mains supply.

3.1 DESIGN SPECIFICATIONS

Supply voltage - +12V d.c.

Max current - 1.5A

Range - 500mm (for prototype garage)

3.2 TRANSMITTER

A beam of IR is produced by the IR diode by feeding it with a pulse from an efficient transmitter. The transmitter is based on the popular 555 timer integrated circuit (IC) and it is used in a standard stable mode. The 555 timer was developed by the Signetics Corporation in 1972. It has become very popular with circuit designers because of its low cost and versatility. It is available in 14-pin dual in-line package and 8-pin mini-dip, but other manufacturers have since provided version of the circuit. It has numerous operational modes. The 555 timer will operate with a d.c. supply from 4.5 to 16V. It is flexible i.e. it can be made compatible with common logic levels as well as operational amplifier levels (op-amp).

Fig. 2.7 below shows the major section of the 555 timer IC. It contains two voltage comparators – a bistable flip-flop, a discharge transistor, a resistor divider network and an output amplifier up to 200mA current capability. There are there divider resistors and each is 5K ohms. The divider network sets the threshold comparator pin point at $^2/_3$ of Vcc and the trigger comparator at $^1/_3$ of Vcc. In this case, Vcc = 12V. Hence, the trigger point will be $^1/_3$ x 12V i.e. 4V and the threshold point $^2/_3$ x 12V i.e. 8V. When pin 2 goes below 4V, the trigger comparator output switches states and sets the flip-flop to the high state and pin 3 goes high.

If pin 2 returns to some value greater than 4V, the output stays high because the flip-flop "remembers" that it was set. Now, if pin 6 goes above 8V, the threshold comparator switches states and resets the flip-flop to its low state. This does two things : the output (pin 3) goes low and discharge transistor is turned ON. It should be noted that the output of the 555 timer is digital; it is either low (0) or high (1). When it is high, it is close to Vcc and when it is low it is near ground potential approximately 0.1V.

Pin 6 is normally connected to a capacitor which is part of an external RC timing network. When capacitor voltage exceeds $^2/_3$ Vcc, the threshold comparator resets the flip-flop to the low state. This turns on the discharge transistor which can be used to discharge the external capacitor in preparation for another timing cycle. Pin 4, the reset, gives direct access to the flip-flop. This pin overrides the other timing functions and pins. It is a digital input and when it is taking low (to ground potential) it resets the flip-flop, turns on the discharge transistor and derives output pin 3 low.

Reset may be used to half-timing cycle. The reset function is ordinarily not needed so pin 4 is typically tied to Vcc. Once 555 timer is triggered and the timing capacitor is charging, additional triggering (pin 2) will not begin a new timing cycle.

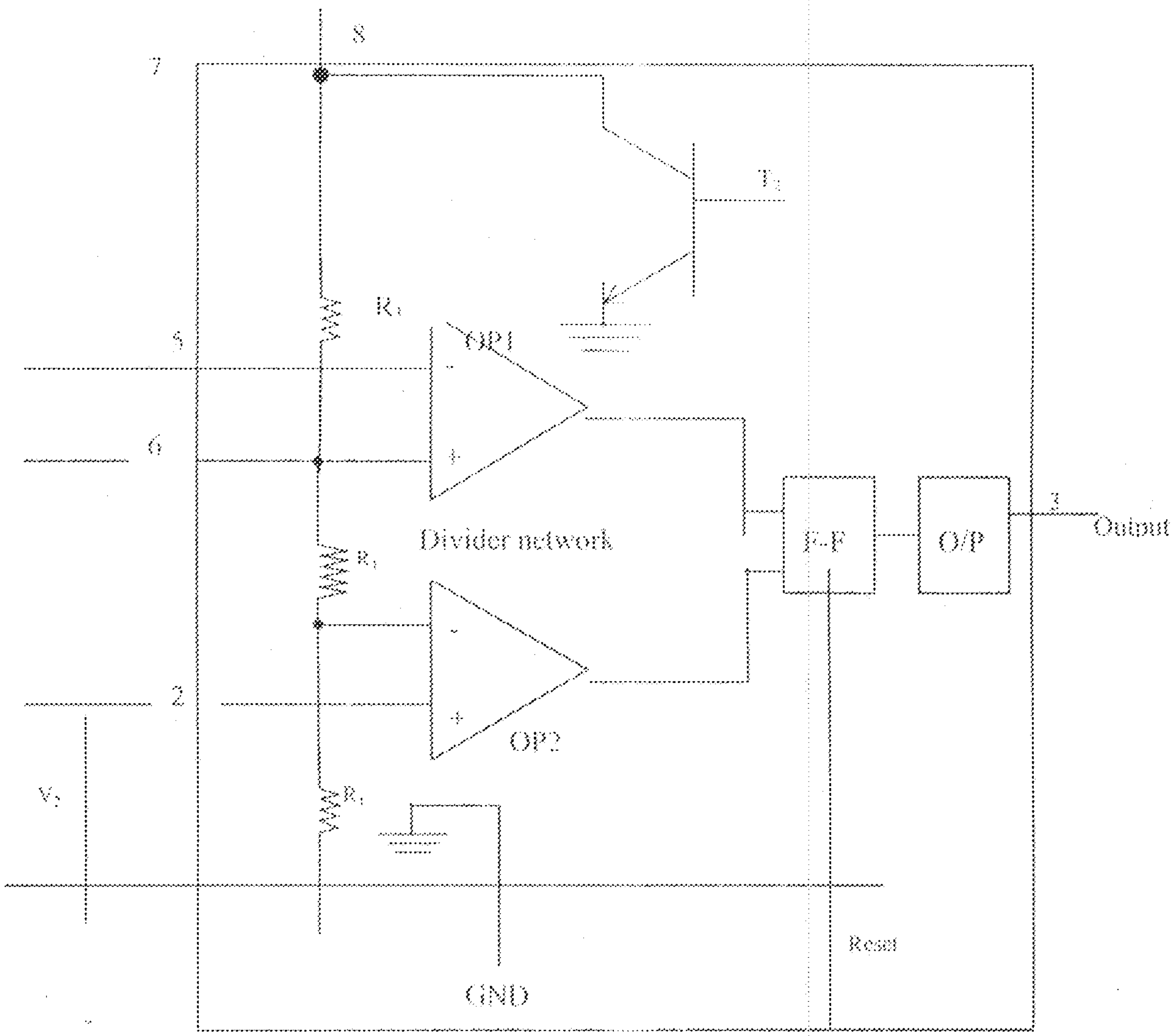


Fig. 2.7: Functional block diagram of 555 timer.

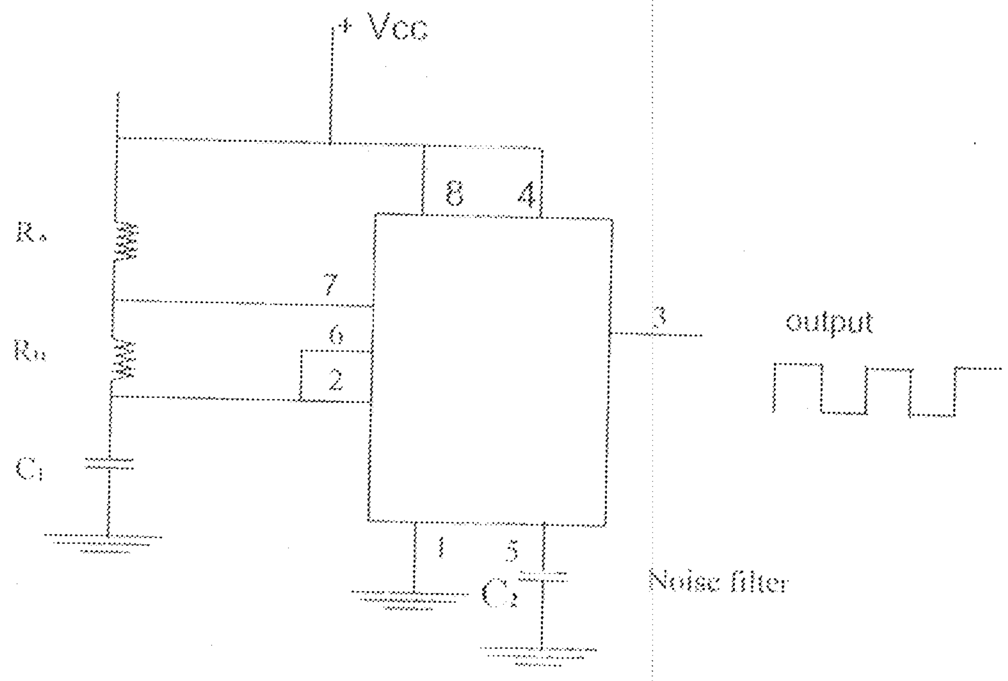


Fig. 2.8: Configuration of 555 Timer for free-running or astable mode.

Fig. 2.8 shows the timer configuration for the free-running or astable mode. The trigger (pin 2) is tied to the threshold (pin 6). When the circuit is turned on, timing capacitor C is discharged. It begins charging through the series combination of R_A and R_B. When the capacitor voltage reaches $^2/_3$ of Vcc, the output drops low and the discharge transistor comes ON. The capacitor now discharges through R_B. When the capacitor voltage reaches $^2/_3$ of Vcc, the output switches high and the discharge transistor is turned OFF. The capacitor now begins charging through R_A

and R_B again. The cycle will repeat continuously with the capacitor charging and discharging and the output switching high and low.

R_A, R_B and C are the timing components and these gives rise to an operating frequency. The output remains in a high state for a longer period than it is in the low state due to the fact that the output goes high during the time the capacitor, C discharges through resistance of R.

The transmitter pulses the infra-red (LED) with a waveform from the output voltage volt of the 555 Timer. This results in a transition from a low to high state. The transmitter is as shown below in fig. 2.9

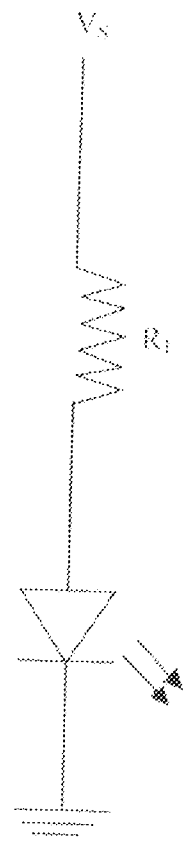


Fig. 2.9: The transmitter stage

D_1 is the opto device (infra-red diode) while R_1 the limiting resistor.

V^+ is gotten from the power supply for the diode to be forward biased.

$V_f = 1.7V$ (V_f = max forward voltage)

$I_f = 150mA$ (I_f = max forward current)

The resistor R will therefore be.

$$R = \frac{V^+ (-V_f)}{I_f}$$

$$R = \frac{12 - 1.7}{150mA}$$

$$= \frac{10.3}{150} \times 10^3$$

$$R = 0.0687 \times 10^3$$

$$R = 69$$

Once forward biased the transmitter emits infra-red rays projected at an angle of about 60^0 from its current surface. To construct and observe the wave form of 1KHz square wave from generator using 555 timer, let us see the following design aspect.

Unsymmetrical square wave generator f = 1KHz

High state time $T_H = 0.693 (R_A + R_B) C_1$

C_1 charges through R_A and R_B

T_L represents the low state.

$T_L = R_B C_1 \Rightarrow T_L = 0.693 R_B C_1$

C_1 discharges through R_B only.

C_1 discharges through R_B only.

The total period $T = T_H + T_L = 0.693 (R_A + 2R_B)C_1$

The output wave form is non-symmetrical. Time total period can be formed by adding T_H and T_L. The output frequency will be equal to the reciprocal of the total period.

So, $f = {}^1/T = 1.45/(R_A + 2R_B)C_1$

D = duty cycle $= [R_B / (R_A + 2R_B)] \times 100\%$

Selected C_1 to be 1μf, $R_A = 10K$, $R_B = 1K$

Then, $T = 0.693 (R_A + 2R_B)C_1 = 0.693 (10k + 2K) \times 1\mu f$

$T = 0.0083sec = 8.3ms$

$$f = {}^1/_T = \frac{1}{0.0083} = 1.2Hz$$

In the actual sense, unsymmetrical square wave generator of 1KHz cannot stand for this project.

$$\text{Hence, } f = 1/T = \frac{1}{0.0083} = 1.2Hz$$

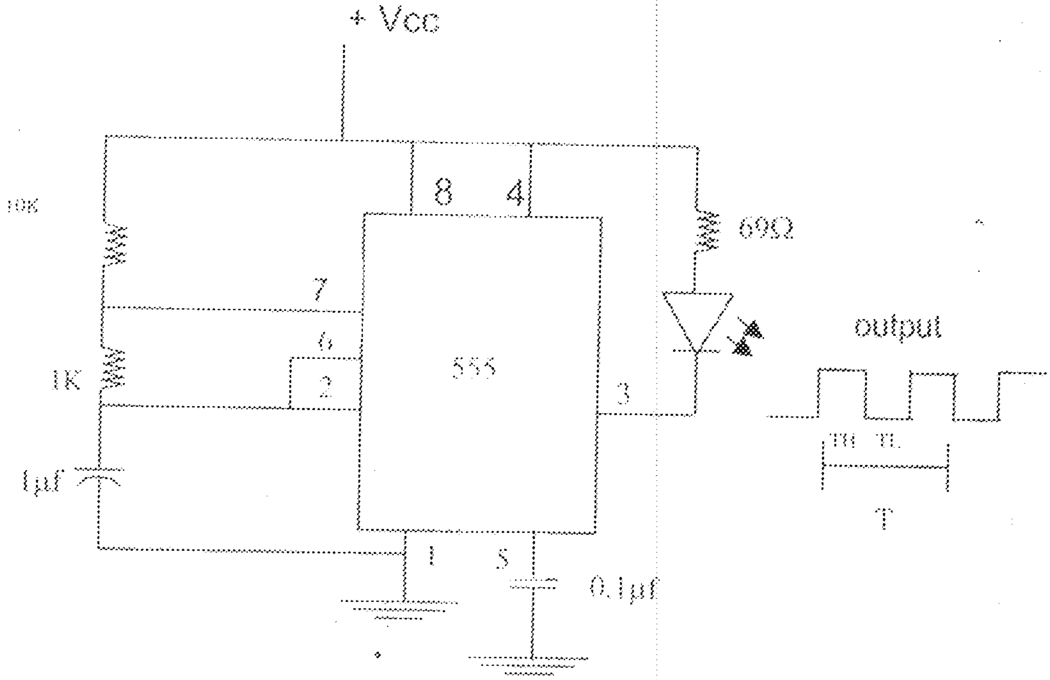


Fig. 3.0 :IR transmitter using 555 Timer in stable multi-vibrator mode

Note: Duty cycle, D of rectangular wave form is the percentage of time that the output is high.

Hence, $T_H = 0.69\,(10K + 1K) \times 1 \times 10^{-6}$

$= \underline{7.6msec}$

$T_L = 0.693(1K) \times 1\ 10^{-6}$

$= 0.693msec$

$= \underline{693msec}$

$D = [1k/(10k + 2k) \times 100\% = \underline{8.3\%}$

3.3 RECEIVER/INTEGRATOR STAGE

The receiver is shown in fig. 3.1 below. The circuit employs the use of a photo diode receiver and an amplifier to enable its output drive other stages.

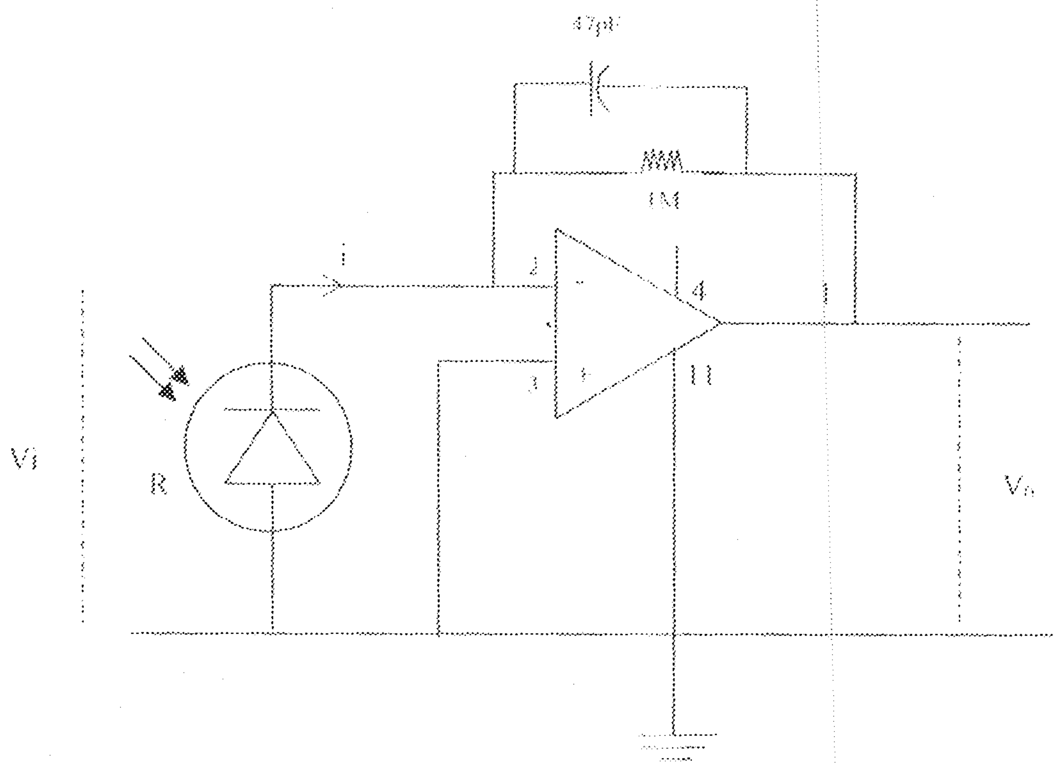


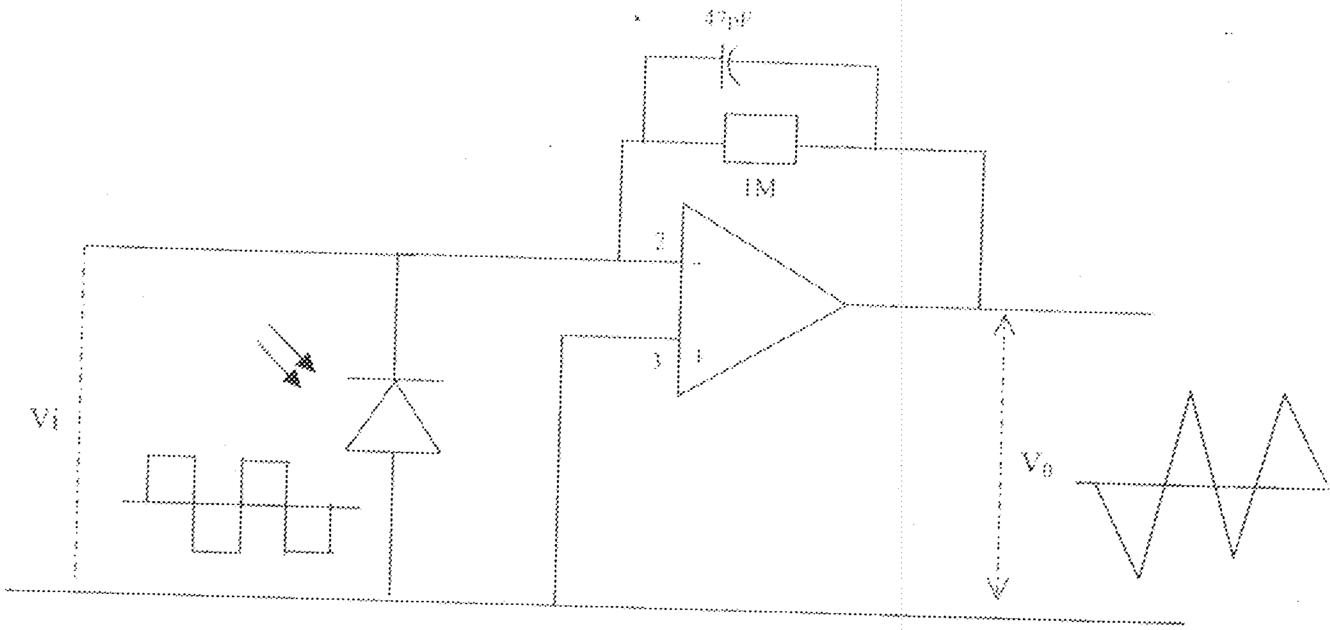
Fig. 3.1: The receiver/integrator stage

The photo diode was used as the main opto sensor due to its ability to resist day light interference better than the other optical devices mentioned.

The photo diode is operated in reverse biased condition. In darkness the photodiode has a high resistance hence a low forward current. The change in resistance causes a change in the output voltage which is fed to the input of the comparators.

The resistance measured from the photodiode when there is no transmission is approximately 1MΩ

The instantaneous current I flowing is equal to V_i/R_i and



When the beam is broken, the voltage to the non-inverting drops below that of the inverting input, which makes the comparator output to fall from a high voltage level (+5V) to zero. This satisfy the condition for switching on the LEDs, which is the next stage.

3.4 COMPARATOR STAGE

The comparator stage is a chain of op-amp with a fixed voltage each at the non-inverting pins, for the chain of comparators below in fig.3.2

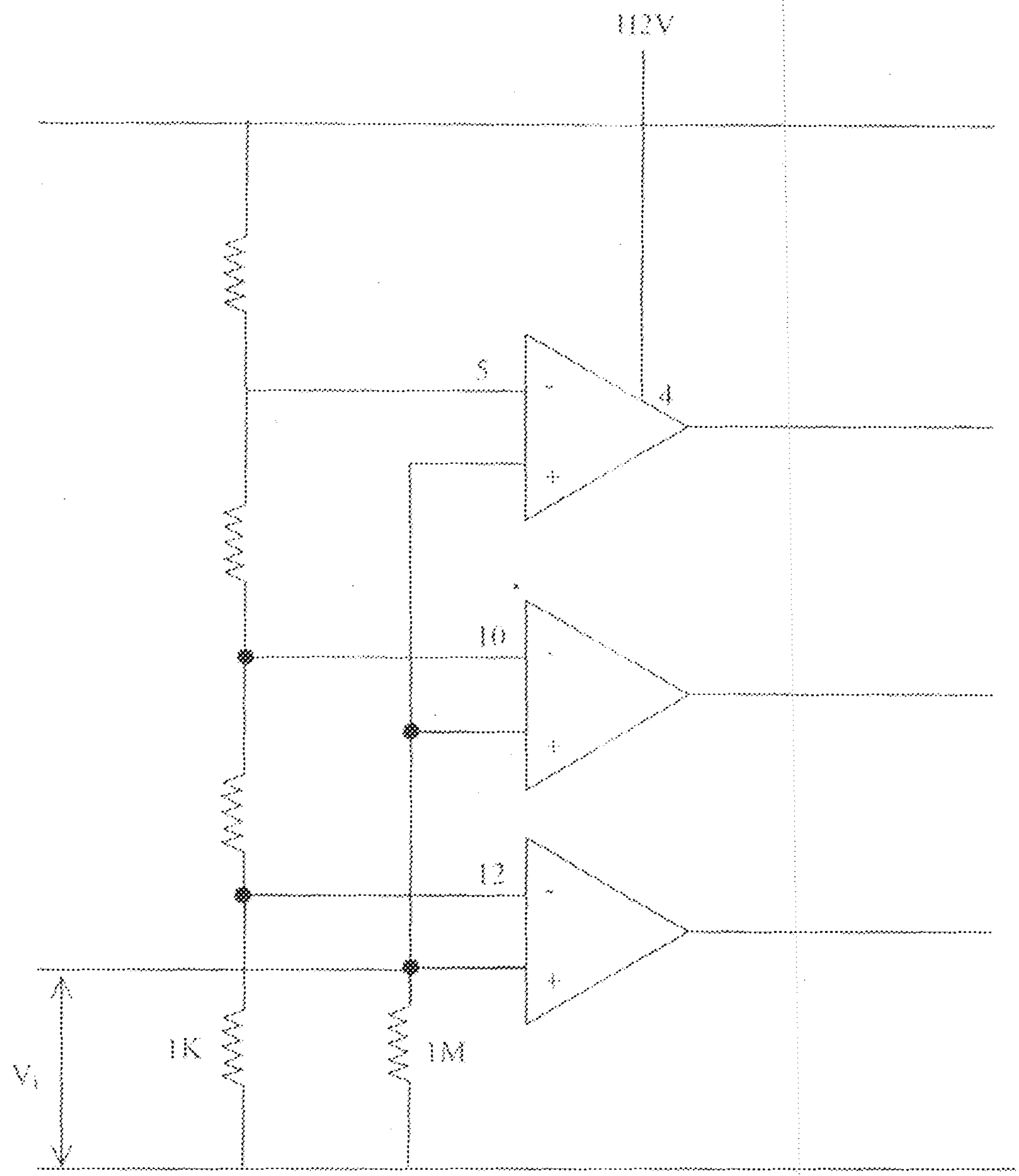


Fig. 3.2 Comparator stage

Drop in pin 5, using the divider network

Pin 5: $V_5 = \dfrac{12 \times 3.5K}{4.7K + 1.5K + 1K + 1K} = \dfrac{12 \times 3.5K}{8.2}$

$= \underline{5.12V}$

Pin 10:

$$V_{10} = \frac{12 \times 2K}{8.2K} = \underline{2.9V}$$

Pin 12:

$$V_{12} = \frac{12 \times 1K}{8.2K} = \underline{1.5V}$$

The individual comparator voltages are then compared with the incoming signal (voltage). For the output of a comparator to be high, the supply voltage to the positive terminal "non-inverting" pin must be higher than the voltage to the inverting terminal. Meaning that the LED will fail to come ON. But for the LED to come ON, the output of the comparator must be low as compared to the supply voltage

$$I_f = \frac{V^+ - V_f}{R} = \frac{12 - 1.7}{1Ks} = \underline{10.3mA}$$

which is enough to glow the LED.

But if the output from a comparator is approximately 6v,

$$I_f = \frac{V^+ - V_{in}}{R} \qquad V_f = \frac{12 - 6 - 1.7}{R} = \frac{4.3mA}{1K} = \underline{4.3mA}$$

which is not enough to glow the LED.

3.5 OUTPUT/INDICATOR STAGE

The output stage is a chain of LEDs to indicate the distance at which the car is close to parking space. If the car is about 20cm to the garage wall. D_7 illuminates, D_7 and D_6 illuminates at 10cm close to the garage wall and D_7, D_6 and D_5 illuminates at about 6cm to the garage wall. In this manner you are alerted when approaching too close to the wall.

3.6 POWER SUPPLY STAGE

All stages in this project uses +12V. The power supply stage is a linear power supply type and involves in step down transformer, filter capacitor and voltage regulators. To give the various voltage levels. The power supply circuit diagram is shown in fig. 3.3 below.

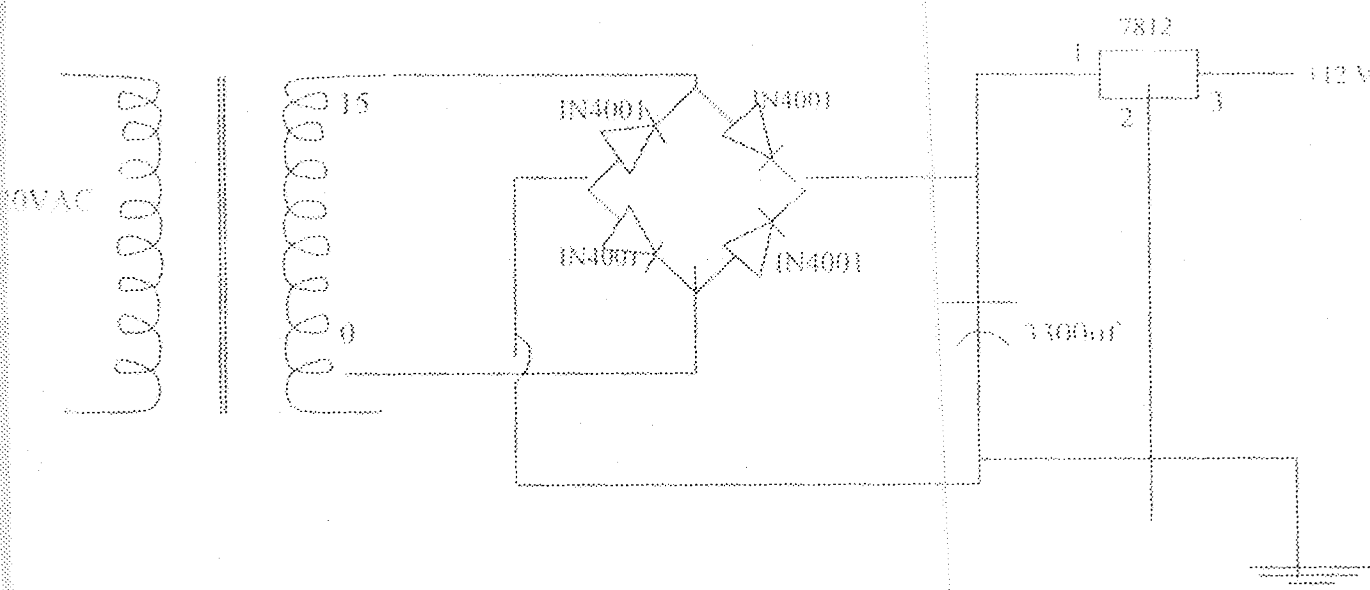


Fig. 3.3(a): Single Power supply circuit

The rectifier is designed with four diodes to form a full wave bridge network. C_1 is the filter capacitor and C_1 is inversely proportional to the ripple gradient of the power supply. Fig. 3.3(b) shows the ripple gradient.

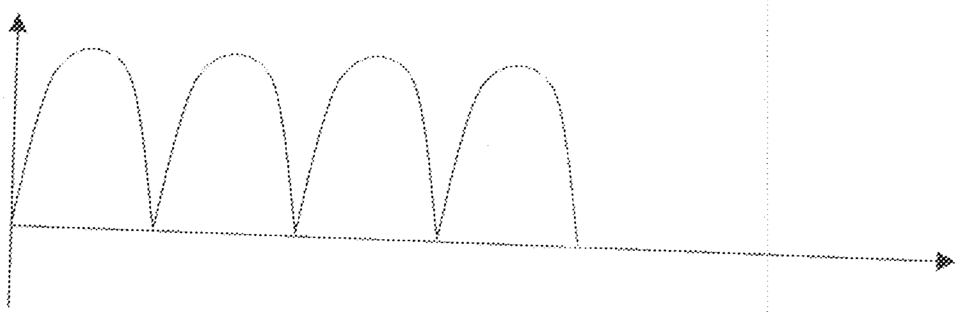


Fig. 3.3(b)

Where dy is the ripple voltage for time dt, where dt is a dependent in power supply frequency.

For an rms voltage of 15 volts (from transformer)

V_{peak} = 15 x 2 (i.e. rms x 2)

= 21.2V

Hence, letting a ripple voltage of 15% makes dv = 3.18

i.e. 15% of 21.2 = 3.18

But $^{1}/_{C} = {}^{dv}/_{dt}$

$^{C}/_{I} = {}^{dt}/_{dv}$

$C = I\, {}^{dt}/_{dv}$

where I = forward current of the diodes = 1A

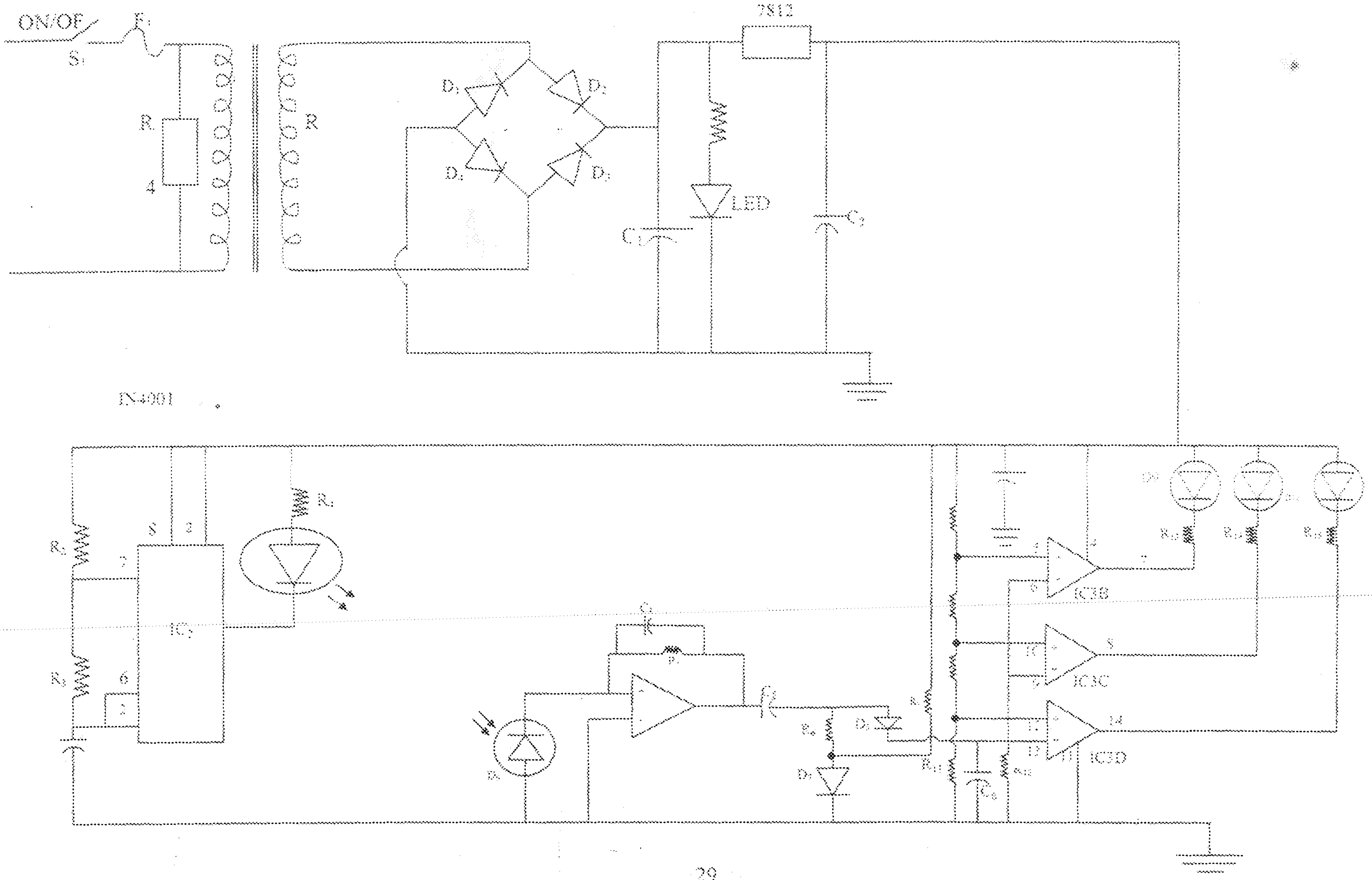
$$dt = \frac{1}{df} = \frac{1}{50Hz} = 0.02s.$$

but dt = 10ms for 50Hz

$$\therefore C = I\,{}^{dt}/_{dv} = 1 \times \frac{0.01}{3.18} = 3144.7\mu f$$

A preferred value of 3300μf was employed for this power supply stage.

A 7812 regulator was used for the 18V supply.


ON/OF
S1
F1
R
4
7812
D1
D2
D3
D4
LED
C1
C2
IN4001
IC2
R1
R2
R3
IC3B
IC3C
IC3D
C6
R11
14

4.4 COMPONENTS LIST

R_1, R_3, R_6, R_7, R_{10}	....	1KΩ
R_2	....	10KΩ
R_4	....	33KΩ
R_5, R_{12}	....	1MΩ
R_8	....	4.7KΩ
R_9	....	1.5KΩ
R_{11}, R_{13} – R_{15}	....	1KΩ
C_1	....	3300μf electrolytic
C_2, C_5, C_7	....	100μf electrolytic
C_3, C_6	....	1μf electrolytic
C_4	....	47pf ceramic
D_1 - D_4	....	1N 4001
D_5	....	infra-red photo diode
D_6	....	Infra-red photo diode
D_7, D_8	....	1N 4148 75V, 150mA diodes
D_9 – D_{11}	....	LEDs (any colour and size)
IC_1	..........,	7812 12V 1A positive voltage regulator IC
IC_2	....	LM555 Timer IC
IC_3	....	LM324 low power quad op-amp
TX_1	....	220/15V Transformer
F_1	....	3A fuse

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.0 TESTING

The physical realization of the project is very vital. This is where the fantasy of the whole idea meets reality. The designer will see his or her work not just on paper but also as a finished hardware.

After carrying out all the paper design and analysis, the project was implemented and tested to ensure its working ability, and was finally constructed to meet desired specifications. The process of testing and implementation involved the use of some equipment stated below.

(I) **BENCH POWER SUPPLY**: This was used to supply voltage to the various stages of the circuit during the breadboard test before the power supply in the circuit was built. Also during the soldering of the project the power supply was still used to test various stages before the d.c power supply used in the project was finally constructed.

(ii) **OSCILLOSCOPE:** The oscilloscope was used to observe the ripples in the power supply waveform and to ensure that all waveforms are correct and their frequencies are accurate. The waveform of the comparator output was checked to see if there were any hysterisis signals which could trigger the astable falsely.

(iii) **DIGITAL MULTIMETER:** The digital multi-meter basically measures voltage, resistance, continuity, current, frequency, temperature and transistor hfe. The process of implementation of the design on the board required the measurement of parameters like, voltage, continuity, resistance values of the components and in some cases frequency measurement. The digital multi-meter was used to check the various voltage drops at all stages in the project, and most importantly the infrared receiver stage, to help check the references in the comparator circuit. Also the Digital multi-meter was used for troubleshooting during the soldering and coupling.

4.01 IMPLEMENTATION

The implementation of this project was done on the breadboard. The power supply was first derived from a bench power supply in the school electronics lab. (To confirm the workability of the circuits before the power supply stage was soldered).

Stage by stage testing was done according to the block representation on the breadboard, before soldering of circuit commenced on Vero board. The various circuits and stages were soldered in tandem to meet desired workability of the project.

For proper understanding of how the system operates and allow for troubleshooting, the pin configuration of the Ics and other active components used are shown below. Fig 4.1a shows the pin out of the NE555 which was used as an astable timer in this project.

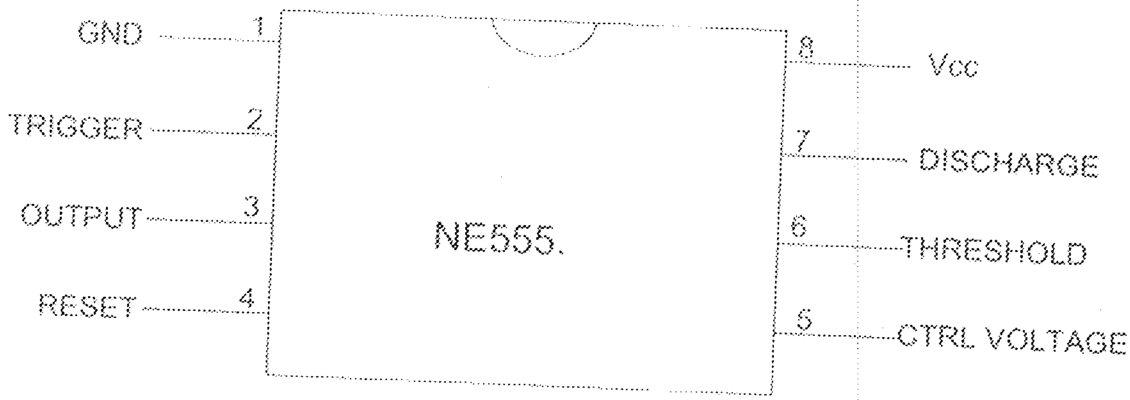


Fig 4.0.1a NE555 pin configuration.

4.1 CONSTRUCTION

The construction of the project was done in two different stages: the soldering of the circuits and the coupling of the entire project to the casing. The infrared transmitter stage was first soldered before the infrared receiver stage and other stages were soldered.

The soldering of the circuit was done on a Vero-board. The second phase of the project construction is the casing of the project. This project was coupled to a metal casing. The casing material being stainless steel designed with special perforation and vents to ensure the system is not overheating and to give ecstatic value.

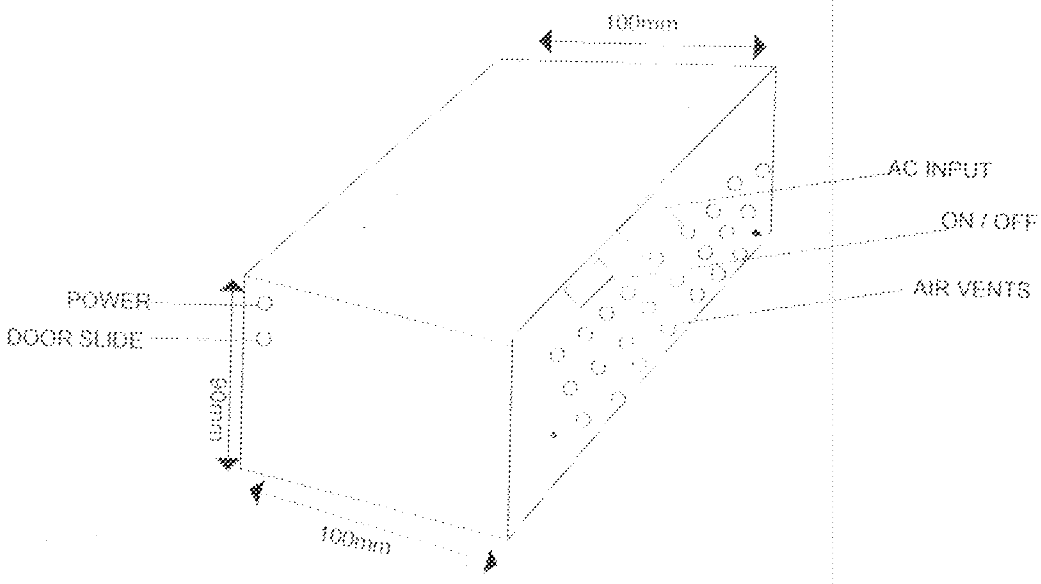
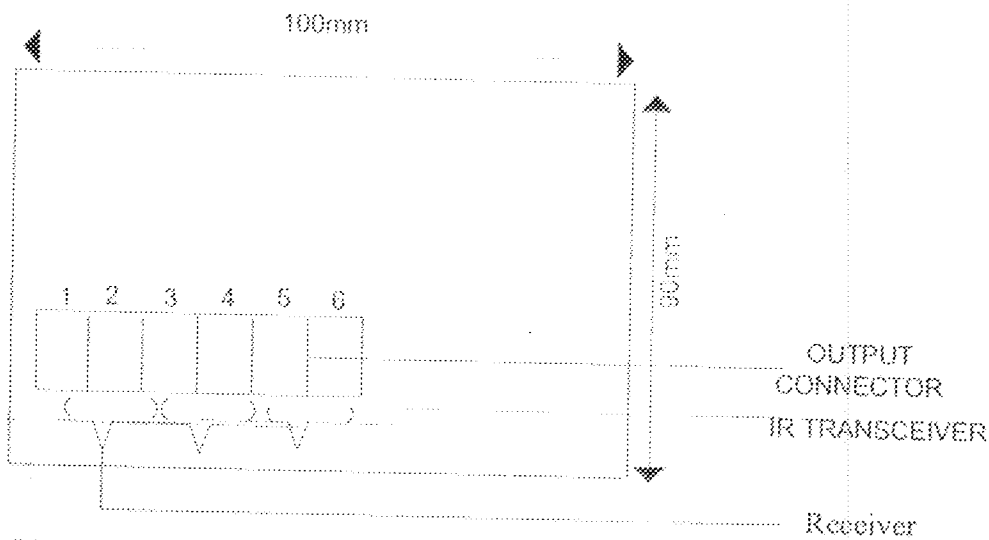


Fig4.1b isometric view of cased job with dimensions.



BACK VIEW

4.2 PROBLEMS ENCOUNTERED

Several problems were encountered during the project. The problems range from design problems to implementation problems and also construction problems. The major problems are as follows:

1 Inability to detect the presence of car. This was the first design challenge the project posed. The problem was solved by adjusting the transceiver and receiver. The LEDs were arranged in such a way that they does not interfere with each other.

2 The LEDs were flicking at some instances. This was discovered to be due to hysterisis. The problem was solved by using filter capacitors at the output of the op-amp.

3 Also, exact calculated values for components were gotten. Preferred values were used instead and this caused drifts in time constant of the timers but these drifts were negligible since they were within range and didn't disturb the opening and closing of the door.

4 Other problems include soldering and measurement errors but these problems were solved by proper troubleshooting serious care in the construction of the project.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 CONCLUSION

The project which is the design and construction of an automatic car parking aid was designed considering some factors such as economy, availability of components and research materials, efficiency, compatibility and portability and also durability. The performance of the project after test met design specifications. The general operation of the project and performance is dependent on the presence car entering or approaching the garage and how close he is to the. The LEDs were meant to open automatically. .

Also the operation is dependent on how well the soldering is done, and the positioning of the components on the Vero-board. The ICs and the exclusive gate were soldered away from the power supply stage to prevent heat radiation which, might occur and affect the performance of the entire system.

The construction was done in such a way that it makes maintenance and repairs an easy task and affordable for the user should there be any system breakdown. All components were soldered on one Vero-board which makes troubleshooting easy.

The project has really exposed me to digital electronics and practical electronics generally which is one of the major challenges I shall meet in my field now in future. The design of the automatic car parking aid

Involves; research in both digital and analog electronics. Intensive work was done on timers and logic control circuits. Also research was done on relays and op-to-devices (e.g photodiode, photo cells etc).

I wish to thank the department, my supervisor and project co-coordinator for giving me the opportunity to do this project. However, like every aspect of engineering there is still room for improvement and further research on the project as suggested in the recommendations below.

5.1 RECOMMENDATIONS

I would recommend that further work be done on the following area.

1) A backup power supply be designed since the system cannot work without constant supply just like any other automatic system (e.g. an inverter, ups or a standby generator)

2) The department should acquire more research-oriented books in the departmental library, to make enough materials available for students use.

REFERENCES

1. WESTPORT H. S. STUTTMAN, *The New Illustrated Science and invention Encyclopaedia*, Vol. 21, pp 459-465.
2. GROLIER , *Encyclopaedia Americana* Vol. 17 (1983), pp 380-392.
3. JOSEPH A. EDMINISTER, *Electric Circuits*, Mc-Graw Hill books, SI edition, pp 16-23.
4. BERNARD GROB, *Basic Electronics*, 4th Edition, pp 599-630.
5. RALPH J. SMITH, *Circuits Devices & Systems*, pp 315-322, 503 - 518, 590.
6. FLOYD L. THOMAS, *Digital Fundamentals*, Prentice-Hall, 6th edition, (1997), pp 470-478.
7. PEATMAN J. B., *Digital Hardware Design*. (1980) pp 47-50.
8. HOLT C. A., *Electronics circuits:* Digital and Analogue (1978) pp 22.
9. RASHID M. A. *Power Electronics Circuits, Devices, and Applications*. (Longman 1986) pp 245-248.
10. MITCHELL F. H., *Introduction to Electronic Designs* (1982) pp. 85-6.
11. RICHARD C. D. *Introduction to Electronic circuits*, New Edition (1986) 208-215.
12. THERAJA B.L and THERAJA A. K, *Electrical Technology*, S. Chand and Company Ltd, India, (1999), pp 1699-1720, 1734-1737, 1998-2006.
13. INTERNET: www.electroforu.net
14. INTERNET www. electronic-labs.com
15. INTERNET www. farnellcomponents.com