DESIGN AND CONSTRUCTION OF AUTOMATIC SLIDE DOOR MAKING USE OF AN INFRA – RED AS MOTION DETECTOR

BY

ADAMU MURTALA ZUNGERU
98/6807EE

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

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FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

ELECTRICAL AND COMPUTER ENGINEERING

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A PROJECT REPORT SUBMITTED IN PARTIAL

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DEGREE OF BACHELOR OF ENGINEERING [B. ENG.]

AT

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA,

NIGER STATE, NIGERIA.

NOVEMBER, 2004.

CERTIFICATION

This is to certify that this project was carried out by **ADAMU MURTALA ZUNGERU** of the Department of Electrical and computer Engineering of the Federal University of Technology Minna under the Supervission of Eng. Musa D. Abdulahi for the award of Bachelor of Engineering (B. ENG.).

....	10/12/2004
ENGR. M. D. ABDULAHI	***DATE***
PROJECT SUPERVISOR	
....	10/12/2004
ENGR. M. D. ABDULAHI	***DATE***
HEAD OF DEPARTMENT	
....	....
EXTERNAL EXAMINER	***DATE***

DECLARATION

I hereby declare that this project report is an original work of mine and has never been presented in any form for the award of a Bachelor degree or Diploma Certificate. All information derived from published and unpublished works have been duly acknowledged.

....	19TH NOVEMBER, 2004
ADAMU MURTALA ZUNGERU	***DATE***
98/6807EE	

DEDICATION

This project is specially and particularly dedicated to Allah Almighty and to my beloved family Mr. and Mrs. Adamu, my brother Adamu Sadiq, My sisters Lanti, Aishat, Jemirat, Semirat, Rabi, Zuwairat (may her soul rest in peace), my step mum, brothers and sisters.

ACKNOWLEDGEMENT

My first and sincere gratitude goes to Allah Almighty without whose love, guidance and protection this work would have not been accomplished.

My special and sincere thanks go to both of my parents, Mallam Adamu Bagudu and Mrs. Mariam Adamu. May Allah, who made it possible for me to be a member of your family and who blessed you with the resources with which you took care of me and ensured my successful of my University Education, continue to bless you all the days of your lives. May you live to enjoy the fruit of your labour in Allah's name (Amin).

I am greatly indebted to my project supervisor Engr. M.D Abdullahi who is also the Head of the Department whose care for his students by providing a conducive atmosphere in the Department Of Electrical Computer Engineering and being a father, and a very good one at that, has left a strong impression in my life.

My sincere gratitude goes to Mr. Agai of NITEL Abuja, Mr. Daniel Duddy the Director Cooper Hill Nig. Ltd., Miss. Sera, to some of my friends and some wonderful students who were always ready to give a helping hand, Alh. Abdulkadir, Ann Baitachi, Elizabeth Agoro, Ibrahim Bawa Ayishi, Opkala Fidelis, Steve, Hafsat Ibrahim Tukura, Abubakar Danjuma, Alli Mariam, Khadijat, Bola, Usman Shehu, Rakiya, Nathosky and the other lot I can not remember.

My special thanks goes to my best friend, Miss Inegbu, Queen of the Quadro Impression, Surulere, Lagos, for being there all through my struggles.

Finally, I would like to thank my only brother Adamu Abubakar Sadiq (Adams) the Manager of Cooper Hill, once again, for being there all through my struggles in life and particularly in academic pursuit that I shall forever be grateful.

ABSTRACT

This project deals with the construction of infra-red (IR) proximity detector which could form the basis for automatic slide door (ASD). This circuit is so versatile, hence, there are various ways in which its objective can be achieved. But emphasis will be given to the techniques employed in proximity switch based on IR transmitter, photo diode amplification of low input signals and comparison of the in coming signal. The circuit will conveniently switch on and cause the door mechanism to start whenever a car / person enters the area. It switches- on spontaneously if any (in the case of person / car) crosses its specified area (i.e it breaks the beam). The opening and closing of the door was such a way that the two relays that switch the mechanical part, make the motor to move in clockwise and anticlockwise direction. This is achieved by the difference in timming of the two monostable multi-vibrators and the Ex - OR Gate, to determine when one of the timer elapsed and the other one still on for the rest seconds.

The ASD system was designed, constructed and tested.

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CHAPTER ONE

INTRODUCTION

1.0. INTRODUCTION

Our contributions to the society are most times fuelled by personal experiences complemented by the knowledge of a particular field of study. Electronic system refine, extend or supplement human facilities and ability to observe, perceive, communicate, remember, calculate or reason. Electronic systems are classified as either analog or digital.

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

This project encomprises both analog circuits and digital circuits. The opto sensing stage is an infra-red transceiver at the base of the door which has a projected infra-red beam to an infra-red receiver on the opposite side of the door. The projected beam is broken by anybody entering the door. Once broken the infra-red receiver stage gives an output which triggers the two monostable multi-vibrators. Monostable (A) has a time constant of 10s and monostable(B), 5s. The output of both monostables goes to the input of an Exclusive-OR gate which allows only one transistors to be high for 5s. Hence, enable timing of the motor in different directions, since opposite polarity voltages are furnished to the motor at different times, to open and close the door via a mechanical metal and bearing system.

The application of this project cannot be overemphasized. Optical interruption, electronic timing functions and delay circuits, logic control (since the movement of the door is controlled logically and in particular directions). The project has both security application and luxury. It is more comfortable and easy if the entering of the door is done automatically. The project could be done and implemented on the building of the school or various departmental buildings.

The mechanical arrangement of the door is done such that the door slides open with the control of a D.C motor and a metal bearing mechanism automatically upon detection of somebody approaching the door when the beam is broken. The generalized block diagram in 1.1 below describes the process.

1.1: GENERAL BLOCK DIAGRAM

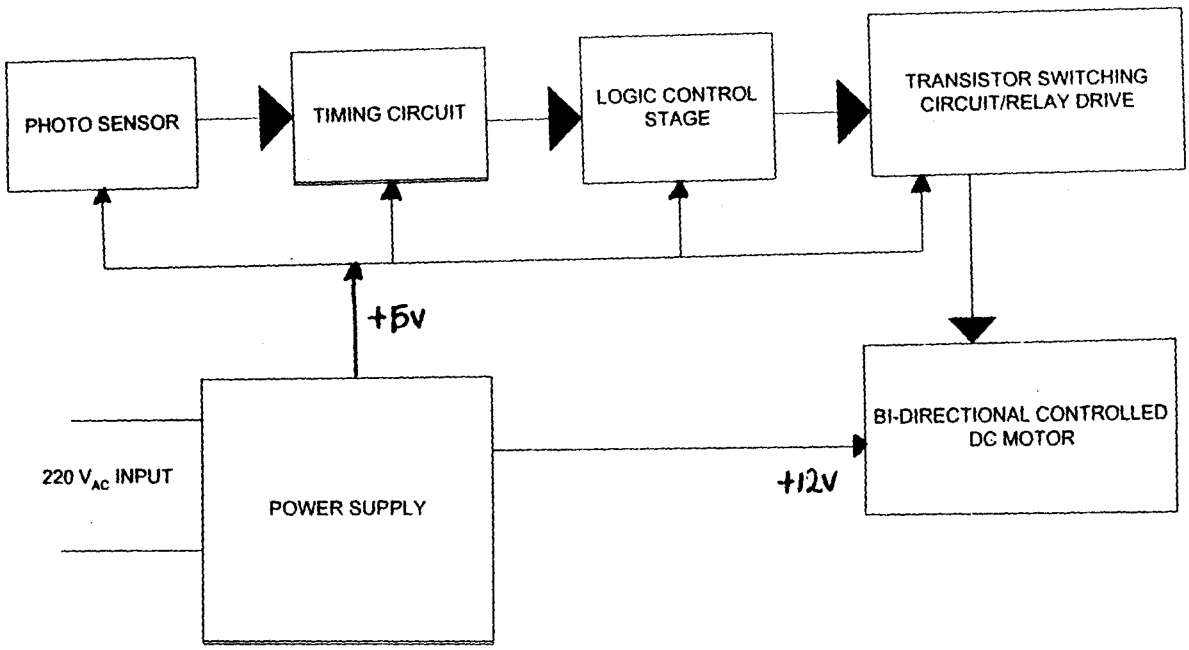


FIG 1.1: GENERALIZED BLOCK DIAGRAM

1.2. DESIGN SPECIFICATIONS

Input Voltage:	220 V ac mains
Supply Voltage :	+5Vdc and +12 V dc
Infra-red range:	1 M (approx)
Physical type of photo -type door:	200 x 500mm

CHAPTER TWO

LITERATURE REVIEW

2.1 OP - AMPS AND COMPARATORS

An operational amplifier is a differential amplifier with an extremely high open loop voltage gain. Negative feed back circuits 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 loop 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 ideal op-amp has the following ideal characteristics:

Infinite voltage gain

Infinite input impedance

Infinite band width.

Zero output impedance

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. The actual characteristics of A741 op – amp are shown below.

Voltage gain = I06 db (numerical gain = 2000000.0)

Input impedance = 1MΩ

Out put impedance = 75Ω

Band with = Up to MHz

V_{out} = A_o V_{in}

Where A_o = *Open loop voltage gain*

and V_{in} = $V^+ - V^-$

2.1.1 STRUCTURES AND OPERATION NOTES

An amplifier is represented diagrammatically by a triangular arrow-head pointing in the direction of data flow i.e. input to output. A differential operation amplifier with a seven-pin base is shown in fig 2.1. The function of the terminal connections will be examined although the numbers and positions shown in fig. 2.1 have no special significance.

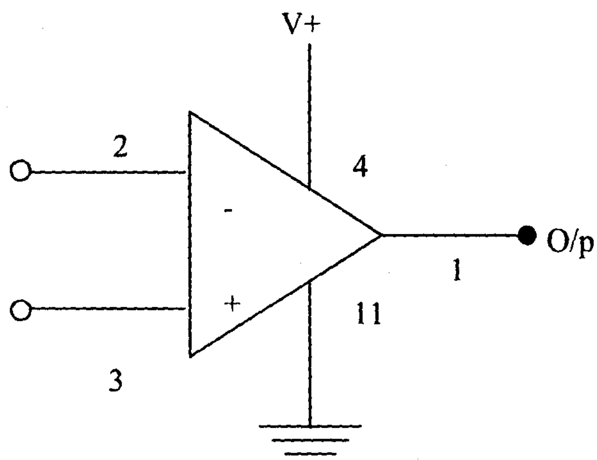


Fig. 2.1: Terminals on a Differential Operational Amplifiers

Terminals 4 and 11 are the power supply terminals in general. The amplifier must be supplied with two stabilised d.c. voltages, e.g. +15 and –15, with respect to the common line or +15 or +12 and –0 volts for single supply. Pin 11 is grounded in such a case and pin 4 taken to V^+ 12v. This enables the unit to amplify a d.c. input signal which may be positive or negative with respect to the common reference level. These supply voltage level are not critical although the manufacturer specifies the voltage at which the reported performance figures were recorded. Most amplifiers will function satisfactorily with reduced gain at voltages +9 and –9. Batteries of adequate capacity may be used or modular mains-operated power supplies are available providing +15 – 0 -15 volt at the terminals of the common line. It is also advisable to provide a ratio frequently by-pass by connecting a 0.1µf capacitor between each power supply terminal and earth. The quiescent current from the power supply may be typically 3mA, whereas the maximum current drawn may be 12mA; operational amplifiers demanding much less power than this are also available.

Terminal 2 is the inverting input terminal. A voltage applied between this terminal and the common line appear in an amplified and inverted form between the output terminal and the common line. For a d.c. input signal inversion means a change of sign, for an a.c. input signal, inversion means a change of phase by 180^0 i.e. the output signal is in anti-phase with the input signal.

In circuit diagram, the inverting terminal is identified by a negative sign. For an amplifier to be termed "operational" it must invert the input signal.

<u>Terminal 3</u> is non-inverting input terminal identified in circuit diagram by a positive sign. Any input signal applied between the terminal and the common line, appear at the output in an amplified form and in-phase with the input signal.

If the input terminal 4 is connected to the common line, the amplifier is left with one input terminal and is said to be "single-end". Difference amplifiers with low inputs are much more versatile so they will be examined more fully and the single-ended version will be treated as a special case.

<u>Terminal 1</u> is the output terminal where the output voltage Vo is developed relative to the common line. An eight pin is provided if frequency-compensating components have to be connected externally. The manufacturers, state the values required when the amplifier is operating at a particular gain. When a different gain is selected, the frequency-compensating component must be changed if the amplifier is to operate in a stable manner.

It will be assumed henceforth that the corresponding components have been incorporated in the operational amplifier itself as is very often the case.

2.1.2 THE IDEAL DIFFERENTIAL OPERATIONAL AMPLIFIER

An ideal differential amplifier is sensitive to a difference of potential between its two point terminals, but will not respond to any voltage applied to both the input terminals simultaneously. The ability of the amplifier to ignore or reject this "common mode signal" is very valuable. An ideal operational amplifier is furthermore assumed to have the following characteristics:

a. **Infinite Gain**

When the gain of an amplifier is very high, the performance of a sub-system which makes use of the amplifier depends only on the input and feedback network. Typically, the d.c. open loop voltage gain, AVo_1 (the voltage gain without feedback) may be 10^5 or 10^6 or more in practice.

b. **Infinite Input Impedance**

With the condition satisfied, the output current to the amplifier is zero by the use of field effects transistors and good design, differential input impedance (impedance between the two input terminal(s) may be as high as 10^{12} in practice). Furthermore, the common mode input impedance (the result of the parallel combination of each input terminal to the common line) may also be 10^5 or 10^6 or more in practice.

c. **Infinite Band Width**

The bandwidth of an amplifier is the frequency range over which the gain is virtually constant. If this extends from zero to infinity, the amplifier will respond equally well to d.c. or a.c. signals of any frequency would occur. In actual amplifier, the gain is reduced progressively at higher frequency up to 100KHz and the frequency at which the voltage gain is unity (i.e. odB) may by 3MHz

d. **Zero Output Impedance**

With this condition satisfied, the output would be unaffected by alteration of band.

e. **Zero Voltage**

This implies that when the voltage between the input terminals is zero, the output voltage will be zero.

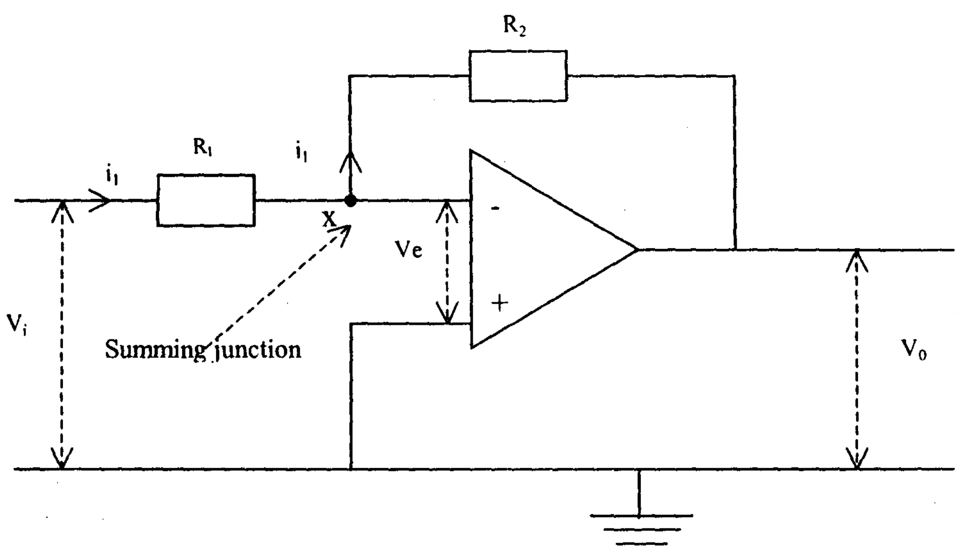


Fig. 2.2: Negative Feed Back

Operational amplifiers make use of external components arranged to provide external feedback except in those occasional cases when they are required to perform a switching action. The feed back path links the output to the inverting input terminal. Whereas one amplifier operating without feedback is said to be "open-loop" the symbol of Avcl denotes the closed-loop voltage gain.

In a simple example of negative feedback (fig. 2.2) the feed back resistor R_2 links the output with the point x – the input terminal of the inverting amplifier.

An amplifier is said to be fully operational if it is stable (i.e. it will not oscillate) when the output is connected directly to the inverting input terminal. This implies that stability will be maintained when a capacitor is used as the feedback component even though this effectively short-circuit the two terminals to high frequency signals.

Assuming the amplifier in fig. 2.2 is to be ideal, any current arising at the point x must flow through the feedback resistor R_2. If the several alternative signal paths connected to x instead of only one via the resistor R_1, the sum of the several currents arriving at x would flow through the feedback path for this reason, the inverting input terminal (point x) is often referred to as the amplifier summing junction.

If the input voltage, tends to drive the potential at the point x positive, the right-hand end of resistor R_2 assumes inverting action of the amplifier. A current if will flow in R_2 in a direction to reduce the positive excursion at the point x to a very low value.

.With the amplifier having a voltage gain of the order of 10^6, an excursion of a few micro volts at x is sufficient to cause the output voltage to swing through its entire range perhaps 10V on either sides of zero. The self-adjusting nature of the negative feed back system has the effect of holding the potential at x to a very low value, i.e. $Ve \rightarrow 0$. No mater what values are chosen for R_1 and R_2. Because the point x is called a virtually earth. Henceforth, the point x at the input to the summing junction or the virtual earth, Whereas, the input terminal will refer to a point at the left-hand side of the resistor R_1.

2.1.3 THE INVERTING AND NON-INVERTING CONFIGURATION: THE CLOSED LOOP VOLTAGE GAIN EQUATIONS

The basic ways in which negative feed back may be applied to a differential amplifier are shown in fig. 2.3, where (a) is the inverting configuration in each case the output is connected via the resistor R_2 to the summing junction of the amplifier.

If the voltage difference between the input terminal fig 2.3(a) $Vc = 0$

$$I_1 = V_i / R_i \text{ and } I_f = -V_o / R_2$$

Because the current flow to the input of the amplifier is zero

$$I_1 = I_f$$

Therefore, $V_i / R_i = -V_o / R_2$

and the closed loop gain:

$$Avcl = V_o / V_i = -R_2 / R_1$$

where the negative sign indicates the inverting nature of the amplifier.

In the case of the circuit of fig. 1.2(b), if no current flows into the amplifier, the voltage at point x is V_x given by:

$$V_x = \frac{V_o R_1}{(R_1 + R_2)} \quad \text{..(1)}$$

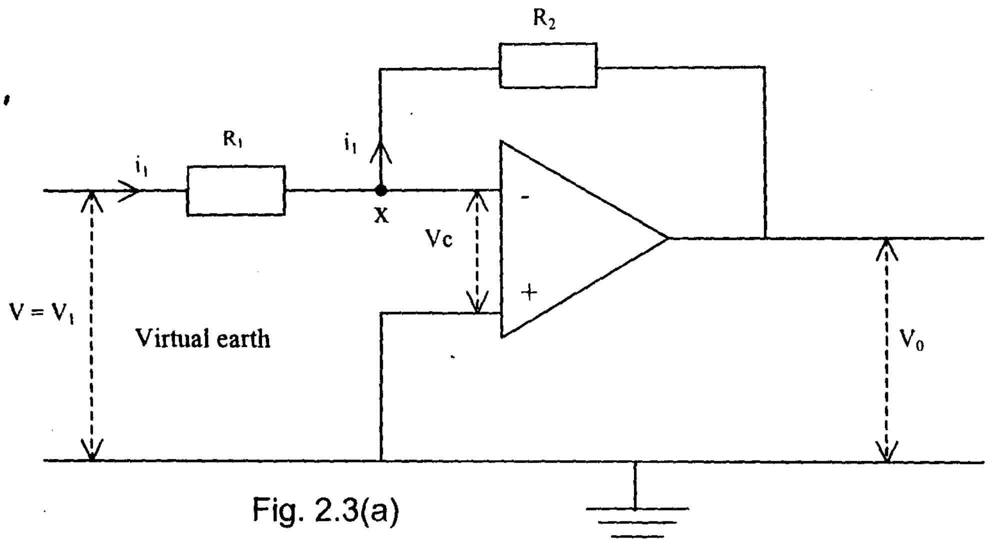


Fig. 2.3(a)

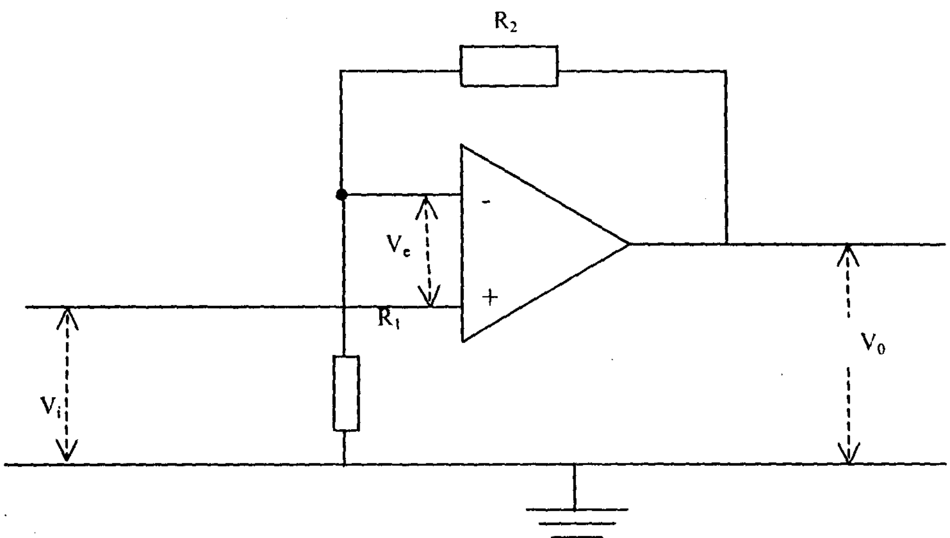


Fig. 2.3(b)

Fig. 2.3 The two basic negative feedback circuit

(a) The inverting configuration

(b) The non-inverting configuration

As $V_e = 0$

$$V_i = V_x = \frac{V_oR_1}{(R_1 + R_2)}$$

and the closed loop gain

$$Avcl = V_o / V_i = (R_1 + R_2)/R_1$$

Therefore, $AVcl = 1 + R_2/R_1$..............................(2)

2.14 NEGATIVE FEED BACK AND LINEARITY

Equation (1) and (2) show that the closed loop voltage gains depend only on the input and feed back components: in the cases represented on the values of the resistors R_1 and R_2. Hence, negative feed back enables the linearity of a good amplifier to be improved beyond recognition. A manufacturer will usually quote the minimum d.c. open loop gain of an operational amplifier at a given temperature say 20^0C. The voltage gain AV_{o1} will vary with temperature, with supply voltage and most important of all, it will vary with the magnitude of the input signal. However, we can now see that this non-linear behaviour on open-loop is not as serious as it might appear because with negative feedback, the closed-loop gain, Ava (which is that require in practice) is dependent only on R_1 and R_2 in the case of the circuits of fig. 2.3. By using precision resistor with negative temperature coefficients for R_1 and R_2, the performance of the amplifier can be made extremely linear and moreover, this linearity is further improved as the negative feedback is increased i.e. as Ava reduced. Much design literature has been published under the general heading of "linear microcircuits" because of the extensive use of operational amplifiers in integrated circuit (micro circuits) form.

It must be recalled that equation (1) and (2) are valid only if the open-loop gain, Avo1 is infinitely large. As large volumes of Avo1 are feature of available operational amplifiers, the errors introduced by using these equations are usually negligibly small.

Apart from inversion, the chief difference between the circuit configurations of fig. 2.3 is the input resistance presented to the source of input signal. In the inverting configuration 2.3(a) feedback presents the voltage at x is virtually at earth potential, and input current, I_1 is determined by the resistors R_1 which is therefore the input. In the non-inverting configuration, no current flows into the amplifier and the input resistance theoretically infinite.

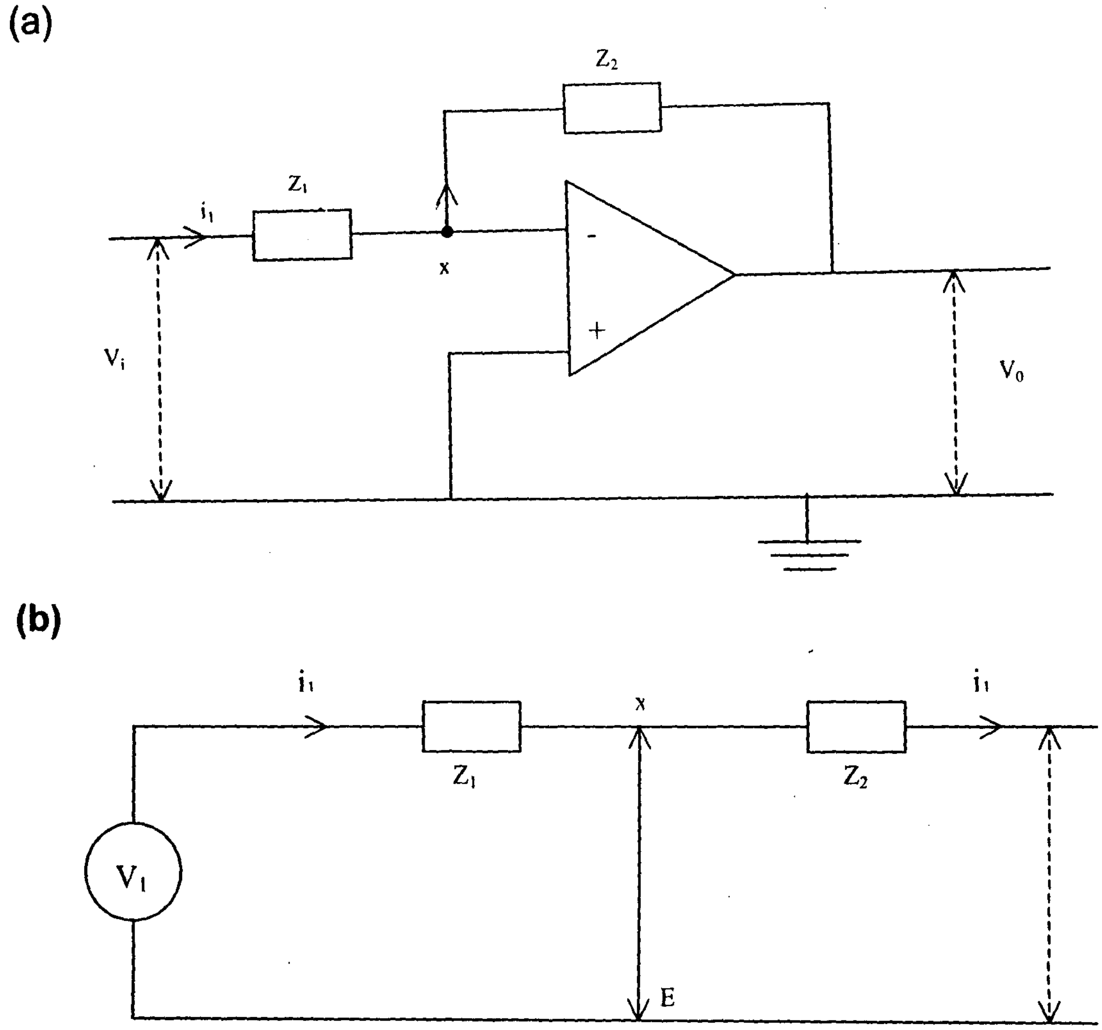


Fig. 2.4 Impedances Z_1 and Z_2 with an inverting amplifier

(a) the feed back amplifier circuit

(b) the equivalent circuit

Replacing the resistance R_1 and R_2 by impedances Z_1 and Z_2 in fig. 2.4(a) is considered from the equivalent circuit of this amplifier fig. 2.4 (b) in which the double headed arrow XE indicates the significance of the virtual earth. This links the point X to the earth even though no current could flow in this fictions connection. Applying a low-frequency sinusoidal signal voltage V_i the same current I_i must flow through Z_1 and Z_2 in fig. 2.4 (b). Therefore

$$I_i = V_i/Z_i$$

$$\text{And Ava} = - I_iZ_2/I_iZ_1 = - Z_2/Z_1 \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Under these conditions, we speak of transfer function of the amplifier rather than the gain. In general, the transfer function is a complex number.

2.15 COMMON MODE REJECTION RATIO

The output voltage Vo from an ideal differential operational amplifier is directly proportional to the input different voltage $V_1 - V_2$ fig. 2.5. Hence, when the two input voltage V_1 and V_2 are equal in magnitude and phase Vo should be zero. However, such perfect balance does not exist in real differential amplifier. The output voltage from such an actual amplifier may be expressed:

$$V_0 = A_D(V_1 - V_2) + m(V_1 + V_2)\ldots\ldots\ldots\ldots(4)$$

Where the first term is proportional to the difference between the two input voltages where as the second is directly proportional to their sum. A_D is called the differential gain whereas M is a constant. If the two points are equal (i.e. $V_1 = V_2$), the output from the real amplifier is $V_0 = 2mV_i$...(5)

The common mode gain Ac is defined as the ratio of the output voltage. Hence, with $V_i = V_2$, $Ac = V_0 / V_1$, Therefore, $AC = 2mV_1/V_1 = 2m$.

Equation (4) can hence be written

$$V_0 = A_D(V_1 - V_2) + (A_D / C)\,[(V_1 + V_2) / 2] \quad \ldots\ldots\ldots\ldots (6)$$

The ratio of the differential gain A_0 to the common mode gain AC is called the common-mode rejection ratio (CMRR). This term, often denoted by the letter C serves as a figure of merit for the difference amplifier.

Re-writing equation (6)

$$V_0 = \underbrace{A_D(V_1 - V_2)}_{\text{Difference term}} + \underbrace{(A_D/C)[(V_1 + V_2)/2]}_{\text{Sum or common mode term}} \quad \ldots\ldots\ldots\ldots (7)$$

The sum term may be regarded as an error term because it is desirable to have the output proportional to the voltage difference alone. This error term is small of the common-mode rejection ratio C is made very large. With good amplifier design, values of C exceeding 10^4 can be achieved.

2.16 FINITE GAIN ERROR, LOOP GAIN AND FEED BACK FACTOR

An ideal operational amplifier is taken to provide an infinite gain so that negative feedback would maintain the voltage across the amplifier input terminals at an infinitesimally small value. In the practical case of an amplifier which provides a finite gain, a small voltage V_e will exist between the input terminal fig. 2.5.

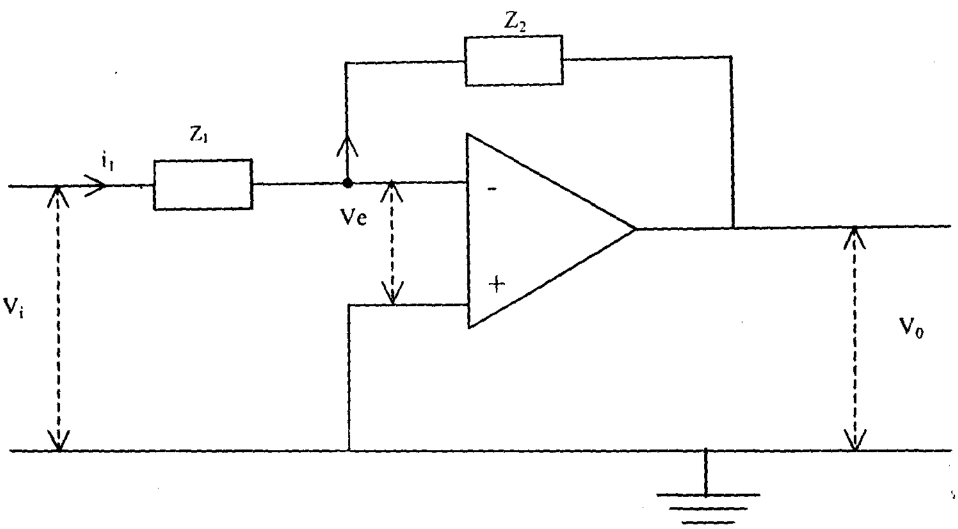


Fig. 2.5: Inverting amplifier with finite open loop gains.

When the current flowing into the amplifier with finite gain is zero, in the inverting configuration (2.5).

$$(V_i - V_e)/R_1 = (V_e - V_0)/R_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

The input error voltage V_e may be defined by

$$V_e = V_0/A \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

where A is written in place of $A_{(Voi)}$, the open-loop voltage gain of the amplifier.

Substituting from equation (a) into equation (2)

$$(V_1 - V_0/A)/R_1 = (-V_0/A - V_0)/R_2$$

therefore $V_0(1/AR_1 + 1/AR_2) = -V_1/R_1$

and the closed-loop voltage is

$$Avcl = V_0/V_1 = -R_2/R_1[{}^1/(1 + {}^1/A(1 + R_2/R_1))] \ldots\ldots\ldots\ldots(10)$$

Writing $R_1/(R_1 + R_2) = B$, gives

$Avcl = -(R_2/R_1)[^1/(1 + {}^1/BA)]$.......................................(11)

Usually, BA >> 1, hence

$Avcl = -(R_2/R_1)(1 + {}^1/BA)$..(12)

Because A $\longrightarrow \infty$, Ava $\longrightarrow -R_2/R_1$ as derived in the ideal operational amplifier.

In the non-inverting configuration,

$Vc + Ve = V_0R_1/(R_1 + Re)$

also, $V_0 = -Ave$

$\therefore \; V_2 - V_0/A = V_0R_1/(R_1 + R_2)$

$\therefore \; V_2 = V_0[^1/A + R_1/(R_1 + R_2)]$ and

$Avcl = V_0/V_2 = [(R_1 + R_2)/R_1] [^1/(1 + {}^1/BA)]$

$= (1 + R_2/R_1)(1 - {}^1/BA)$..............................(13)

Again as A $\longrightarrow \infty$, Avcl $\longrightarrow$ $(1 + R_2/R_1)$ as derived in section 2.13.

The term $^1/(1 + {}^1/BA) = 1 - {}^1/BA$ is sometimes called the "finite gain error". The quantity B is known as the feedback fraction and BA is the loop gain, which is clearly a very important factor in determining the closed performance.

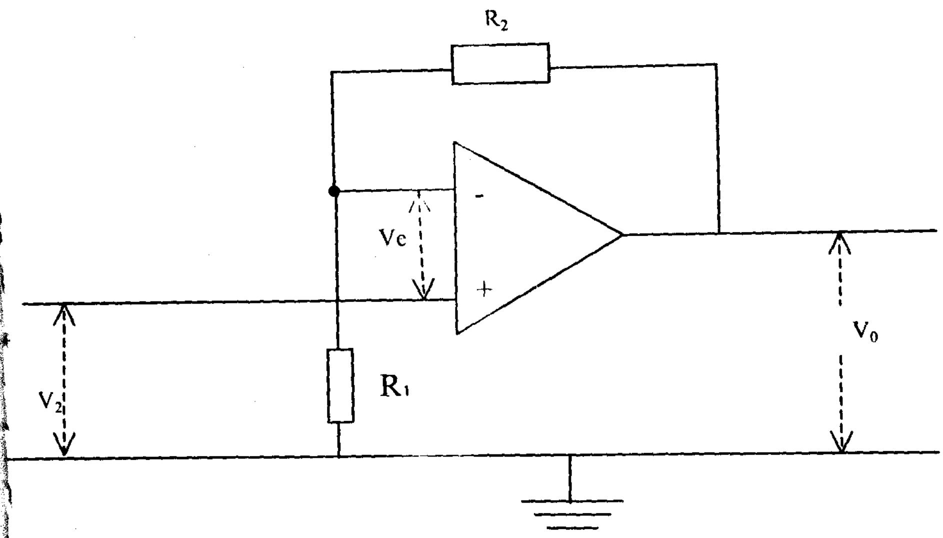


Fig. 3.6: A finite gain amplifier in the non-inverting configuration.

A large value of the loop gain provides a system behaviour dependent only on input and feed back component. Furthermore, frequently four other important improvements are ensured. The first is that the closed loop stability is improved as BA is increased. This can be shown by considering the ratio SAvcl/Avcl, where SAvcl denotes a small change in Avcl. It is easily seen that SAvcl/Avcl = (SA/A)/BA and as SAvcl need to be small for closed loop stability, clearly BA needs to be large.

The second improvement consequent upon increasing BA is reduction of the closed-loop output impedance, Zocl. This is given by Zocl = Zocl/Ba.

where Zoo1 is the open loop output impedance. Obviously,

BA needs to be large for Zocl to be small.

The third is that the closed-loop distortion Dcl is reduced because $DCl = D_{01}/BA$. Where D_{01} is the open-loop distortion.

Fourthly, the frequency response of the amplifier is improved.

2.17 THE OPERATIONAL INTEGRATOR

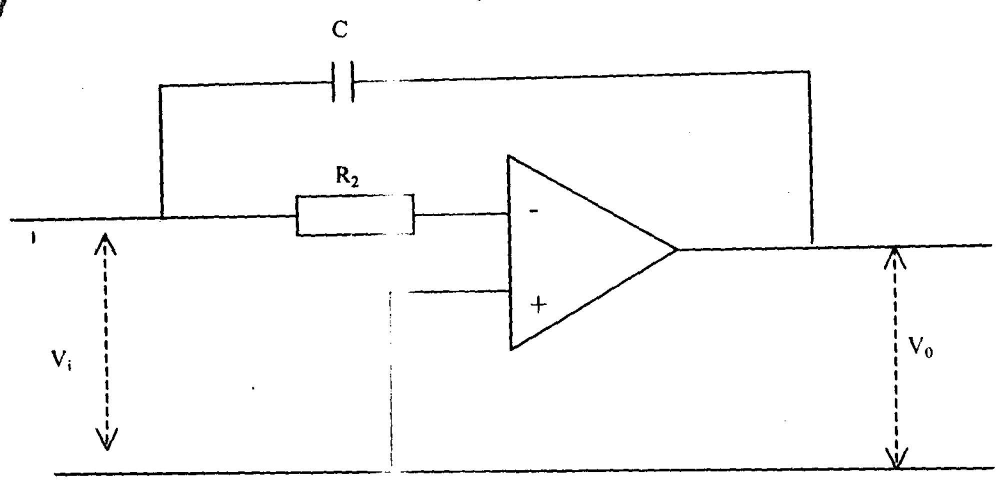
The circuit of figure 2.7, with a capacitor as the feedback component, forms a basic operational integrator in the equivalent circuit of the integrator fig. 2.7(b) the double-ended arrow indicates the virtual earth x. With an input signal V_i (a function of time) applied via the input resistance R_i, the instantaneous current (V_i/R_i) through this input resistance must pass through the feedback capacitor.

Since $I = V_i/R_i$

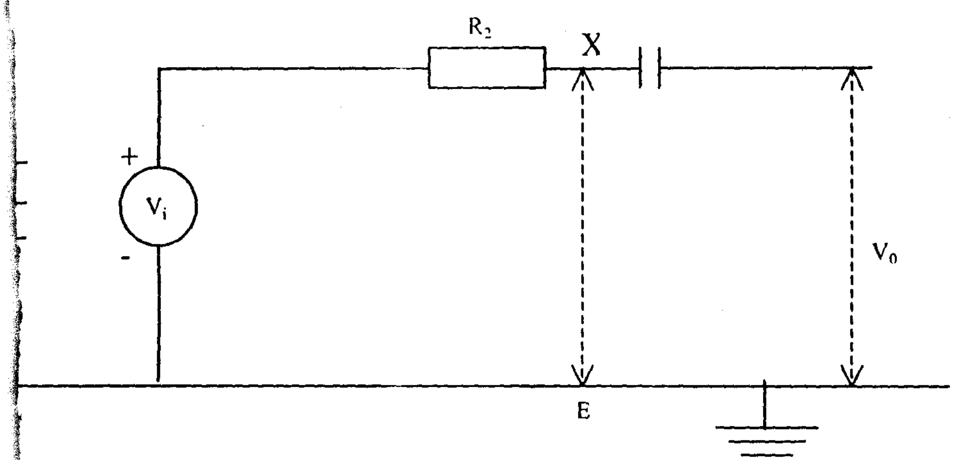
$$\text{and } V_0 = -{}^{1}/C \int_0^t i\,dt \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

$$\text{then } V_0 = -{}^{1}/R_1C \int_0^t V_i\,dt \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

Hence, the output voltage is proportional to the time integral of the input voltage. The time constant $T = CR_1$ in equation (15) is sometimes called the "Characteristic time" of the integrator. The term ${}^{1}/T$ may be termed the integrator "gain" because it indicates the rate of change of output voltage in volts per second per unit input. If the unit input voltage V_i is constant then the output voltage rises linearly with i.e. a linear amp waveform is generated. It is unwise to use a low cost amplifier like the 741 op-amp as an integrator because the input offset voltage and bias current cause a continual charging of the feedback capacitor. Hence, even with no signal applied to the input terminals, the output voltage of the free-running integrator drifts until the amplifier saturates. The circuit of fig. 2.8 is equivalent to a basic integrator in which a leaky capacitor is used as the feed back component. The circuit can be used as the feedback wave generator to apply an input signal of BV peak to peak at a frequency of 5KHz. The output voltage, across the capacitor is rising exponentially but the observed portion is almost linear because the resistance in parallel with C is large. Only the initial portion of the charging cycle is being observed at this sequence. To verify that the output voltage is part of an exponential curve, replace the 1m with 500k resistor and observe the output wave form as the frequency of the input signal is reduced.



(a)



(b)

Fig. 2.7: *The basic Operational Integrator and equipment circuit.*

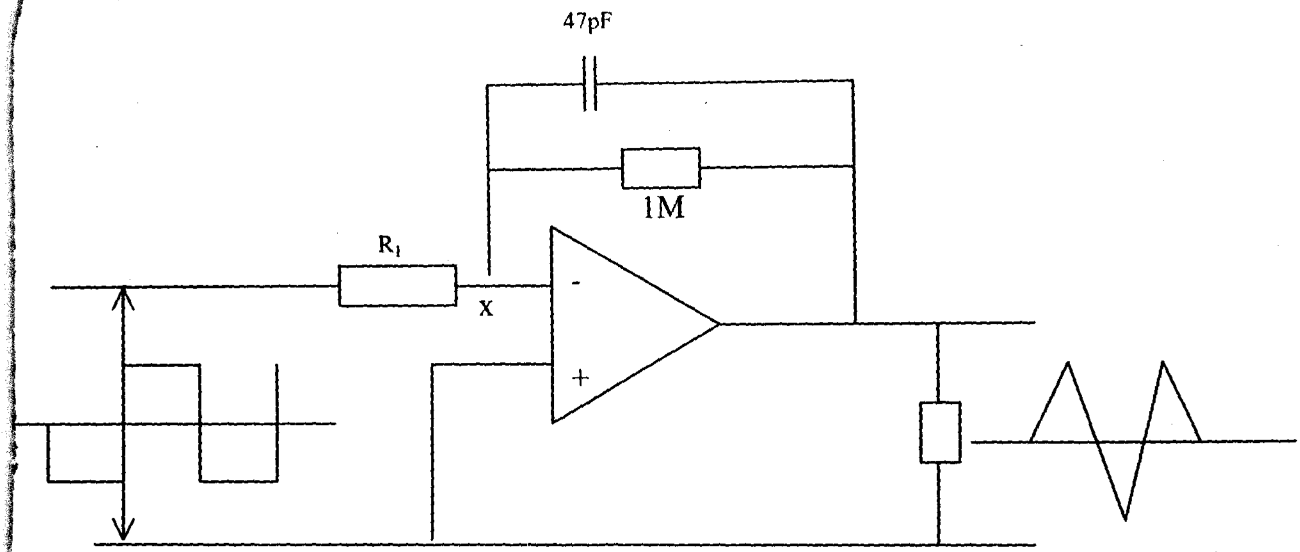


Fig. 2.8: *Circuit to convert a square wave to a linear triangular wave.*

2.18 APPLICATION OF OP-AMPS

(i) AS AN AMPLIFIER

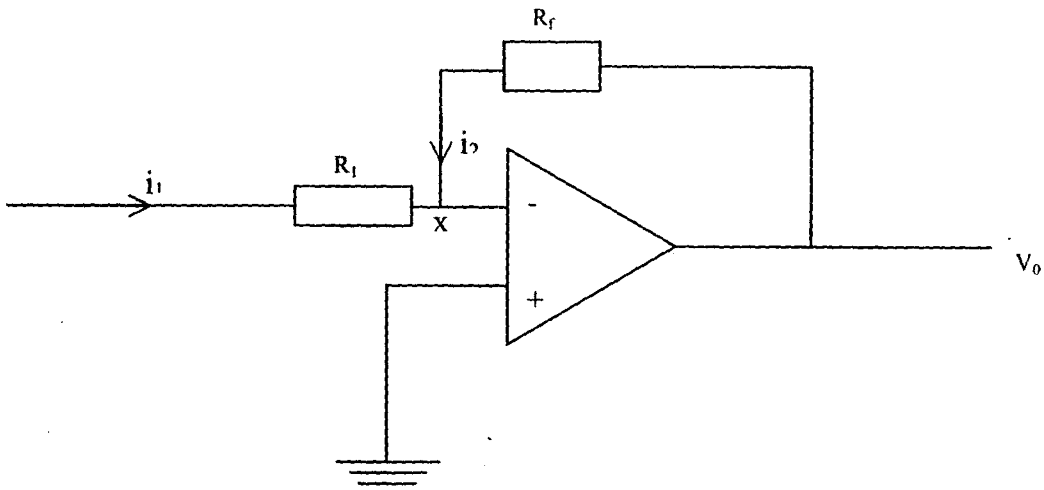


Fig. 2.9: *Op-Amp as an amplifier*

At the summing junction (SJ), the sum of the input and output current is zero, i.e. $i_1 + i_2 = 0$

$$I_1 = -i_2$$

But $i_1 = \frac{e_1}{R_1}$ and $i_2 = \frac{e_0}{R_f}$

i.e $\frac{e_1}{R_1} = \frac{-e_0}{R_f}$

i.e $\frac{e_0}{R_f} = \frac{-e_1}{Ri}$

or $\frac{e_0}{E_i} = \frac{R_f}{R_i}$

Where $\frac{e_0}{e_i} = A_v$ = gain There for $A_v = \frac{-R_f}{R_i}$ = The amplification factor

(ii) AS A SUMMER

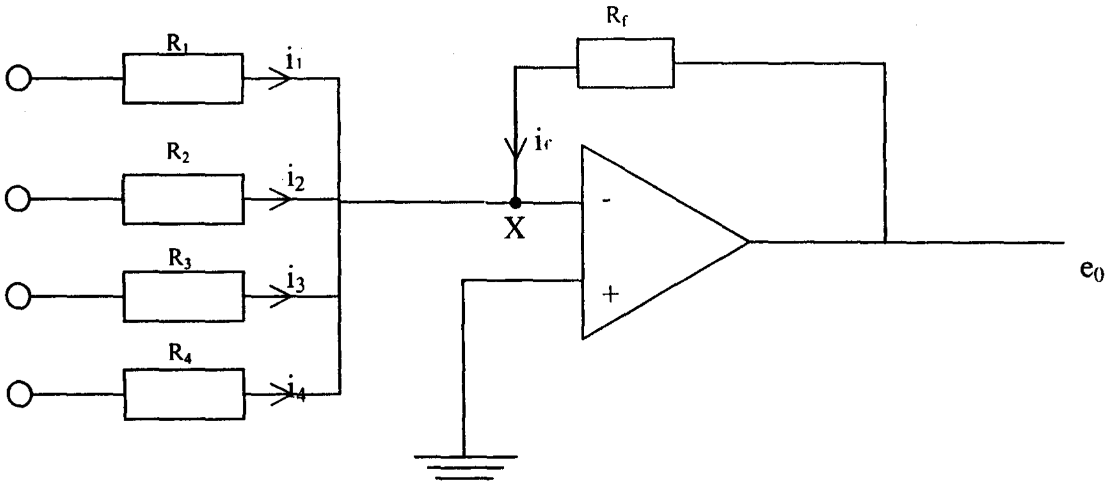


Fig. 2.91: *Summing Amplifier*

From the Figure above assuming the corresponding current flows in each circuits; Applying KCL to node X, we have:

$$\sum i_m = 0$$

$$i_1 + i_2 + i_3 + i_4 = -\, i_f$$

But $i_1 = \frac{e_1}{R_1}$

$$i_2 = \frac{e_2}{R_2}$$

$$i_3 = \frac{e_3}{R_3}$$

$$i_4 = \frac{e_4}{R_4}$$

And $i_f = \frac{e_0}{R_f}$

If $R_1 = R_2 = R_3 = R_4 = R$, then $\left(\frac{1}{R}\; e_2 + e_3 + e_4\right) = \frac{-e_0}{R_f}$

e. $$\frac{e_0}{e_1+e_2+e_3+e_4} = \frac{R_f}{R}$$

r $$e_0 = -\frac{R_f}{R}(e_1 + e_2 + e_3 + e_4)$$

here $\frac{R_f}{R}$ = Mixer factor.

.20 OPTO-DEVICES

Opto-devices convert light energy from one form to another. They are used for transmission of infrared rays, emission of light in different colours (i.e. LED's), sensing of light rays of different intensity (LDRs, photo diodes and phototransistors), and for the conversion of light to different electrical quantities like current voltage and frequency. The various opto-devices are reviewed below.

21 INFRARED EMITTERS (LED)

A LED (generally) is a junction diode made from the semi-conductor material, gallium arsenide phosphide. Its action and the type of ray is dependent on the type of semi- conductor doping used.

The infrared type when furnished with appropriate voltage and current (which could be gotten from data sheets), emits infrared ray at a given wavelength. Typically the 5mm LED emits infrared current of about

150mA at a voltage of about 1.7v.d.c forward current. The symbol for the infrared emitter is shown in fig 2.92 below.

a

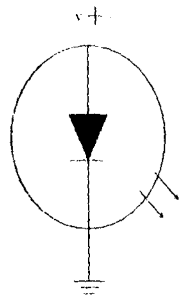


Fig 2.92. INFRARED EMITTING DIODE.

2.22: **THE PHOTO – TRANSISTORS**

The photo – transistor is a semiconductor 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 2.93 shows the schematic representation.

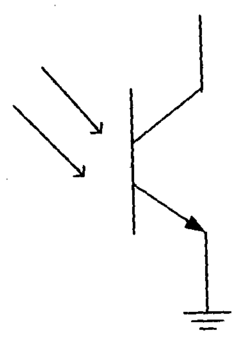


Fig 2.93 A schematic representation for phototransistor

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 photodiode 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 semiconductor 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 2.94.

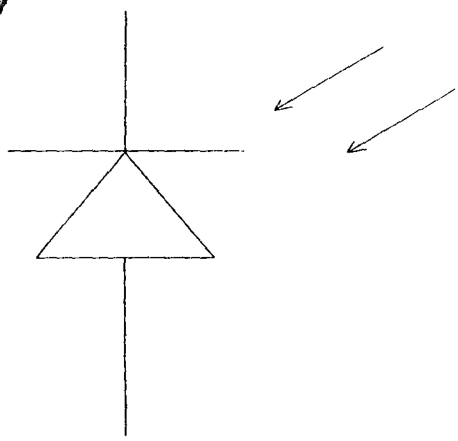


Fig 2.94. A schematic symbol for photo diode.

2.24 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 2.95 shows the transistor as a switch.

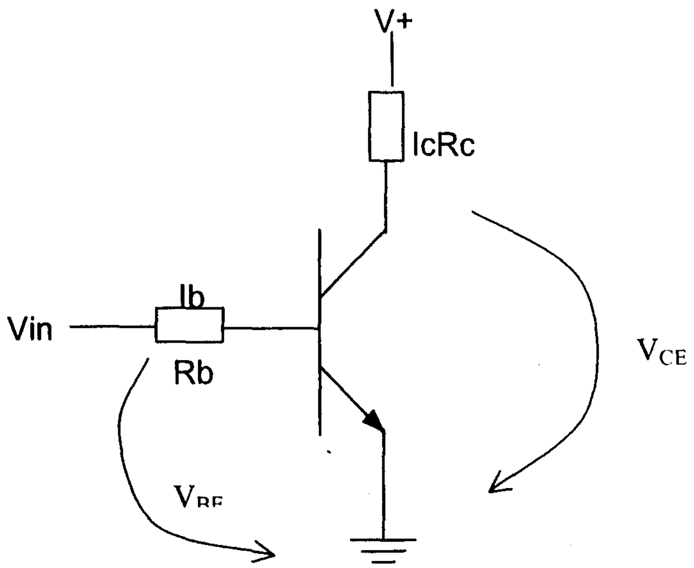


Fig.2.95: TRANSISTOR AS A SWITCH.

For the transistor configuration, since the transistor is biased to saturation.

V_{CE} =O, when the transistor is ON.

Which implies that,

$$V_{+} = I_c R_c + V_{CE} \quad \text{----------------------(2.5)}$$

$$V_{in} = I_B R_B + V_{BE} \quad \text{---------------(2.6)}$$

$$\frac{I_c}{I_b} = h_{fe} \quad \text{-----------------------(2.7)}$$

$$R_b = \frac{V_{in} - V_{BE}}{I_b} \quad \text{-----------------(2.8)}$$

Where,

I_c = collector current

I_b = base current

Vin = input voltage

V_+ = supply voltage

V_{CE} = collector-emitter voltage

H_{fe} = current gain.

V_{BE} = Base-emitter voltage

2.25 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 change after a predetermined time interval. This is, of course, the action of the monostable multivibrator, which will give time delay after a fraction of a second to several minutes quite accurately. The most popular of the present IC, which is available in an eight, pin dual in line package in both bipolar and CMOS form. The 555 timers is a relatively stable IC capable of being operated as an accurate bistable, monostable or astable multivibrators. The timer comprises of 23 transistors, 2diodes and 16 resistors in its internal circuitry. Its functional diagram is shown below in fig 2.96

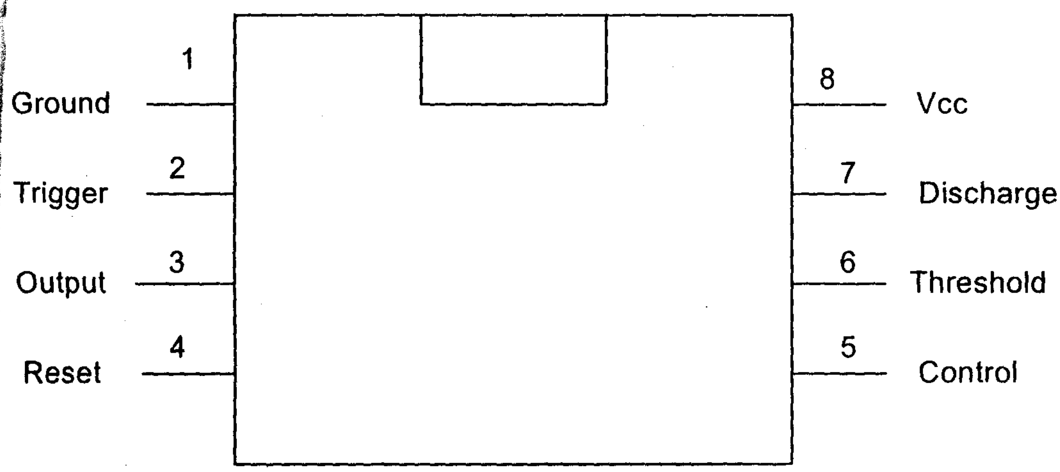


Fig 2.96: 555 timer pin orientations

The functional diagram consists of two comparators, a flip-flop, two control transistors and a high current output stage. The two comparators are actually operational amplifiers that compare input voltage to internal reference voltages which are generated by internal voltage divider of three 5K resistors.

The reference voltage provided are one third and two third of Vcc. When the input voltage to either of the comparators is higher than the reference voltage for the comparator, the amplifier goes to saturation and produces an output signal to trigger the flip-flop. The output of the flip-flop controls the output stage of the timer. The 555 timer chip works from a d. c. supply between 3-15V and can source or sink up to 200mA at its output.

The operation of the 555 timers is further defining the functions of all the pins. The details regarding connection to be made to pins are as follows.

Pin 1: This is the ground pin and should be connected to the negative side of the supply voltage.

Pin 2: This is the trigger input. A negative going voltage pulse applied to this pin when falling below 1/3Vcc causes the comparator output to change state. The output level then switches from LOW to HIGH. The trigger pulse must be of shorter duration than the time interval set by the external CR network other wise the output remains high until trigger input is driven high again.

Pin 3: This is the output pin and is capable of sinking or sourcing a load requiring up to 200mV and can drive TTL circuits. The output voltage available is approximately –1.7V.

Pin 4: This is the reset pin and is used to reset the flip-flop that controls the state of output pin 3. Reset is activated with a voltage level of between 0V and 0.4V and forces the out put low regardless of the state of the other flip-flop inputs. If reset is not required, then pin 4 should be connected to same point as pin 8 to prevent accidental resetting.

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 Vcc 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 10nF 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 rises above two-third of the voltage applied to pin 8. Additionally a current of minimum value 0.1 A 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 although devices, which operate up to 18V, are available

2.26 OTHER PASSIVE COMPONENTS

Passive components are components, which cannot amplify power and require an external power source to operate. They include resistors, capacitors, indicators, and transformers etc. their application range from potential dividers to control of current (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 2.4a below.

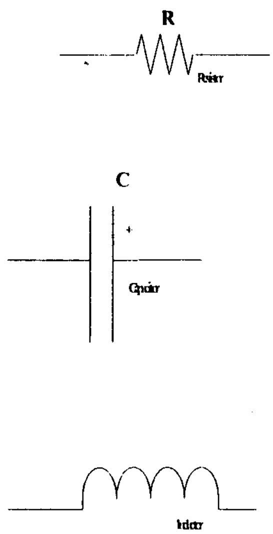


Fig 2.97: Schematic representation for passive components.

CHAPTER THREE

DESIGN AND ANALYSIS

3.0 PRINCIPLE OF OPERATION

The comparator output goes low when the beam is broken and triggers two timers. Both timers are triggered simultaneously but both of them have different time constants. The first timer has a time constant of 5s while the second has a time constant of 10s. When the beam is broken, both timers go to their unstable states. Timer A drives the transistor switch that controls opening of the door. Hence, 5s the door is opened.

The timer outputs are fed to an exclusive OR gate which gives us an output only when its inputs are un-identical. This implies that before breaking the beam the exclusive gate output is low and when the first timer elapses its time constant, the input of the exclusive gate becomes un-identical and another relay is switched to make the gate close.

Closure of the gate is achieved by reversing the polarity of the supply to the motor. The relay contacts are fed with 12v d.c. (since the motor is a positive 12V motor) and is arranged in such a way that the polarity connected to the motor is reversed when the door is to close.

The system with a dual voltage level supply of +12v d.c. and 5 d.c is used to power the switching circuit and the relays while the +5v power the other electronic circuits in the project including the TTL stage. The system gets power from mains, supply.

3.1 DESIGN SPECIFICATIONS

SUPPLY Voltage	-	+5 & 12vdC
MAX CURRENT	-	1.5A
INFRA-RED RANGE	-	500mm (for proto type door)

3.2 TRANSMITTER STAGE

The transmitter stage is not too complex since no coding is involved. The infrared diode is forward biased to meet the electrical conditions, which it operates.

The transmitter is as shown in Fig. 3.1 below

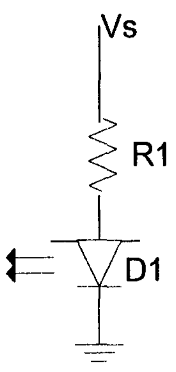


Fig. 3.1: The Transmitter Stage

D 1 is the opto device (infrared diode) while R1 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,

$$R = \frac{V+ (-V_F)}{I_F}$$

$$R = \frac{5-1.7}{150mA}$$

$$= \mathbf{22\Omega}$$

Once, forward biased the transmitter emits infrared rays projected at an angle of about 60^0 from its current surface.

3.3 RECEIVER / AMPLIFIER STAGE

The receiver is shown in Fig. 3.2a below. The circuit employs the use of a photodiode receiver and an amplifier to enables its output drive other stages.

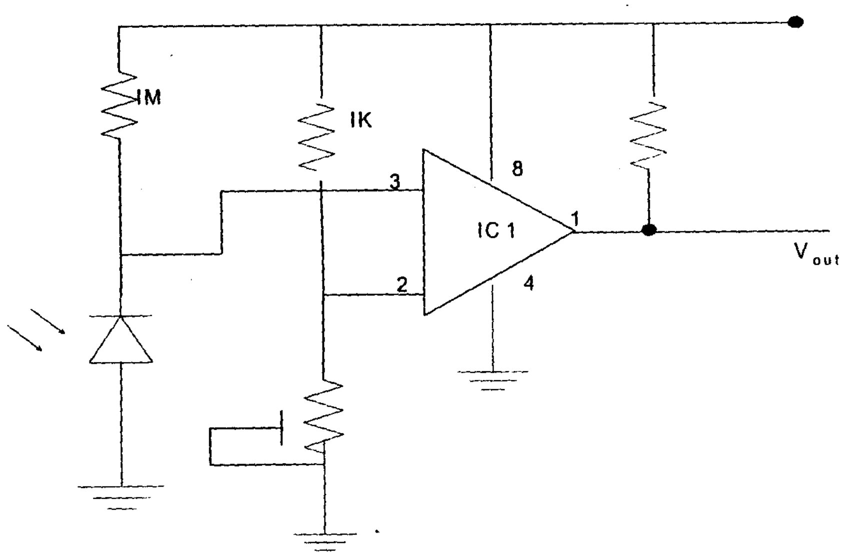


Fig. 3.2 (a) : The Receiver or Amplifier Stage

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 photodiode 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 drop across R2, which is fed to the input of the comparator ICI.

The resistance measured from the photodiode when there is no transmission is approximately 1MΩ. fig. 3.2(b) shows the potential divider network formed using the photodiode and the resistor R_1 and R_2.

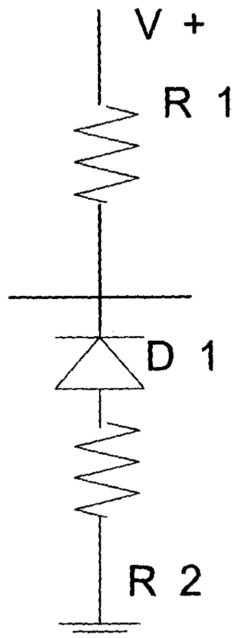


Fig. 3.2 (b) : Potential DIvider

R_2 is set at 1MΩ (to allow in appreciable drop)

At V+ =5V the drop across R_2 will be

$$\frac{R2 \times V+}{(R_1 + R_2)}$$

if VR_2 is the drop across R2

$$\Rightarrow VR2 \quad = \quad \frac{IM\Omega \times 5V}{IM\Omega + IM\Omega}$$

= 2.5V

R is a resistor of 1KΩ whose resistance is negligible compared to that of D1. Hence R_1 is referred to be the resistance of the diode.

The resistance reduces to about 10KΩ on reception of the infrared.

$\therefore$ VR_2 in this case will be,

$$\frac{10k \quad X\ 5}{6.6k + 10k}$$

= 3 V

Hence, suffice to say that the resistance drops from 2.5V to about zero volts, with the reception of infra-red rays.

The voltage comparator ICI, is used to compare this change with a given reference generated by R_3 and R_4.

R_4 should vary between zero and about 3_V, hence R_3 is used to drop 2V.

$\therefore$ if drop across R_4 is 3V, and letting R_4 be 10KΩ

$$\Rightarrow VR3 = \frac{R3}{R_3 + R_4} \times V+$$

$$\therefore 2V = \frac{R_3 \times V+}{R_3 + R_4} \quad \text{(since } VR_3 = 2v\text{)}$$

$$= \frac{R_3}{10\Omega + R_3} \times 5V$$

$$04\ (10\Omega + R_3) = R_3$$

R_3 = **6.6KΩ**

Preset value of 10K was used.

The use of a preset resistor is to allow variation of resistance, which would give room for sensitivity of range.

When the beam is broken, the voltage to the non-inverting input drops below that of the inverting input, Which makes the comparator output to fall from a high voltage level (+5v) to zero. This satisfies the condition for triggering the 555 timer, which is the next stage.

.4 MONOSTABLE MULTIVIBRATOR

The monostable multi-vibrator creates the time constant, which enables opening and closing of the door. Two monostable stages were used. The first monostable opens the door, while the second monostable closes the door. The stages are shown in Fig. 3.3 below

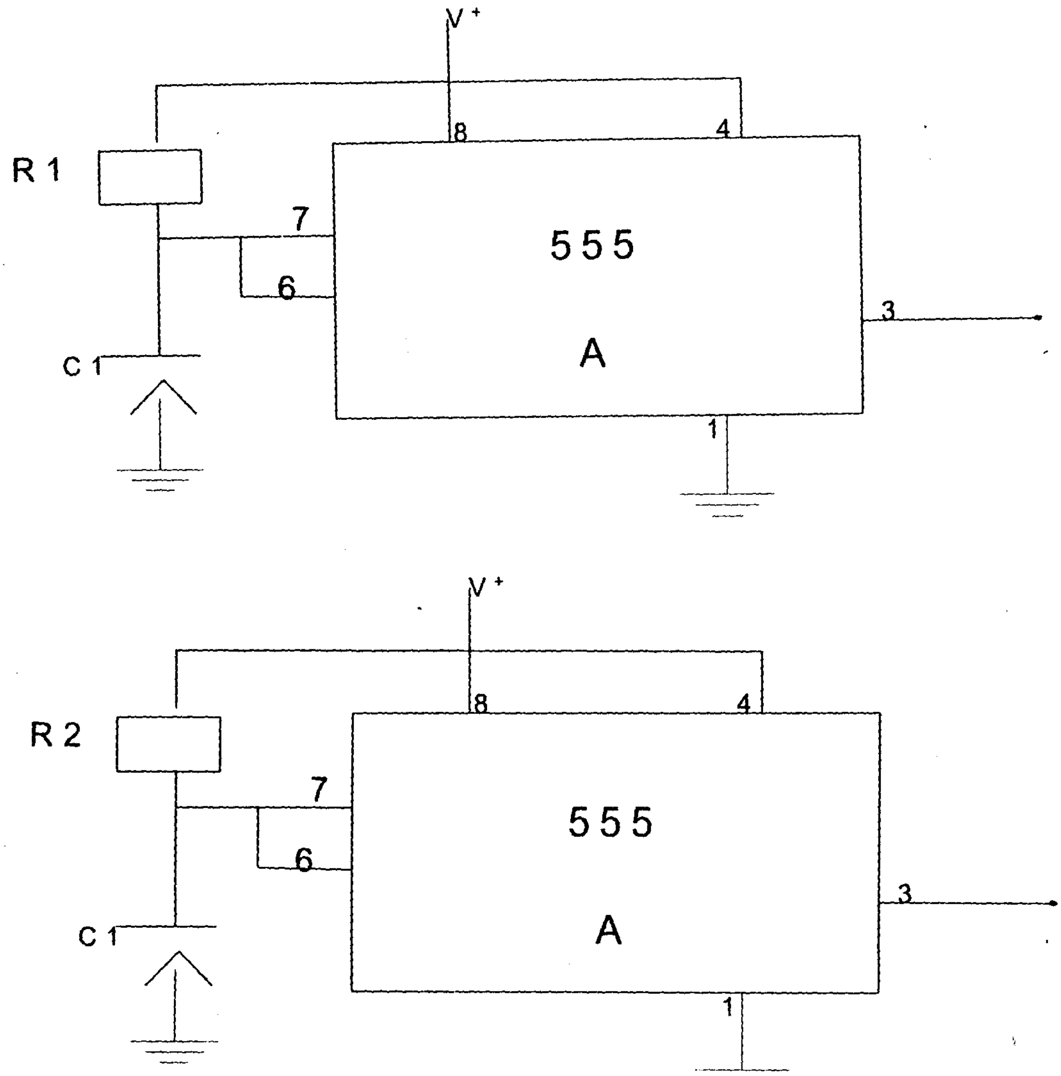


Fig. 3.3: . Block Diagram of Infrared Door Opener

Since T = 1.1 RC.

Where T = time constant (i.e the monostable ON time),

R = the resistor in the timing circuit and C= Timing capacitor.

Both monostable stages are triggered simultaneously. Monostable (A) has a time constant of 5s.

$\therefore$ Setting C =470μF

$T = 1.1R \times 470\mu F$.

For $T = 5s$

$\Rightarrow R = 9.6K$

= 10K (preferred value).

The 5s-time constant was fixed because it is estimated that it would take approximately 5s to walk trough the door from the sensor on a worse case condition.

The design is such that exclusive gate gives an output when the inputs are un-identical. Making the inputs unequal is achieved by having a longer time frame on monostable (B); hence, duration of 10s was chosen so that the remaining 5s would switch another relay, which closes the door.

For monostable B letting $C = 100\mu F$ and $T = 10s$

$$\Rightarrow R = \frac{10s}{1.1 \times 100\mu F}$$

= 90.9 KΩ

= 100K (preferred value).

The 100K preferred value was used. Though there might be a slight time difference but this could be neglected.

3.5 COMBINATIONAL LOGIC CIRCUIT

An Exclusive-OR gate was used to determine when then the door should lock or open. The exclusive OR gate is shown in Fig. 3.4 below,

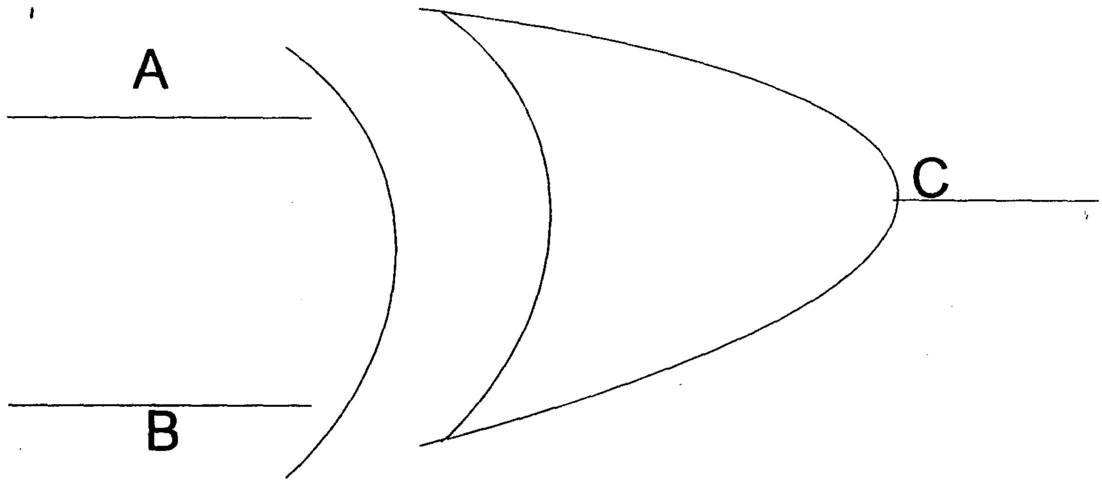


Fig. 3.4: Exclusive-OR-Gate

INPUT		OUTPUT
A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

Table 3.4. Truth table of the OR Gate

From the table it can be shown that when the inputs are identical, the output is zero. The two-monostable outputs are LOW before triggering and simultaneously go to a HIGH after triggering until the time constant of monostable A elapses (i.e 5s). When this occurs the output of the exclusive gate goes high for the remaining duration of monostable B and closes the door before going back to a low state.

3.6 DRIVER STAGE

The driver stage is composed of a switching transistor stage, which switches the relays that control the D.C. motor. Two switching transistors are used. This is to enable alternate switching to allow for movement of the motor in dual directions. The circuit diagram of the switching transistor is shown in Fig. 3.5

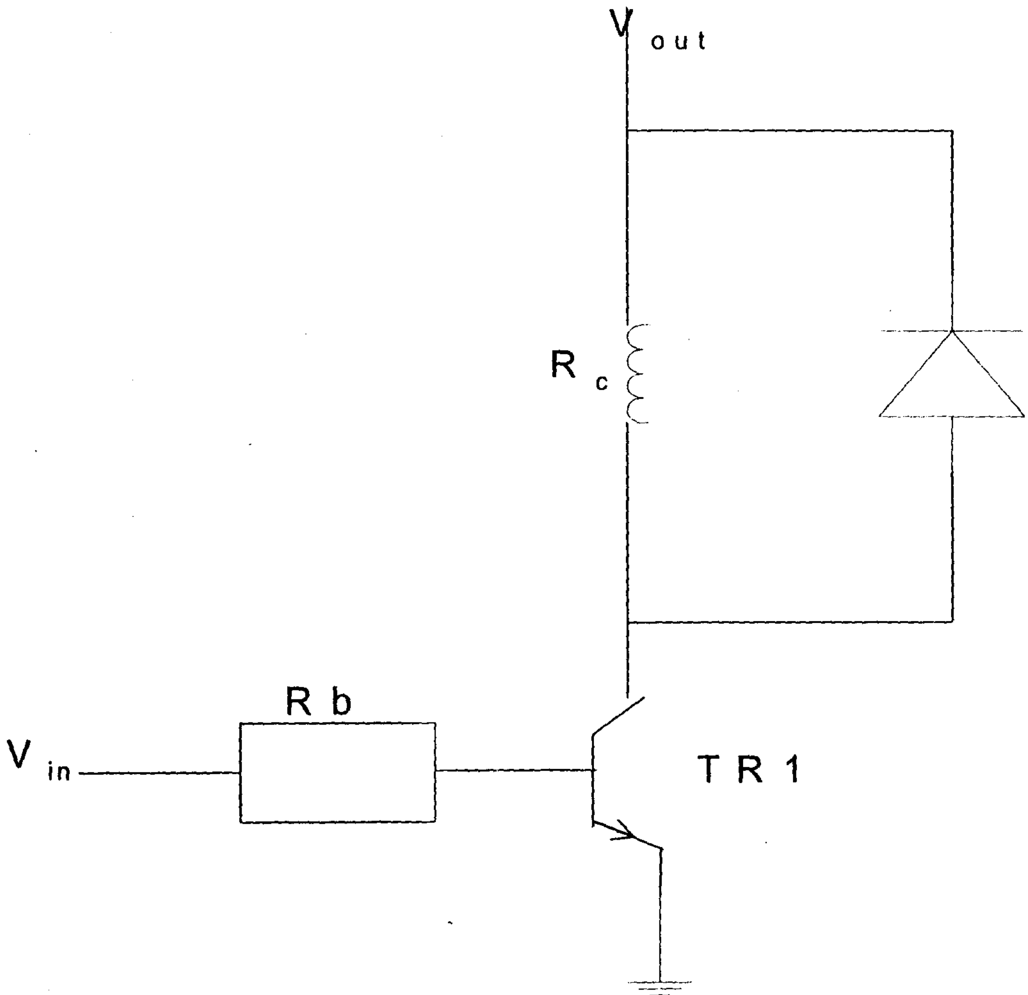


Fig. 3.5: The Switching Transistor

Where R_C is the coil resistance of the relay

R_B the base resistor,

V+ is supply voltage =12v

V_{in} is input voltage ≈5v

TR1 is switching transistor

From Fig. 3.5(a) in the literature review, it could be recalled that,

$V^+ = I_C R_C + V_{CE}$

Since the transistor is acting as a switch, $V_{CE} \approx 0$

$$I_C = \frac{V^+}{R_C}$$

Since $R_C = 400\Omega$. (coil resistance)

$$IC = \frac{12}{400}$$

$$= 0.03A$$

since $I_B = \frac{I_C}{h_{fe}}$

$= 0.03/300$ ($h_{fe} = 300$ from data sheets)

$= 100\ \mu A$

also $V_{in} = I_B R_B + V_{BE}$

$5 = 100\mu A\ R_B + 0.6v$ (where $0.6 = V_{BE}$ for silicon, where $v_{in} = 5V$ from monostable and exclusive gate stages)

$$\therefore RB = \frac{5 - 0.6}{100\mu A}$$

$$= \mathbf{44K\Omega}$$

A preferred value of 47K was however used.

The diode across the coil is used to protect the transistor against back e.m.f, which might arise from the coil since it is an inductive load

3.7 POWER SUPPLY STAGE

All stages in the project uses +5V or 12V d.c.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. 3.6(a)

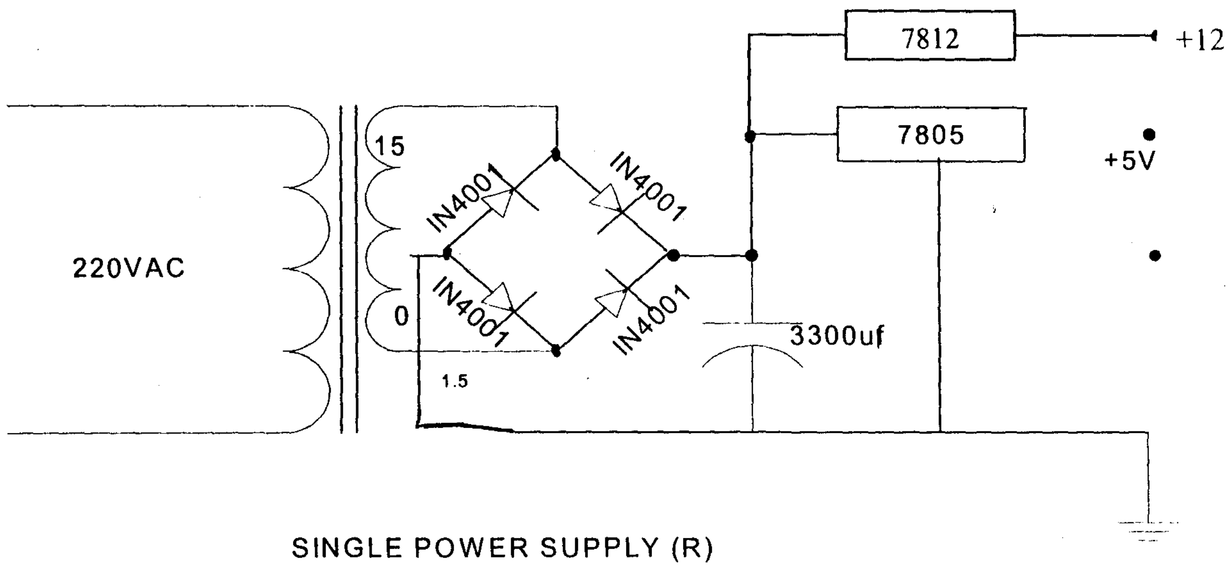


FIG 3.6(a): POWER SUPPLY CIRCUIT

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. 3.6(b) shows the ripple gradient

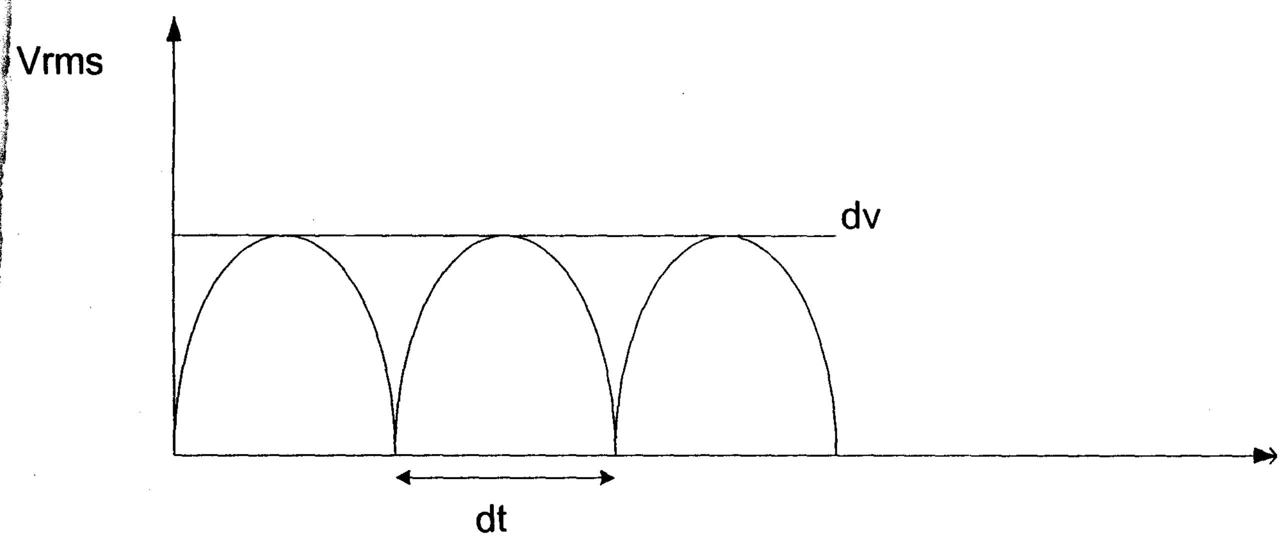


FIG. 3.6(b)

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

For an rms voltage of 15volts (from transformer)

$$Vpeak = 15 \times \sqrt{2} \text{ (i.e., rms} \times \sqrt{2}$$

= 21.2V

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

$$\text{But } 1/C = \frac{dv}{dt}$$

$$C = \frac{dt}{dv}$$

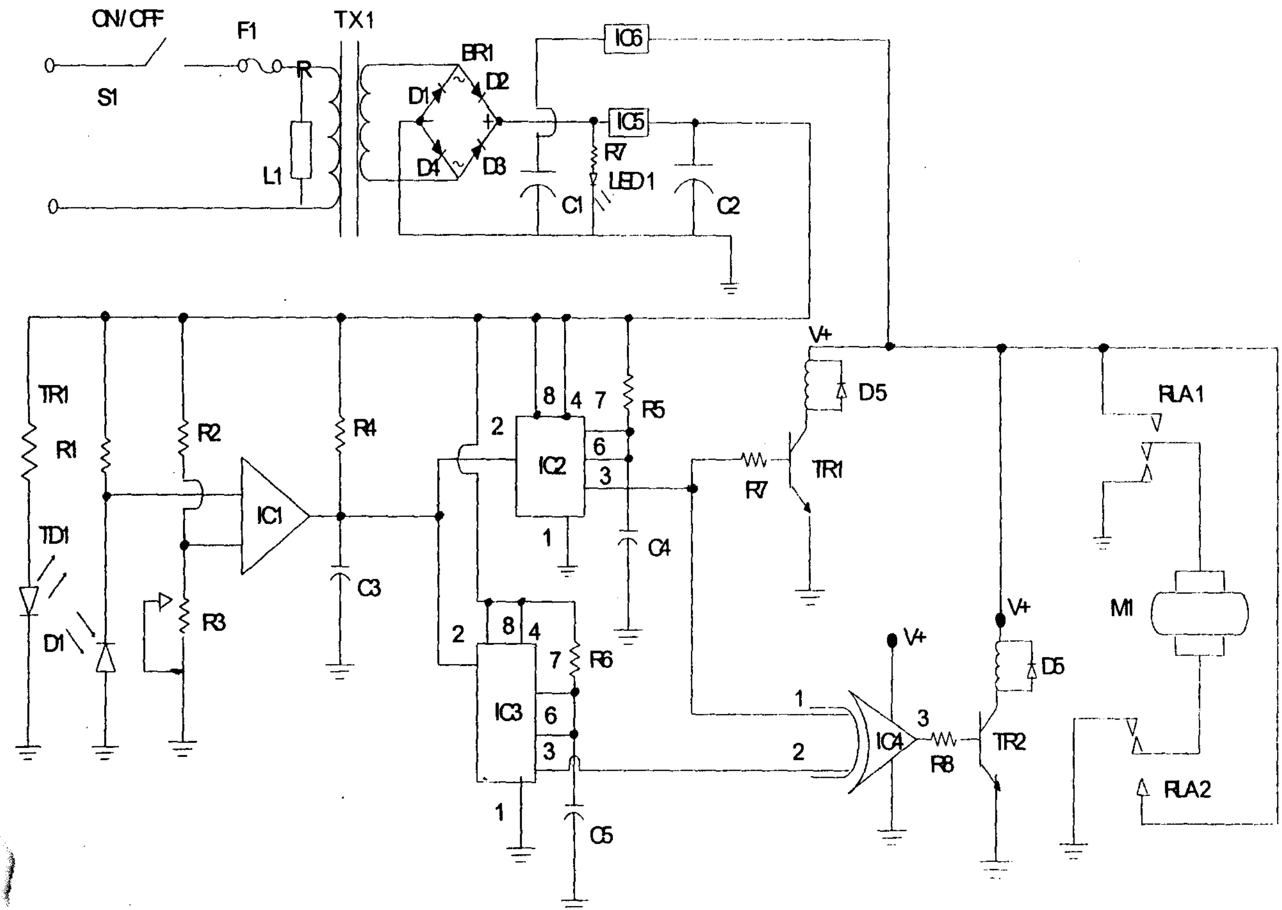
$$= \frac{10ms}{3.1V} \text{ (where dt = 10ms for 50Hz)}$$

$$= \mathbf{3225.8\mu F}$$

A preferred value of 3300µF was employed for the power supply stage.

A 7805 Regulator was used for the 5V supply.

3.8. COMPREHENSIVE CIRCUIT DIAGRAM



AUTOMATIC SLID DOOR

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 monostable falsely.

(iii) **DIGITAL MULTIMETER:** The digital multimeter 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 multimeter 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 multimeter was used for troubleshooting during the soldering and coupling

4.0.1 **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 a monostable timer in this project.

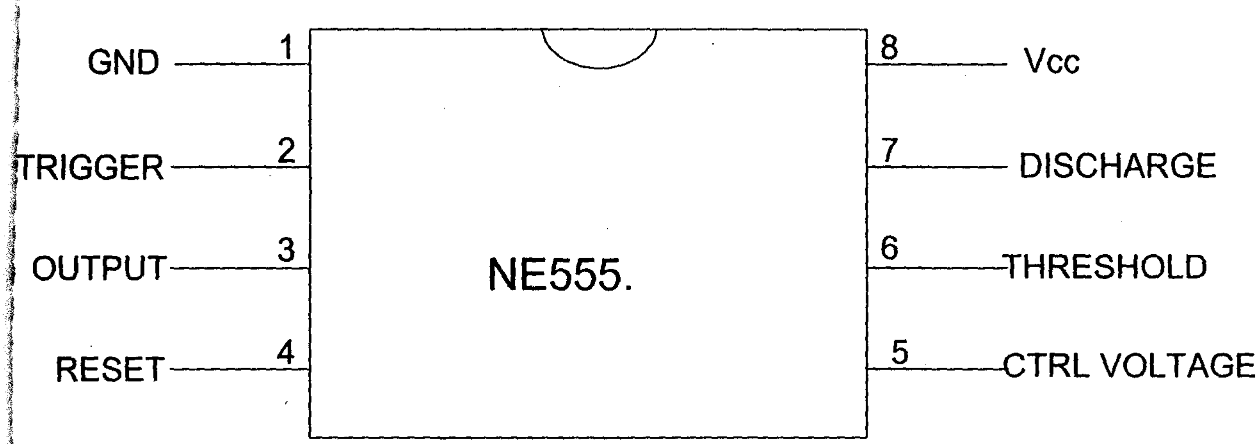
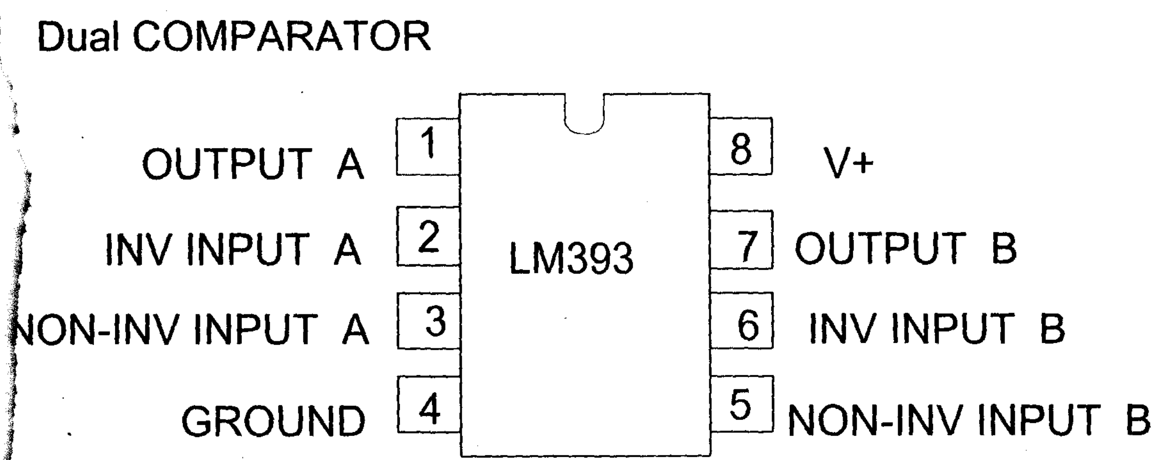


Fig 4.1a: NE555 pin configuration.

LM393 comparator was used in the sensor stage. Fig 4.1b shows the pin out.



4.1b: LM393 Dual comparator.

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

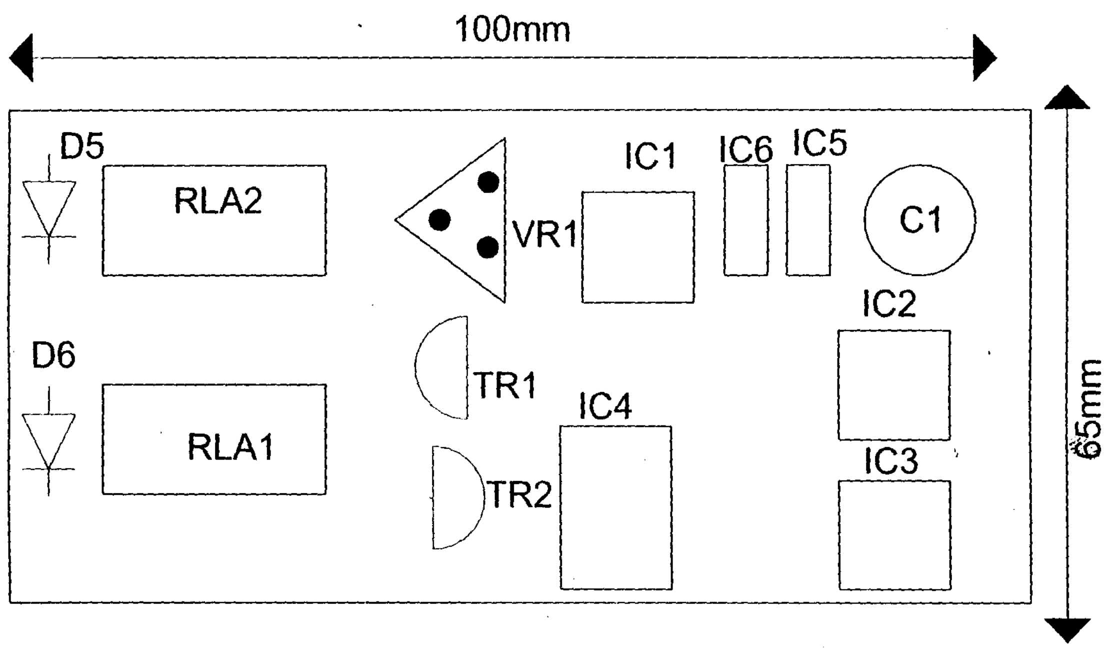


Fig.4.2: components layout on Vero-board 1.

Components list on Vero board

IC1	LM393
IC2&IC3	NE555
IC4	74LS86
IC5	7805
IC6	7812
TR1 & TR2	546
RLA1 & RLA2	12V D.C 10A
D5 &D6	IN4007

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.

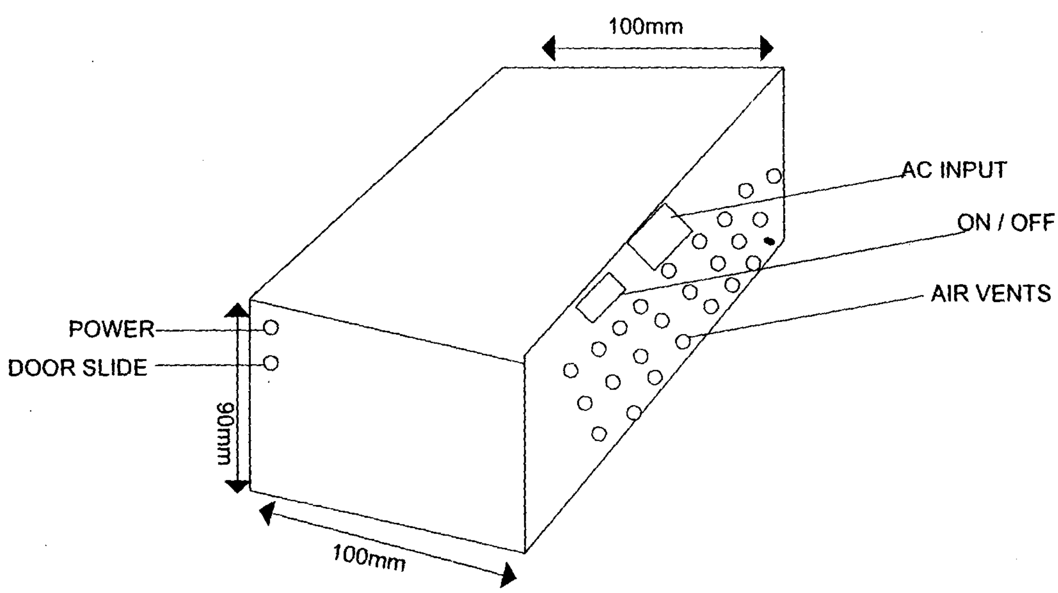


Fig. 4.2b: Isometric view of cased job with dimensions.

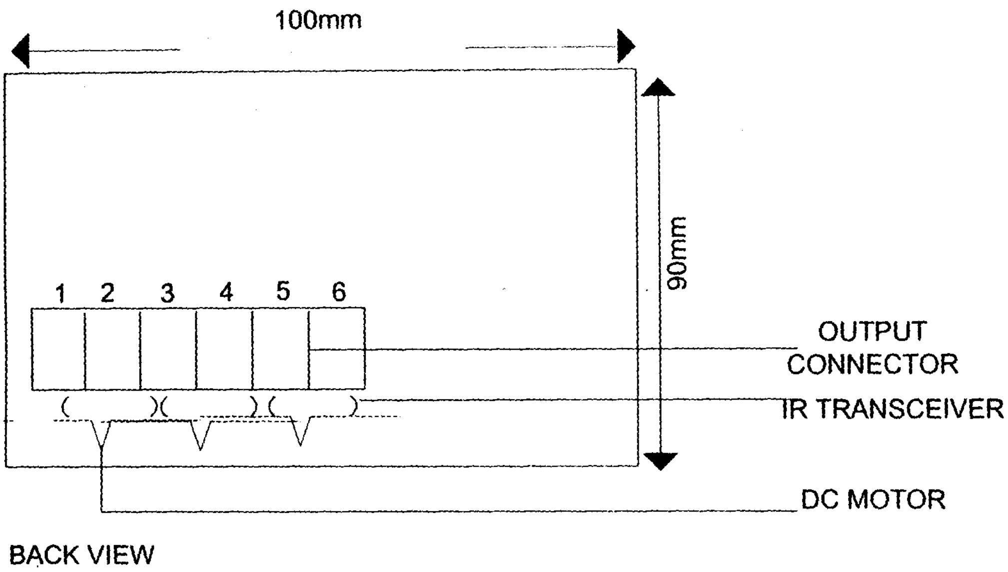


Fig. 4.3: Back view

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 turn the motor in both directions. This was the first design challenge the project posed. The problem was solved by using two relay drivers and combinational logic circuit (i.e the exclusive OR gate). The relay contacts are arranged in such a way that their polarity is reversed when alternative occurs.

2 The relays were irking at some instances. This was discovered to be due to hysterisis. The problem was solved by using filter capacitors at the output of the comparator and across the relays.

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.

4.3 BILL OF QUANTITY.

S/NO	DESCRIPTION	QTY	UNIT PRICE	TOTAL AMOUNT
1	CASING & HARDWARE	1	1500.00	1500.00
2	SLIDE DOOR	1	2500.00	2500.00
3	CONSTRUCTION	1	80.00	80.00
4	LM393	1	150.00	150.00
5	Transformer 18V, 1000mA	2	50.00	100.00
6	NS555	1	150.00	150.00
7	74LS86	2	100.00	200.00
8	12V RELAYS (10A)	2	30.00	60.00
9	BC337	1	80.00	80.00
10	7805	1	90.00	90.00
11	7812	1	120.00	120.00
12	3300µF 50V	6	10.00	60.00
13	IN4007	4	100.00	100.00
14	VEROBOARD	2	15.00	30.00
15	LEDS (5mm)	12	5.00	60.00
16	RESISTORS	1	30.00	30.00
17	100µF	1	30.00	30.00
18	470µF	1	30.00	30.00
19	2.2K PRESET	2 Yards	60.00	120.00
20	CABLES & WIRES	2 Yards	60.00	120.00
21	CONNECTING WIRES	....	....	500.00
22	Misc.	1	250	250
23	DC MOTOR	1	120	120
	TOTAL			**N6510**

.4 COMPONENT LIST

D_1 - D_6	-	IN4001
D_7	-	RED LED
R_1	-	1MΩ
R_2	-	470Ω
R_3	-	2.2KΩ
R_4, R_9	-	1KΩ
R_5, R_6	-	100KΩ
R_7, R_8	-	10KΩ
R_{10}	-	33Ω
C_1	-	2200μF
C_2, C_5		100μF
C_3	-	10μF
C_4	-	477μF
IC_1	-	LM 393N (Dual Comparator)
IC_2, IC_3	-	NE 555 Timer
IC_4	-	74LS86 EX-OR
IC_5	-	7805 Regulator
IC_6	-	7812 Regulator
TR_1, TR_2	-	BC 546 Transistor
RL_1, RL_2	-	12V, 10A Relay
M_1	-	12V D C Motor
S_1	-	ON/OFF Switch
F_1	-	250 mA fuse
Tx_1	-	220/18 Volts AC Transformer
DT	-	TSUS5400 Infra-red Transmitter
DR	-	BPW41 Photo Diode.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 CONCLUSION

The project which is the design and construction of an automatic slide door 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 of the person entering the door and how close he is to the door. The door is meant to open automatically but in a case where there is no power supply, trying to force the door open would damage the mechanical control system in the unit.

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 slide door 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) A software model of the design should be done to enable further research and improve the performance of the system to include a 3-d version door or control of multiple doors simultaneously)

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

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