DESIGN AND CONSTRUCTION OF INFRARED REMOTE CONTROL FAN REGULATOR

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NOVEMBER, 2004

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT OF THE AWARD OF BACHELOR OF ENGINEERING (B.ENG), DEGREE IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA.

NOVEMBER, 2004

DECLARATION

I hereby declare that this project is the result of my handwork and research which has never been presented anywhere by anybody. I was under the supervision of my lecturer Mr. Ozomata David Ahmed in the department of Electrical and Computer Engineering of the Federal University of Technology, Minna, Niger State.

Mopayi ______________________ 25/01/2005 ______________________

Student Date

Mopayi Afolabi Emmanuel

CERTIFICATION

This is to certify that this project titled DESIGN AND CONSTRTUCTION OF INFRARED REMOTE CONTROL FAN REGULATOR was carried out by MOPAYI AFOLABI EMMANUEL (98/7067EE) under the supervision of my lecturer, Mr. Ozomata David Ahmed and submitted to Electrical and Computer Engineering department, Federal University of Technology, Minna in partial fulfillment of requirements for the award of Bachelor of Engineering (B. Eng) Degree in Electrical and Computer Engineering.

Mr. Ozomata David Ahmed — Date: 25/07/05

Eng. Musa D. Abdullahi — Date: 25/07/2005

(Head of Department)

External Examiner — Date

DEDICATION

This project work is dedicated to the Almighty God through our Lord Jesus Christ for His mercy, guidance and blessing over me and to my parents, Mr. and Mrs. J.E. Mopayi for their sincere care and encouragement.

ACKNOWLEDGEMENT

I am grateful to the Almighty God who has given me the strength and courage in all my endeavours. My due thanks to my supervisor, Mr. Ozomata David Ahmed, for humbly sacrificing most of his time in advising and assessing me whenever I had problems on this project. I also appreciate my HOD, Eng. Musa D. Abdullahi and all the lecturers in the department, for all their efforts in making best out of me, in my vocation. I will like to express my profound gratitude to my parents, Mr. and Mrs. Mopayi, for their untiring support and love, since the beginning of my academic pursuit.

I also appreciate the advice and encouraging supports of all my sisters, brothers, relatives and friends; those who had assisted me in any form, for the successful completion of my programme, at the Federal University of Technology, Minna.

May God bless and prosper you all, in all your good pursuit in life, in Jesus' name. Amen.

ABSTRACT

In the world where ease and comfort is the priority, the design and construction of an Electric fan regulator using infrared remote control is undoubtedly appreciated.

The remote control circuitry consists of an oscillator, a driver and infrared transmitter units, while the main regulator circuitry consists of an infrared sensor, a current-gain amplifier, an input logic, output and a speed display units.

Both the practical aspects and theories behind the construction of a prototype have been adequately treated in this project report.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

In a world where comfort and ease constitute some of man's basic desires, the electronic world has not in anyway been overwhelmed in its contribution to achieving these desires.

In this light came the invention of electric fans. An electric fan is a device to agitate or move air or gas. It is basically a device for creating a current of air by the movement of surface(s). It is used to move air or gas from one location to another within or between spaces for industrial reasons or for residential use, for ventilation purposes or increase the circulation of air in a living space. Fans have broad surfaces that usually revolve in motion.

Fans could also be used for ornamental decoration, climate control, cooling system, refreshing air, personal wind-generation (electric table fan), ventilation (exhaust fan) winnowing chaff or grain removing dust (vacuum cleaner) cuttings and to provide draft for a fire.

Electric fans has regulator through which the rate of its speed /revolution is controlled (i.e. put on, reduce, increase or put off). Fan regulation may be designed to operate manually or automatically (i.e. its speed rate automatically increases or decreases with a raise or a fall in atmospheric temperature respectively) or digitally by the use of a toggle switch or remote control device. The remote control device gives one a privilege to operate fans from a reasonable distance away from its regulator.

1.2 Aims And Objectives

In other to add ease and more comfort to life this project is oriented mainly at monitoring and controlling the speed at which an electric fan rotates, by means of an infrared –red remote control fan regulator.

1.3 Literature Review

Fan history stretches back to thousands of years. Since antiquity, fan possessed a dual function; one of a status symbol and the other of useful ornament .In the course of their development fans have been made of variety of materials, have included decorative artwork and have been a universal tool. The simplest kinds are loaves or flat objects waved to produce a more comfortable atmosphere. These rigid or folding hand-held device has been used for cooling air circulation, ceremonial device, and a sartorial accessory throughout the world from ancient times .They are still used.

Originally the fan could be seen as having tropical origins .The earliest known fans were called “Screen fans” or “fixed leaf fans”. These instruments were manipulated by hand to cool the body, to produce a breeze and ward of insects. Early fans are usually made in the form of palm leaves .Some of the earliest known fans have come from Egyptian tombs .Early Assyria and Egypt employed slave and servants to manipulate these instruments. In Egyptian, relief's fans were of the rigid type.

Tutankhamum's tombs possessed gold fans with ostrich feathers, matching depictions on tomb walls .Long–handled, disk–shaped fans were carried by attendants in ancient times and were associated with regal and religious ceremonies .They had handles or sticks attached to a rigid leaf or to feathers. Plumages of birds were used in fans, such as the Egyptians and Native American Indians that had practical and ceremonial uses.

In the ancient Americans the Aztec, Maya and south America cultures used birds feathers in their fans .This had a religious connotation as to the use of bird in the fans .In India the Hindu term for a fan is parkkha' (a derivative of a "a feather" or a device. In Greece, linen was stretched over a leaf-shaped frame.

In Rome, gilded and painted wooden fans were used. Roman ladies through the empire used circular fans .Chinese sources link the fan with mythical and historical characters.

In Europe, during the Middle Ages, the presence of fans was absent. The West's earliest fan is a flabellum (or ceremonial fan) and it dates to the 6th century. Hand fans were reintroduced to Europe in the 13th century and 14th century. Fans from the Middle East were brought back by crusaders. In the 15th century Portuguese traders brought fans to Europe, Rome, china and Japan. Fans became generally popular in1600's the folding fan, introduced from china, became popular in Europe. In the 17th century and 18th century, fans reached a high degree of artistry and were being made throughout Europe. Folded fans of lace silk or parchment were decorate and painted by artists. Fans were imported from china by the East India companies at this time, also around the middle 1700s, inventor started designing fans mechanically. Wind-up fans, similar automotive engines and air-conditioning system, which were driven by belts or direct motor. Fans create a wind chill but do not lower the temperature directly. Hence, electric fans were constructed .These fans generally consists of a set of rotating blades that are placed in a protective housing that permits air to flow through it .

The blades are rotated by an electric motor that is either AC powered or battery (DC)-powered.

However, there was a growth in integrated circuits for controlling the speed of these fans.

In the recent years the technology of using these fans has evolved significantly.

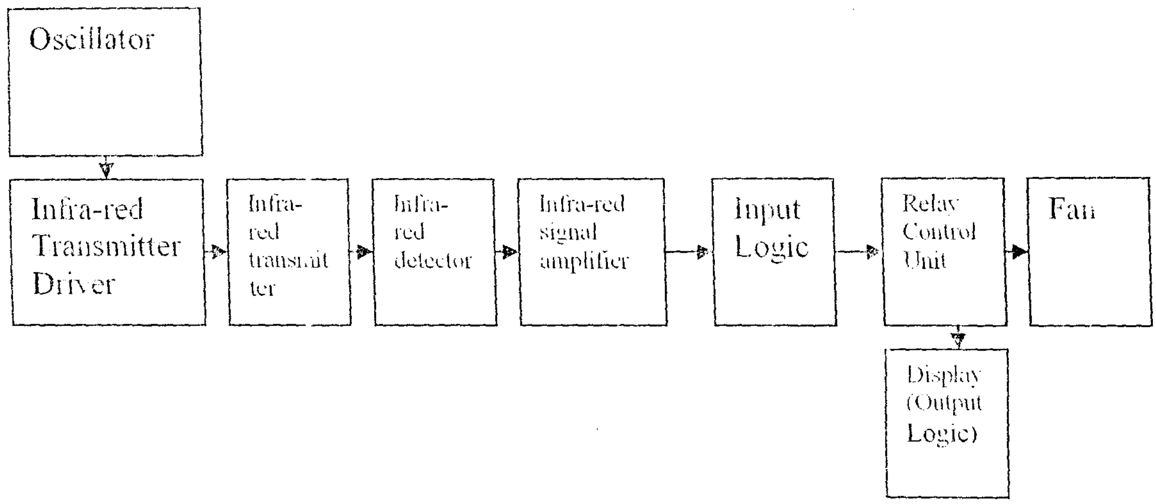


Figure 1.1

1.4 Project Outlines

This project is divided into four chapters: Chapter one discusses general introduction, aims and object of the project and the literature review.

Chapter two is on system designs. Here calculations leading to the choice of component used are shown.

Chapter three is assigned with construction, testing and results .The method of construction and the construction of the boxes containing the circuit are discussed here.

Chapter four is the conclusion and recommendations.

CHAPTER TWO

SYSTEM DESIGN

2.1 The Power Supply Unit

The A/D converter used in this project design required a voltage supply of 12V. The connection of the power supply unit is as shown in fig. 2.2.

The circuitry consists of 240V/12V transformer whose output is fed into the diode bridge rectifier to produce a d.c voltage output. A capacitor of a specified capacitance value was used to remove a.c ripples by way of filtering.

The 7809 IC voltage regulator was used to produce constant dc voltage supply of +12V, which is required to power the circuitry IC chips used in the project and to drive the transistors 2SC945 and 2SC603. The +12V dc and the +12V ac supplies are connected to drive the IC chips and the 12V relays respectively.

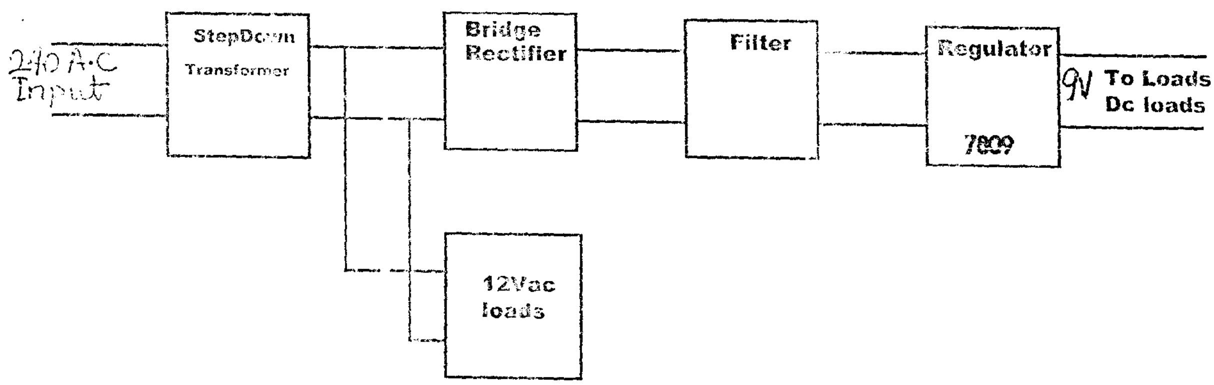


Figure 2.1 Block Diagram of Power Supply

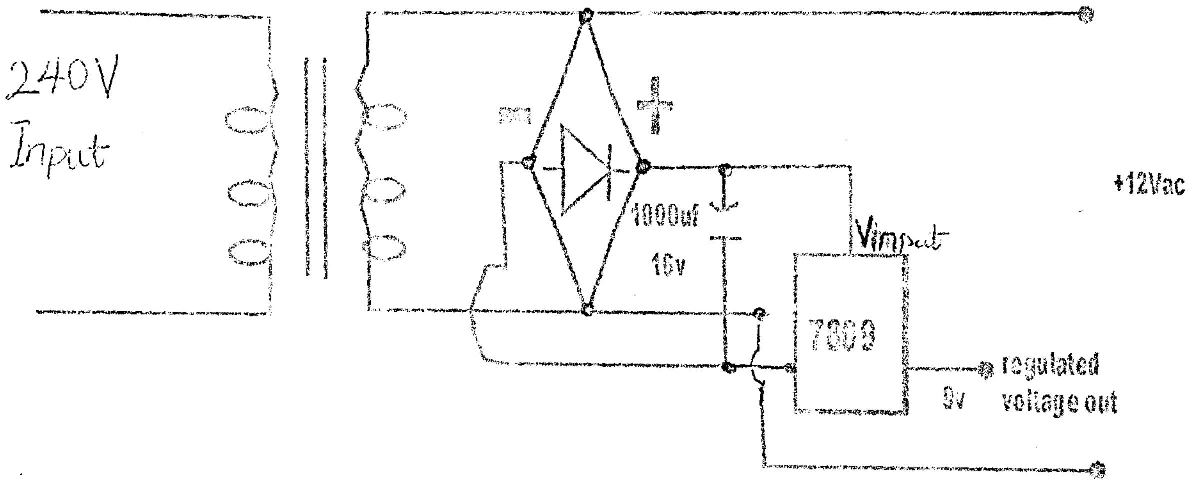


Figure 2.2 Voltage +12AC and DC Supply Unit

i. Transformer selection

$P_o = V_{dc} * I_{dc}$

$= 2V_m/\pi * 2I_m/\pi$

$= 2\sqrt{2}\ Vrms/\pi * 2\sqrt{2}\ Vrms/\pi * vrms/R$

$= 8V^2rms/\pi^2R$

Therefore,

$Vrms = \sqrt{P_o\pi^2R/8}$

For this project, $P_o = 9W$, $R_L = 9.5\Omega$

$Vrms = \sqrt{9 * \pi^2 * 9.5/8}$

$= 10.27 \approx 12V$

ii. Diodes rating

Voltage rating: the maximum voltage, which occurs across the diode in the reverse direction, peak inverse (PIV) must be less than the break down voltage of the diode if it is not conducting appreciably in the reverse direction.

For a full-wave,

PIV = 2Vm

Vm = √2 Vrms

Vm = √2 * 12 = 16.97

Vm ≈ 17V

Therefore,

PIV = 2 * Vm = 2 * 17

= 34V

The breakdown voltage must be greater than PIV (B_{dc} > PIV)

iii. Capacitor selection

Voltage rating

Capacitor voltage, Vc rating ≥ √2 Vrms

√2 * 12 = 16.97V

Vc ≥ √2 Vrms

Vc ≥ 16.97V

Therefore, a capacitor of voltage rating of 25V was chosen

Capacitance rating:

ΔV = Vm/2FRC

ΔV α 1 / C

If a peak-to-peak ripple voltage of not more than 10V is to be tolerated.

10 = 12√2 / (50 * 8 * C)

C = 12√2 / 8000

C = 2121μF

Therefore a capacitor of 2200µF capacitance was chosen.

2.1.1 The Bridge Rectifier Circuit

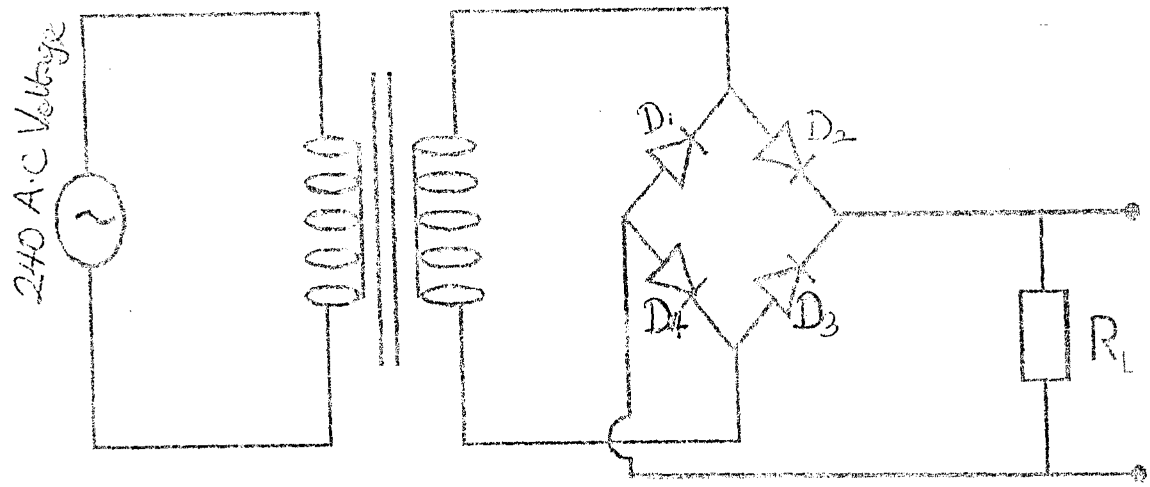


Figure 2.3 The Bridge Rectifier Circuit

A rectifier is the arrangement of diode(s) to convert AC voltage to a pulsating DC voltage. For analysis, we shall limit our scope to the full-wave bridge type of rectifier. The full wave bridge uses four diodes arrayed in bridge shown in fig. 2.3.

During the half cycle of the input a point A, positive with respect to B: diodes D_2 and D_4 conducts. Current therefore flows. During other half cycle, that is point A is negative with respect to B: D_1 and D_3 conducts while D_2 and D_4 blocks. Current flows from B to A through D_3, R_L and D_1. Both current pass through the load, R_{L1} in the same direction and so as fluctuating un-directional voltage is developed across the load having the wave form as shown in figure 2.4.

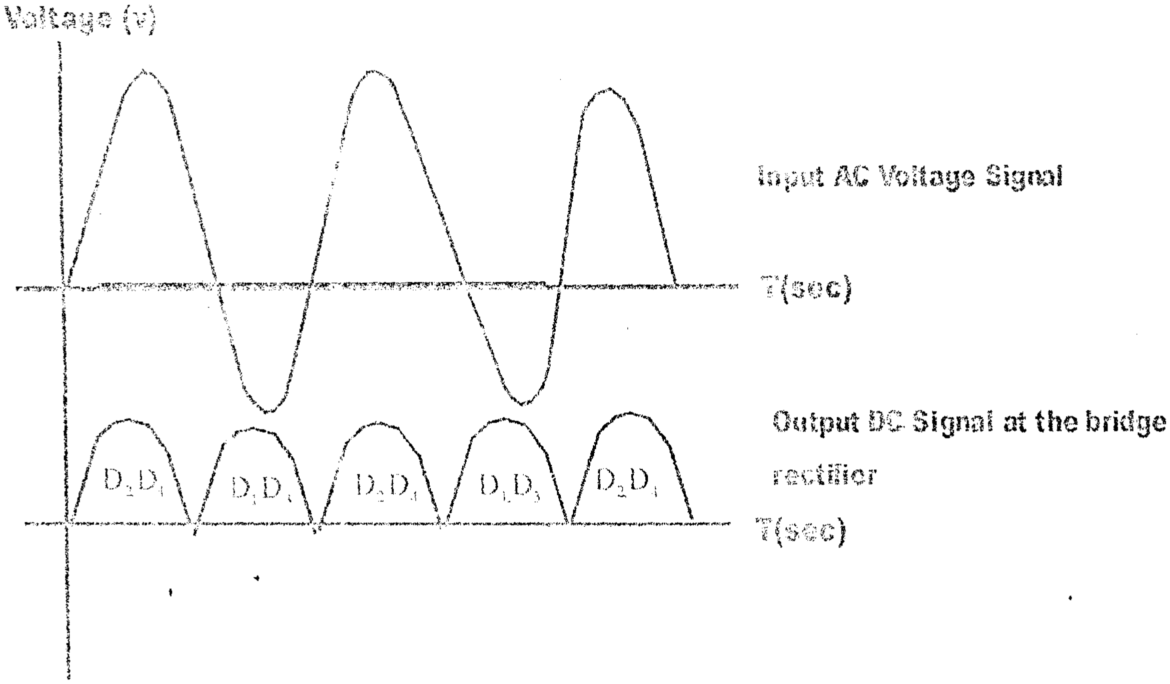


Figure 2.4 Input and Output of Bridge Rectifier Circuit

In considering rectifiers for design purposes, it is always important to know the peak voltage PIV that appears across the diodes. The PIV of a full wave bridge type is twice the maximum voltage.

$V_{rms} = V_{max}/\sqrt{2}$

$= 1/\sqrt{2} * V_{max} = 0.707V_{max}$

$V_{d.c} = aV_{max}/\pi = 0.636V_{max}$

$PIV = 2V_{max}$

The bridge rectifier used has the following rating

Maximum input voltage = 70V

Maximum Capacitance = 2500μF

Maximum Voltage per diode = 1.1V at 1A

2.1.2 A.C. Filtering/Smoothening

A half or full wave rectified voltage wave form may be smoothened out to provide an approximate d.c. voltage using a capacitor shunted across the load to act as a filter. The capacitor stores energy during the conducting period and delivers this energy to the load during the non conducting period. The deviation of the load voltage from its average or d.c. value is referred to as the ripple voltage.

2.1.3 IC Regulators

Integrated circuit voltage regulators provide the benefits of low cost, small size and high performance. They are normally used to regulate supply voltages locally on each individual circuit board of a large system. A wide range of types are available as either fixed voltage (three-terminal) or variable voltage (four-terminal) in which the fourth lead is used as the control terminal. A typical fixed voltage regulator is the 7809 voltage regulator, which is easily used as shown in figure 2.2.

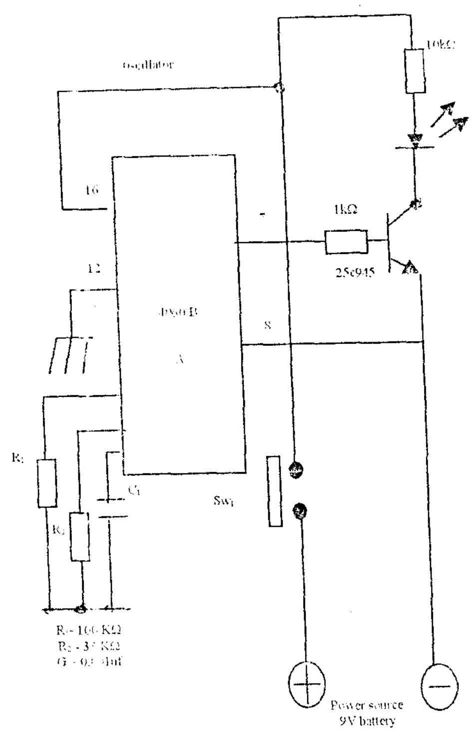
More complex forms such as switching regulators are quite common owing to their flexibility in application and their ability to provide good regulation at low cost.

For the purpose of this project the type of power IC regulator used is 7809 IC which supplies power to all the circuits except the relay section (which uses 12V a.c. supply).

2.2 REMOTE CONTROL

2.2.1 Oscillator

The remote control circuitry comprises of an oscillator, a transistor driver and an infrared transistor. In this project, the HEF4060B is used as an oscillator as well as a divider. It is designed to generate pulses at an average desired frequency of 4.35 KHz. A desired frequency of 271.74 KHz is taken from pin 7. This pin is connected to the base of a common-emitter 2SC945 transistor driver, via a 1KΩ resistor. The output of the driver is in turn connected to an infrared transmitter as shown in figure 2.5.



2.2.2 Description of HEF4060B IC

The HEF4060B is a 14-stage ripple-carry binary counter/divider and oscillator with three oscillator terminals (R_3 R_{TC} and C_{TC}), ten buffered outputs (O_3 to O_9 and O_{11} to O_{13}) and an over riding asynchronous master reset input (MR). The oscillator configuration allows design of either RS or crystal oscillator circuits.

The oscillator may be replaced by an external clock signal at input R_3. The counter advances on the negative going transition of Rs. A high level on MR resets the counter (O_3 to O_9 and O_{11} to O_{13}) are LOW, independent of other input conditions.

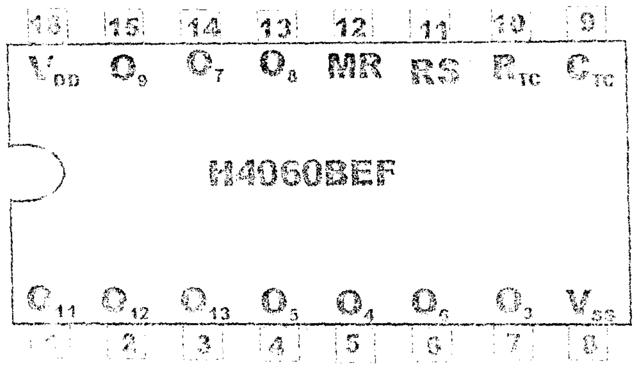


Figure. 2.6 Pin Out Line

Pinning

MR	Master reset
RS	Clock input/Oscillator pin
R_{TC}	Oscillator pin
C_{TC}	External Capacitor Connection
O_3 to O_9	Counter Outputs
O_{11} to O_{13}	Counter Outputs

The average frequency generated by the oscillator is

$F_{osc} = 1/2.3R_1C_{13}$

Hence $R_1 = \dfrac{1}{2.3C_1F_{osc}} = \dfrac{1}{2.3X0.001X4.35X10^{-3}}$

$R_1 \approx 100k\Omega$

The frequency of pin 7:

$F_{pin\,7} = F_{osc}/2^4$, because pin 7 is the fourth output pin of the HEF4060B IC

Therefore,

$F_{pin\,7} = 4.35 * 100^3/16 \approx 271.74 * 10^{-6}Hz$

2.2.3 The Infrared Transmitter

This is a solid gallium arsenide that emits a beam of radiant flux when forward biased, electrons from the n-regions will recombine with excess holes of the p-material in a specially designed recombination region sandwiched between the p and n-type material.

During recombination process, energy is radiated away from the device in the form of photons. The generated photons will either be reabsorbed in the structure or leave the surface of the device as radiant energy. A few areas of application for such devices include card paper tape reader shaft encoders, data transmission system etc.

2.3 Fan Regulator.

2.3.1 Infrared Detector/Receiver

The receiver circuit shown in figure 2.7 is divided into infrared detector and infrared signal amplification.

When infrared signals fall on the infrared diode, the potential at the pn-juncton is reduced to almost zero, hence current flows through it to the transistor base with negligible resistance, only about 0.6V is dropped on the diode. The infrared signals are received as pulses. The resistor R_1 serves as a current-limiting resistor, which avoid damage to the infrared diode hence allows a current of only 35.45nA to flow through the diode.

2.3.2 Current-Gain Amplifier

The infrared signal amplifier is designated to greatly amplify the very weak current generated by the infrared detector diode, through its exposure to the infrared signal from the remote control infrared transmitter.

For this project, the amplifier is a 3-stage feed back amplifier. The input voltage is the one across the infrared detector. The couple network adopted is Resistance-Capacitance (RC) coupling.

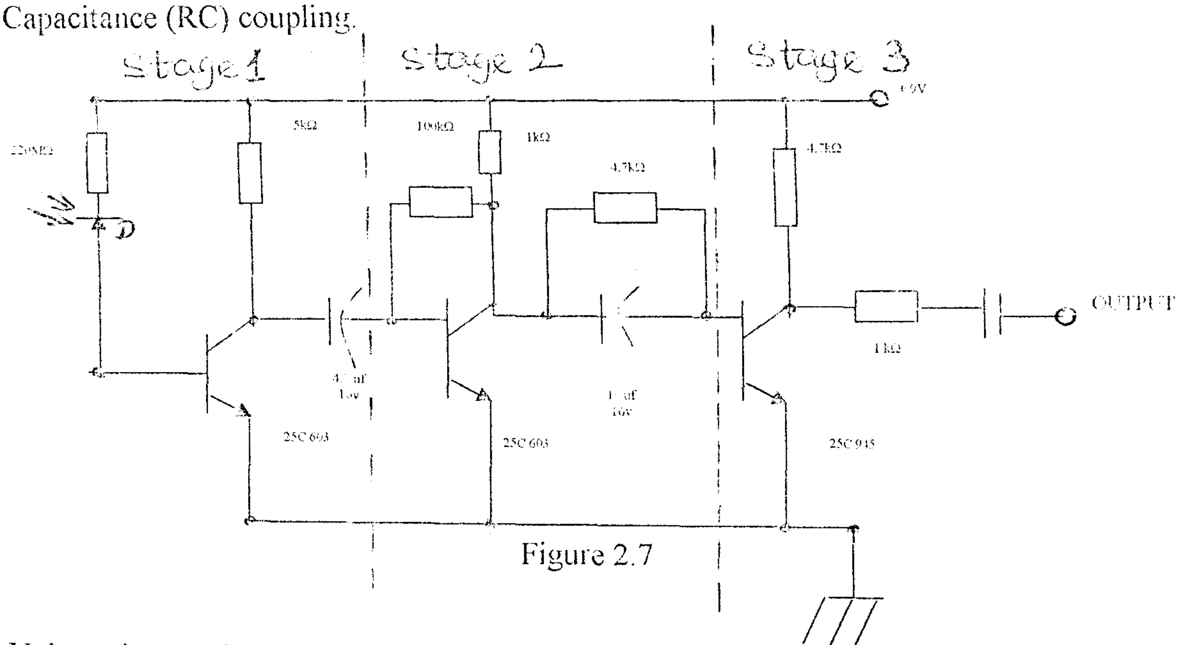


Figure 2.7

Voltage input when infrared signals fall on photodiode in such a way that the diode is fully illuminated with infrared beam the voltage across the diode is 0.5V and V_{BE} is 0.7V.

R_1=200MΩ, R_2=5KΩ,

Hence,

Voltage across $R_1 = 9 - 0.5 - 0.7$

$= 7.8V$

Therefore,

$I_{in} = 7.8/220 * 10^6 \approx 35.45nA$

$I_{in} = I_{B1} = 35.45nA$

Where I_{B1} is the base current of Q_1

$I_{C1}/I_{B1} = \beta$

$\beta = 50$

Hence,

$I_{C1} = \beta I_{B1}$

$= 50 * 35.45 * 10^{-9}$

$= 1.77 * 10^{-6} = 1.77\mu A$

For stage 2:

The output of stage one becomes the input of stage two.

Therefore,

$I_{B2} = I_{C1} = 1.77\mu A$

$I_{C2}/I_{B2} = \beta$

$I_{C2} = \beta I_{B2}$

$I_{C2} = 50 * 1.77 * 10^{-6}$

$= 88.64 * 10^{-6}$

$\approx 88.64\mu A$

For Stage 3:

The output of stage two becomes the input of stage three.

Hence,

$I_{B3} = I_{C2} = 88.64\mu A$

$I_{C3}/I_{B3} = \beta$

$I_{C3} = \beta I_{B3} = 50 * 88.64\mu A$

$= 0.0044A$

$\approx 4.43mA$

2.3.3 Input Logic Unit

The input logic Unit is to select and control the input state of the relay control circuitry. The input logic unit shown in fig. 2.8 is divided into:

Input divider, SR flip-flop and a reset oscillator.

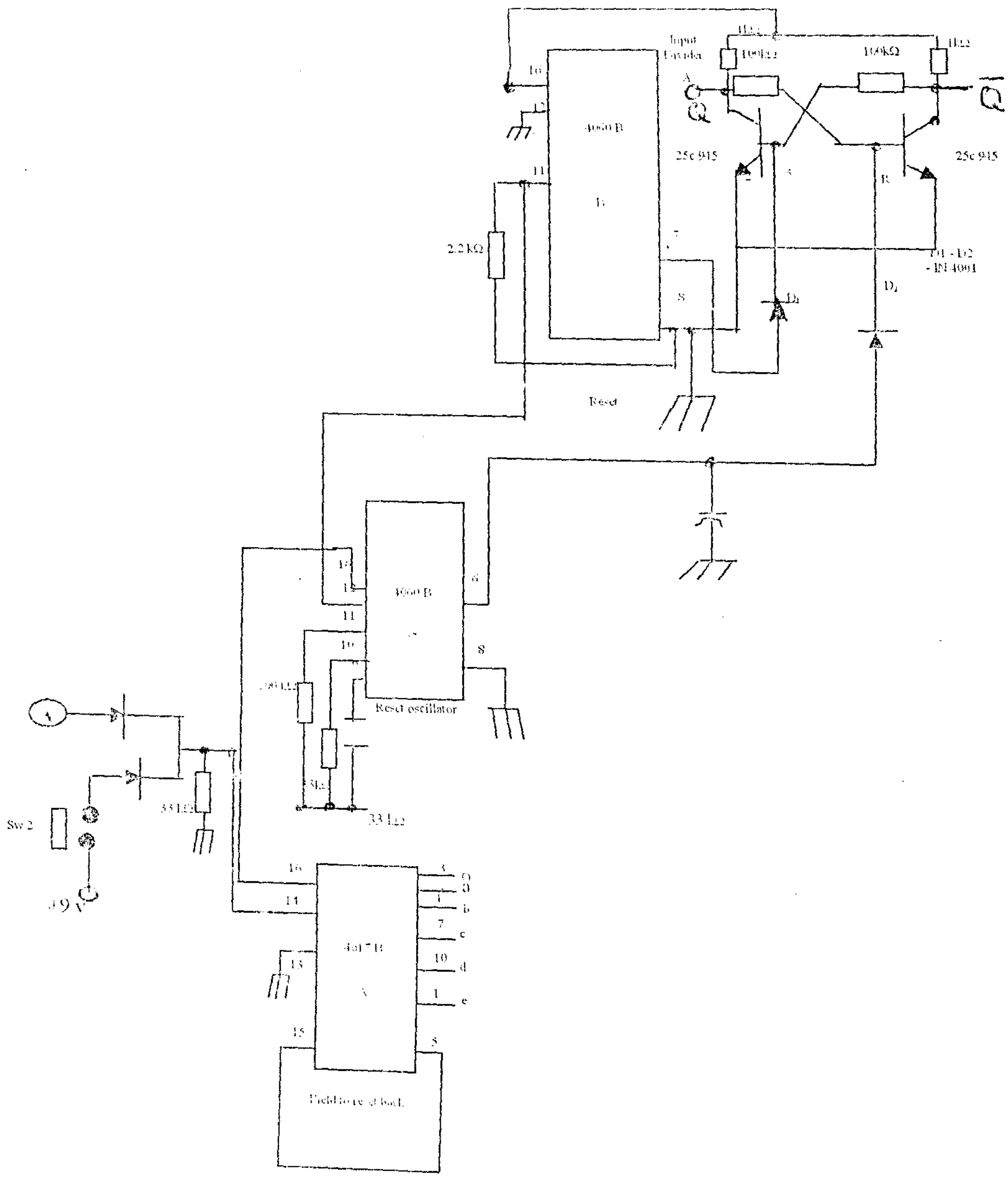


Figure 2.8

2.3.4 Input Divider

The output of the last amplifier is fed into the input of another 4060B (here use as an input divider for pin 11 is the clock input. Thus due to the internal division in the IC, the high frequency pulse from the infrared source, through the signal amplifier is divided by the 4060B. Pin 7 becomes logic 1 for a short time of acceptable signal reception. Hence, the logic 1 is used to reset a Resistor Transistor Logic (RTL) SR flip-flop.

The input divider circuit is shown in fig. 2.8.

The output frequency of the divider circuit is

$F_D = F_{in}/2^4$

$F_{in} = F_{pin\ 11} = F_{pin\ 7}$

Hence,

$F_D = 271.74 * 10^{-6}/16 \approx 16.98 * 10^{-6}Hz$

2.3.5 Reset Oscillator

The Reset Oscillator is a control design to automatically reset the elementary SR flip-flop. Since 4060B IC oscillates only when pin 12 is logic 0 or negative. A logic 1 pin 12 produces no frequency or output for the integrated circuit.

The pin 12 of IC 4060B-C is connected to pin11 of 4060B-B which is also the output from the signal amplifier holding the infrared generated pulse (indicated as point F as shown in fig. 2.8). Therefore, when no pulse / signal or button SW_1 of the infrared source/remote controller is off, no signal is at point F, so pin 11 of the 4060B-B and pin 12 of 4060B-C are at logic 0, which is attributed to no-signal. Hence, resistor 2.2KΩ is connected to the ground.

The effect of the logic 0 on 4060B-B is that no output at pin 7 (i.e. pin 7 remains at logic 0). But logic 0 on pin 12 of 4060B-C produces oscillation and outputs pulse at pin 6. The pulse or logic 1 resets the SR flip-flop.

Therefore, when the system is stable or at ground state; no operation is on. Hence, Q or point A is always logic 0. But by the time SW_1 is pressed on the infrared remote controller, point 'f' holds the pulse. This pulse causes an output at pin 7, which sets and turns Q to 1. The leading pulse creates an ON and OFF effects on pin 12 of 4060B-C at no pulse or output at its pin 6.

2.3.5 Output Stepper

This part of the project uses HEF4017B IC. This IC is usually called a decode steeper because its ten outputs behave like a decoder output, in which logic 1 moves across the output as illustrated in figure. 2.9.

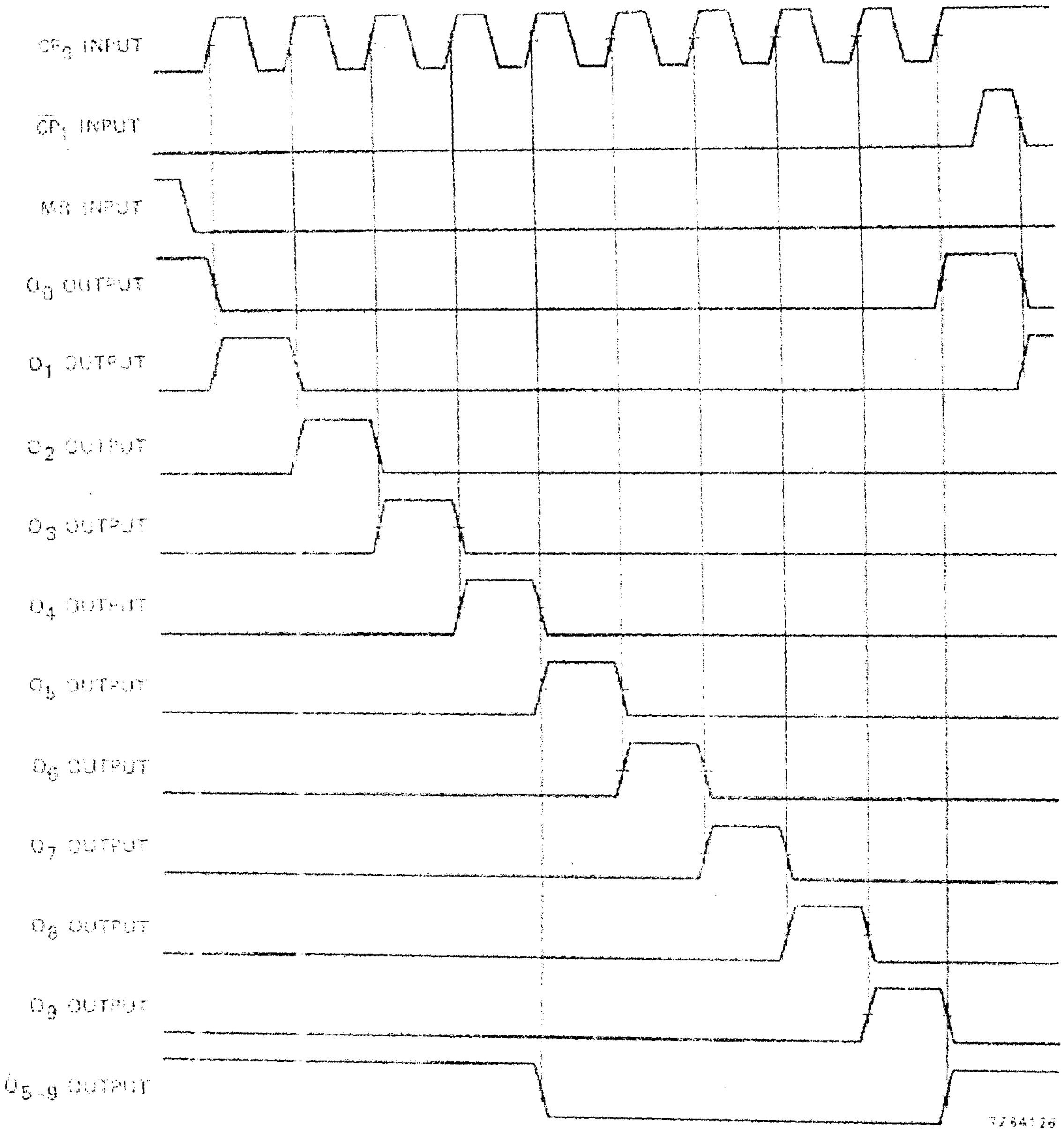


Figure 2.9

The logic 1 moves across the outputs for every clock input and after the whole length is covered, the logic 1 goes back to the start and operation goes on in cycle.

In this project, six of its outputs pins were connected to the display unit and the last five of these six pins were at the same time connected to relays via 2.2KΩ resistors and 2SC954 transistors driver. The seventh output is used to reset the IC.

Moreover, Q at logic 1 advances the steeper by one step. The operation of the system is toggle in nature. The operator requires the ON and OFF of SW_1/ SW_2, in order to advance the steeper more than once. When SW_1or SW_2 is toggled, Q turns to logic 1 and releasing the switch makes pin 12 of HEF4060B-C IC logic 0 and then resets Q to logic 0. A subsequent press of SW_1/ SW_2 returns Q to logic 1 and 0, continuously. This effect of making Q ON and OFF generates pulses to clock the steeper.

2.3.7 Description of HEF4017B IC

The HEF4017B is a decode counter with ten spike-free decoded active HIGH outputs (O_0 to O_9), and active LOW output from the most significant flip-flop (O_{5-9}), active HIGH and active LOW clock inputs (CP_0, CP_1) and an overriding asynchronous master reset input (MR).

The counter is advanced by either a LOW to HIGH transition at CP_0 while CP_1 is LOW or a HIGH to LOW transition at CP_1 while CP_0 is HIGH. As illustrated in the function table, table 2.11.

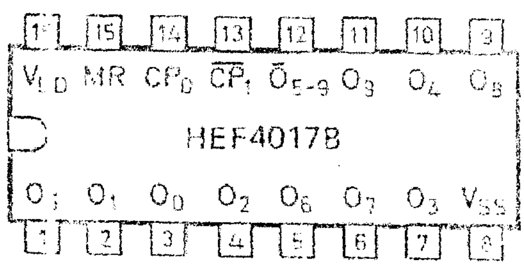


Figure 2.10.

Pinning

CP0 clock input (LOW to HIGH triggered)

CP1 clock input (HIGH to LOW triggered)

MR master reset input

O0 to O9 decoded outputs

O5-9 carry output (active LOW)

Table 2.11.

FUNCTION TABLE

MR	CP_0	$\overline{CP_1}$	OPERATION
H	X	X	$O_0 = \overline{O}_{5\text{-}9} = H$; O_1 to $O_9 = L$
L	H	↓	Counter advances
L	↑	L	Counter advances
L	L	X	No change
L	X	H	No change
L	H	↑	No change
L	↓	L	No change

Notes

H = HIGH state (the more positive voltage)

L = LOW state (the less positive voltage)

X = state is immaterial

↓ = positive-going transition

↑ = negative-going transition

MR, CP_0 and CP_1 are operands.

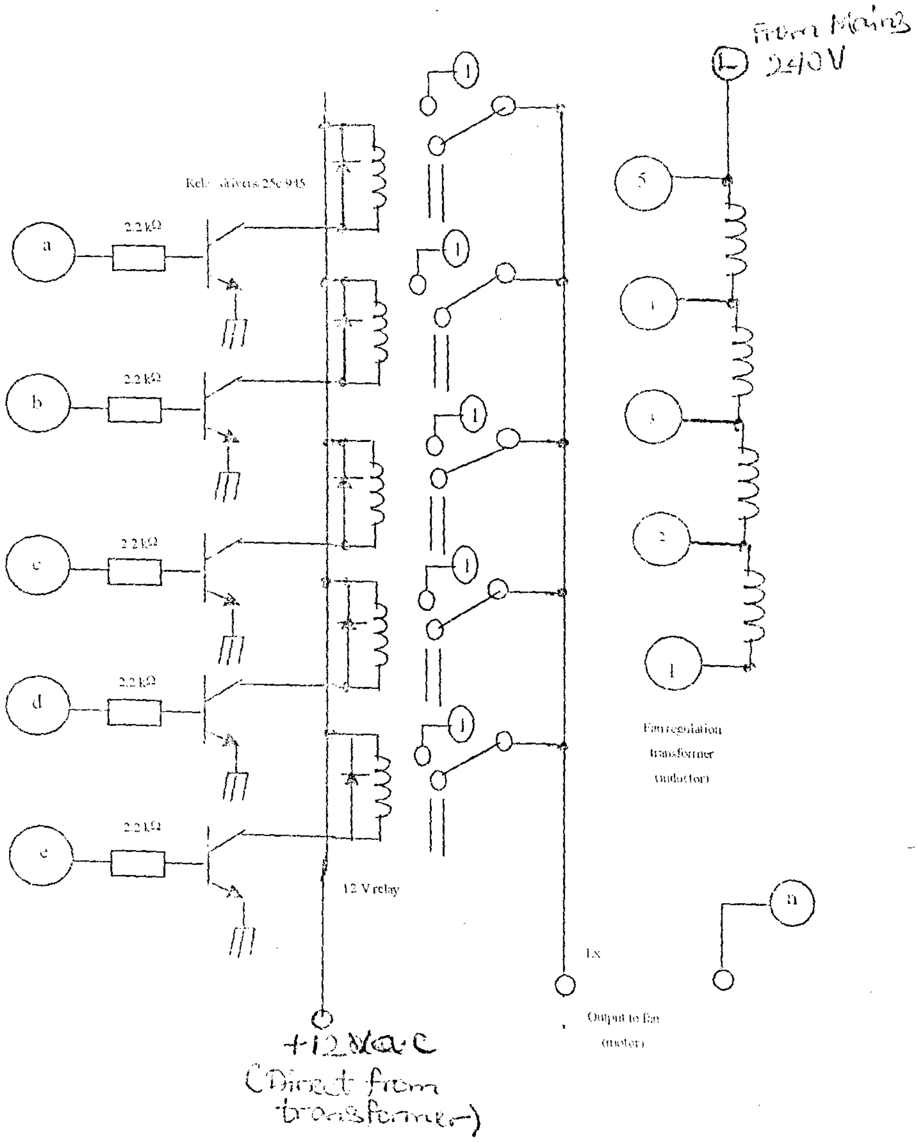
When cascading counters, the O_{5-9} output, which is LOW while the counters in the state 5, 6, 7, 8 and 9 can be used to drive the CP_0 input of the next count counter.

A HIGH on MR resets the counter to zero ($O_0 = O_{5-9}$ = HIGH; O_1, to O_9 = LOW) independent of the clock inputs (CP_0, CP_1).

2.3.8 Output Unit

This unit embodies five relays, five transistor drivers and a potentiometer. A diode was connected across each relay in a reverse bias with respect to the drive current. Its purpose is to short-circuit the back e.m.f. generated by the relay whenever it de-energizes, otherwise the voltage can be high enough to damage the transistor driving it.

The relays were connected to produce the early basic circuit. The drivers adopted in this project are NPN (2SC945) transistors, which were connected in a common emitter mode. The outputs of the steeper were connected to the base of each transistor via 2.2KΩ resistor. As shown in fig. 2.12.



Output Unit

Figure 2.12

The transistors are to amplifier the weak current from the steeper outputs in order to drive the relays. In this circuit switching, one relay is selected at any given time.

The inductor of the potentiometer is the main element of the speed regulation. It behaves like a resistor in an A.C. circuit.

Such as:

$$X_L = \omega L = 2\pi f L$$

Therefore,

$X_L \alpha L$

Where

X_L is the inductance

L is the length of the wire

Hence, the more the inductance, the more the impedance and the less the current flow.

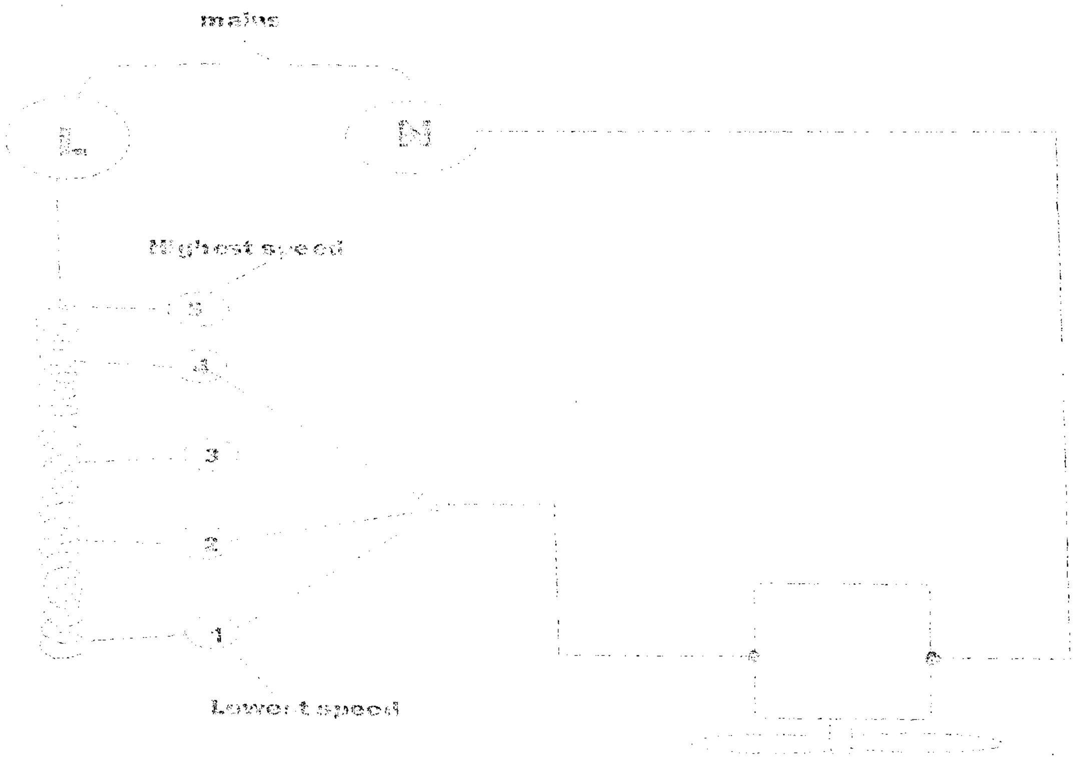


Figure 2.13. **Basic Circuit**

Speed 1 is the lowest because it is linked through the highest inductance and speed 5 is the highest because it is linked through the lowest inductance.

2.3.9 Speed Display Unit

This unit is designed to display speed 0 to 5 or the degree of regulation of the fan.

i.e.

0 Means off

1 Minimum speed

2

3 Increasing

4

5 Maximum speed

A very common digital output display is used; the seven segment LED display. This device is used to convert a 4 bit BCD into a visible readout. It consists of seven LEDs arranged as shown in fig. 2.14.

Modern hand calculators, wrist watches, multimeters, all use the seven-segment display for their readout. The LED type is cost efficient, reliable, and very bright with low voltage integrated circuitry.

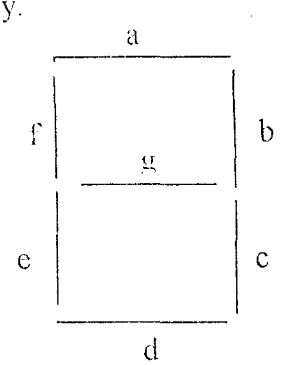
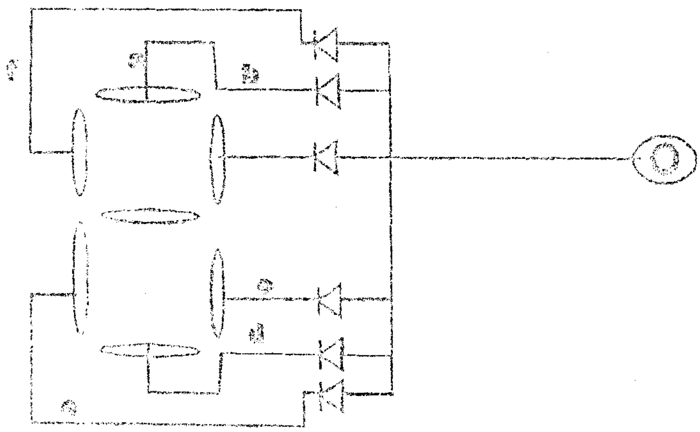


Figure 2.14. **Common-Cathode Seven-Segment Display.**

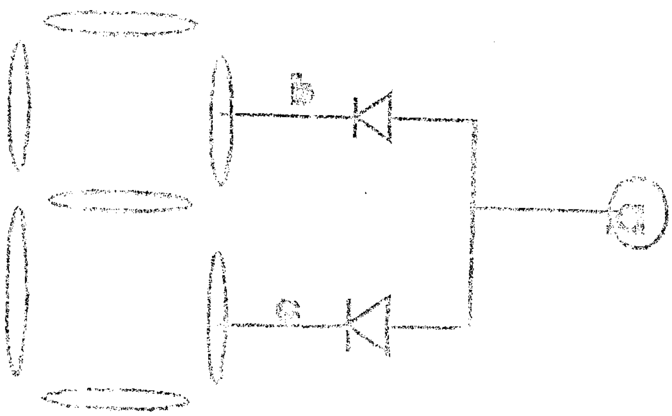
In this project, the display is done using diode. For instance, the active logic 1 from the 4017B is connected to corresponding set of diodes to display a particular digit.

To display digit 1, b and c must be at logic 1 (because the seven-segment display is a common-cathode type). Therefore, to display any digit the corresponding segments must be at logic 1.

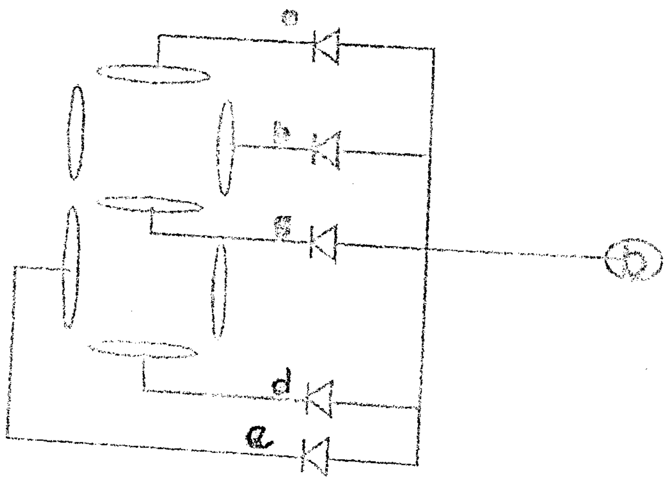
Diodes are used to distribute the logic 1 to corresponding segments, so as to direct the flow of current in only one direction. This is shown in fig. 2.15 'a' to 'f'



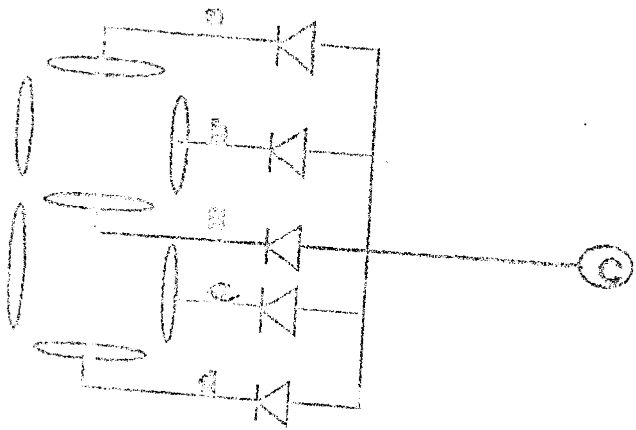
(a)



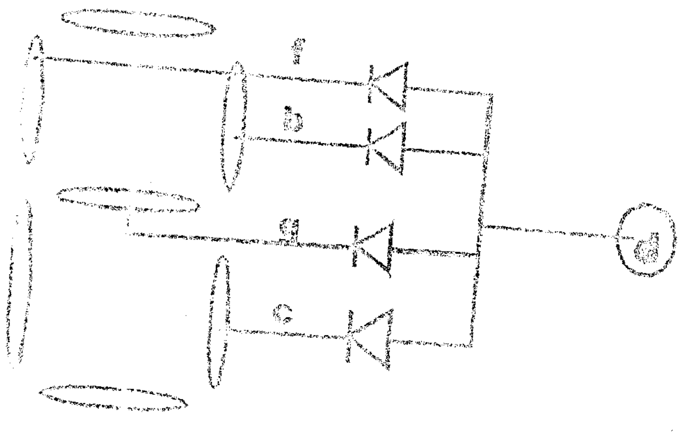
(b)



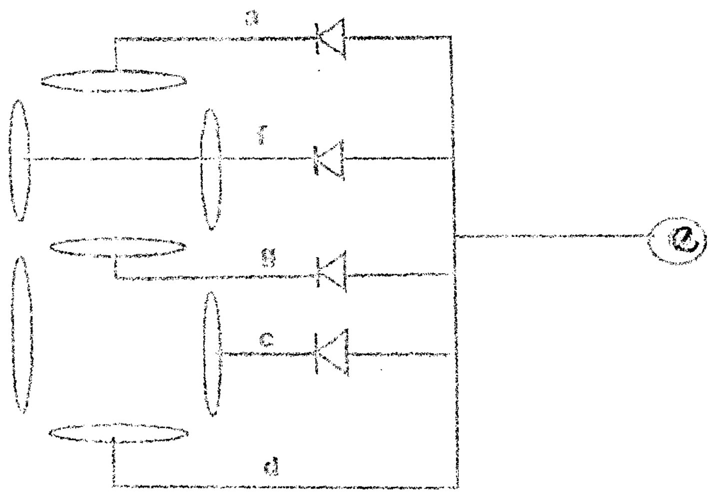
(c)



(d)



(e)



(f)

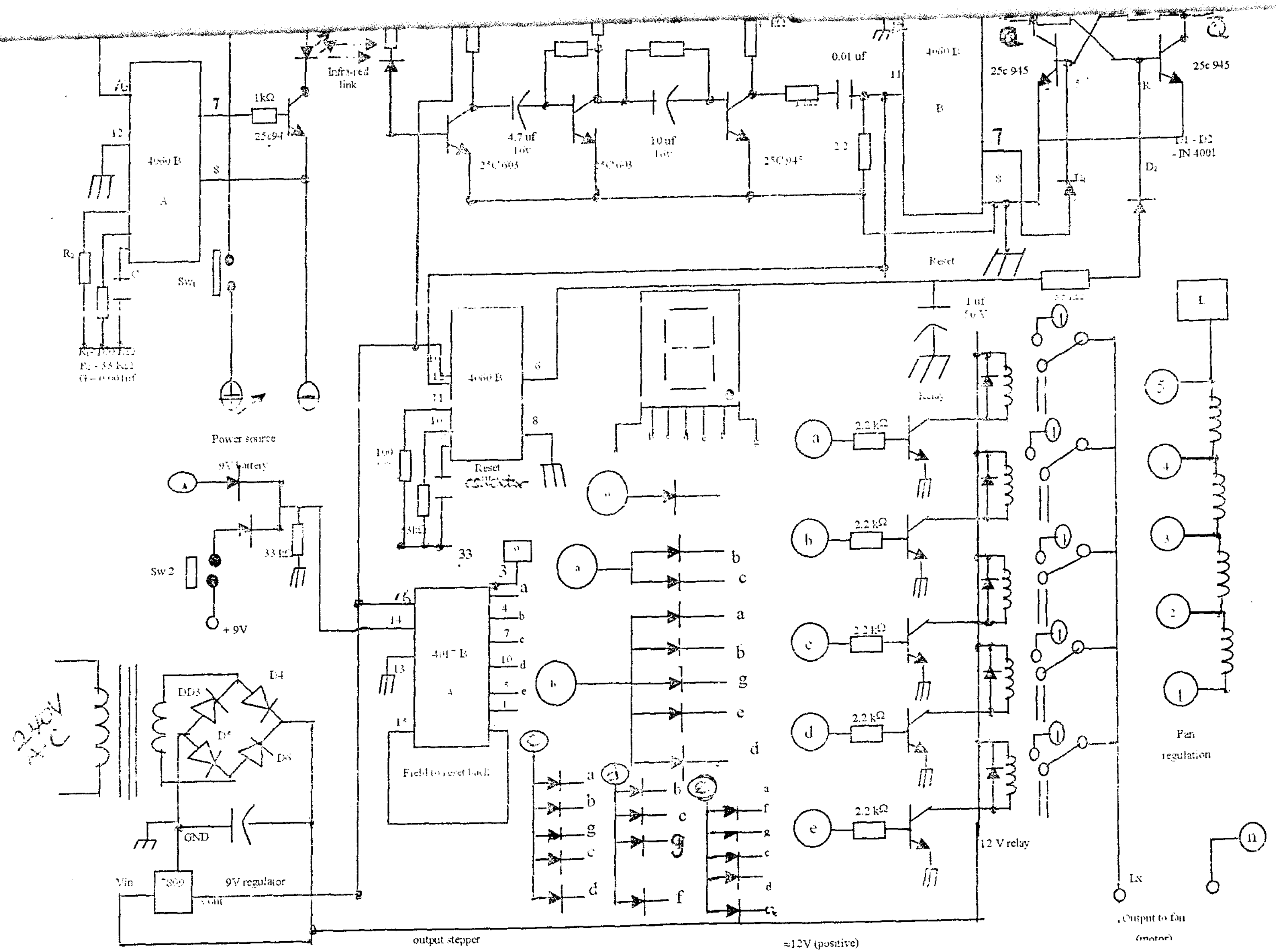


Figure 2.16 Complete Circuit Diagram

CHAPTER THREE

CONSTRUCTION AND TESTING OF RESULTS

3.1 Construction

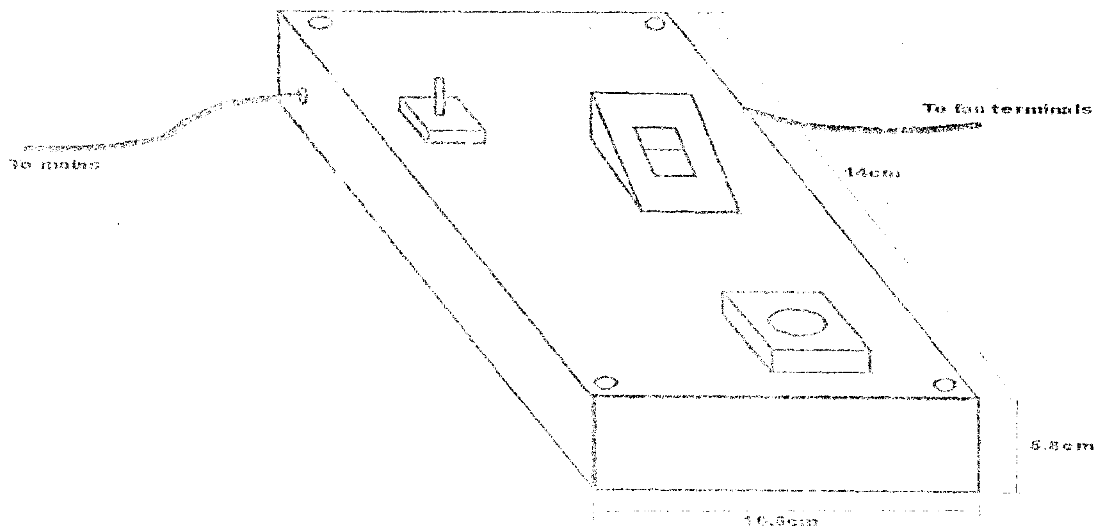
The project was constructed based on the different building stage, as indicated by the block diagram. The remote control was first built and tested. In the same way the receiver circuit was built on a separate veroboard and tested along with other circuits. IC sockets were used to avoid damage to chips due to excessive heat during soldering.

On testing with the remote control, the effective range of control was over 10 metres.

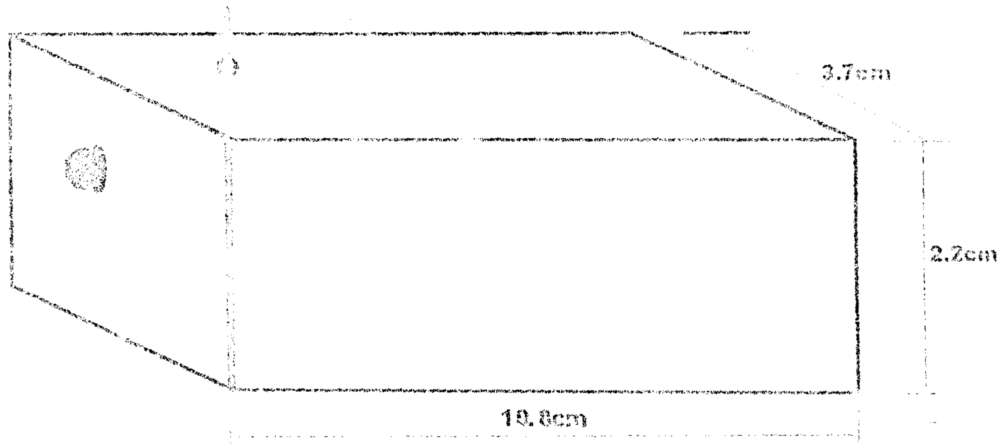
3.2 Casing

After mounting the circuits on Vero boards, the whole circuit was then put in a case made of plywood and well dimensioned as shown in fig. 3.1. It was constructed in such a way to accommodate the circuit boards conveniently, spacious enough for proper ventilation, easy operation, easy handling, and heat dissipation. Lastly the cases were polished thus making them attractive and virtually appealing.

A battery compartment was made at the tail end of the remote control casing.



(A) Fan regulator



(D) Remote control

Figure 3.1

3.3 Cost Estimate

The total cost of construction is shown in the table 3.2

TABLE 3.2: Cost Estimate

NO. OF ITEMS	DESCRIPTION OF ITEM	UNIT COST (₦)	TOTAL COST (₦)
1	Veroboard	100	100
20 Yards	Soldering Iron	10	200
3	HEF4060B IC	40	120
1	HEF4017B	50	50
40	Diodes 1N4001	5	200
2	Toggle switch	40	80
1	7809 IC (9V regulator)	30	30
4	Electrolytic Capacitors	30	120
4	Ceramic Capacitors	5	20
9	2SC945 transistor	10	90
2	2SC603 transistor	10	20
1	220V/12V transformer	120	120
1	9V battery	60	60
1	Fan regulation potentiometer	250	250
5	12V relay	40	200
1	Seven segment display	40	40
1	Infrared transmitter (LED)	40	40
1	Infrared sensor	40	40
26	Resistor	3	78
1	Wooden case	75	75
2 yards	Flexible wire	10	20
		Total	**1,953**

CHAPTER FOUR

4.1 CONCLUSION

This project was well designed, constructed and of great performance. The ultimate aim of an Engineer is to design and construct a workable circuit at a minimal cost, which this work has really shown.

4.2 RECOMMENDATION

Regular power supply may not be guaranteed in Nigeria, therefore, it is recommenced that this project should be powered by a separate 9 volts d.c. power supply. If the distance at which the remote control effectively controls the regulator is to be increased, it is recommenced that the amplifier circuitry is to be improved.

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