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REMOTE CONTROLLED CEILING FAN REGULATING SYSTEM

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KeyWords
Transmitter, Reciever,Speed Selector, Counter,Display and Bell .

ABSTRACT

The paper presents a simple design and implementation of a remote controlled system for ceiling fan. It enables the user to operate a fan regulator from approximately 10 meters away. That is, the speed of the fan can be changed from your couch or bed. The remote transmits a signal or pulse by means of an infrared light emitting diode (LED). This signal is then received by an infrared (IR) receiver which then switches to activate the receiver circuit for the remote controlled ceiling fan regulator. A display unit indicates the speed levels. Five speed levels are digitally displayed as the speed of the fan is automatically selected. The entire system was broken down into functional unit blocks namely: Infrared transmitter, infrared receiver, control logic and driver, display unit, automatic speed selector, manual speed selector, load control and power supply unit. Details of each sub-unit are fully analyzed in the paper.

CHAPTER ONE

1.0 INTRODUCTION

A circuit that allows total control over your equipments without having to move around is a revolutionary concept. Total control over the speed of the fan is an advantage to many. This design brings to you this very concept.

Remote control facilitates the operation of fan regulators around the home or office from a distance. It provides a system that is simple to understand and also to operate, a system that would be cheap and affordable, a reliable and easy to maintain system of remote control and durable system irrespective of usage. It adds more comfort to everyday living by removing the inconvenience of having to move around to operate a fan regulator. The system seeks to develop a system that is cost effective while not undermining the need for efficient working.

The first remote control, called “lazy bones” was developed in 1950 by Zenith Electronics Corporation (then known as Zenith Radio Corporation). The device was developed quickly, and it was called “Zenith space command”, the remote went into production in the fall of 1956, becoming the first practical wireless remote control device. Today, remote control is a standard on electronic products, including VCRs, cable and satellite boxes, digital video disc players and home audio players. In the year 2000, more than 99 percent of all TV set and 100 percent of all VCR and DVD players sold are equipped with remote controls. The average individual these days probably picks up a remote control at least once or twice a day[4].

Basically, a remote control works in the following manner. A button is pressed. This completes a specific connection which produces a Morse code line signal specific to that button. The transistor amplifies the signal and sends it to the LED which translates the signal into infrared light. The sensor on the appliance detects the infrared light and reacts appropriately.

The remote control’s function is to wait for the user to press a key and then translate that into infrared light signals that are received by the receiving appliance. The carrier frequency of such infrared signals is typically around 38kHz. The approach used in this work is the modular approach where the entire design is broken into functional units, block diagrams, where each block in the diagram represents a major section of the circuit that performs a specific function.

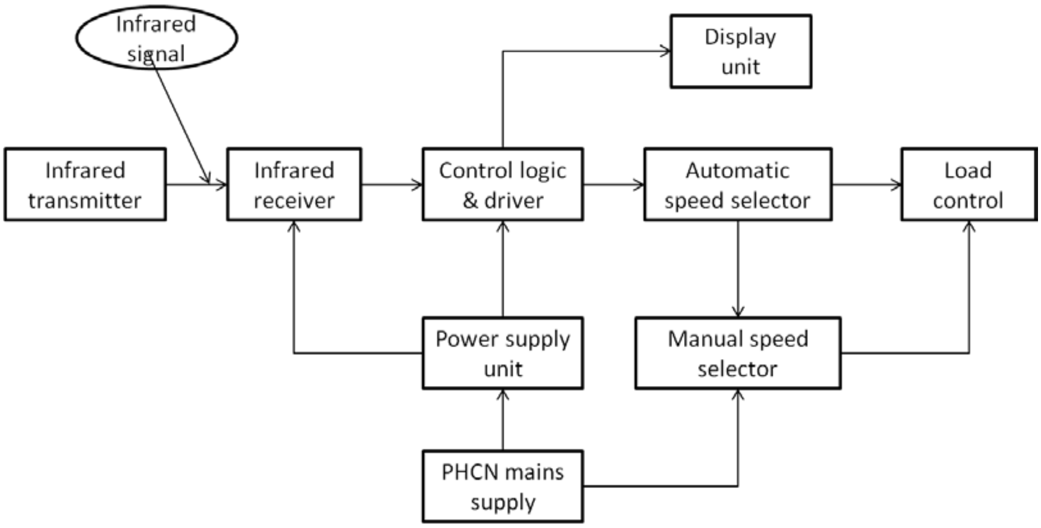

Fig. 1.0 functional block diagram

The infrared transmitter consists basically of the remote control handset. The transmitter is always directed to the infrared receiver which senses the transmitted signal. As the infrared receiver senses an infrared signal it switches appropriately thereby enabling the control logic and driver circuit which then sends the necessary signals to activate the automatic speed selector and display unit accordingly.

The automatic speed selector has a direct path to the load and an indirect path to the load via the manual speed selector. The manual speed selector is powered by the 220v, 240v, 50Hz AC supply from power holding company of Nigeria (PHCN). The manual speed selector has a direct link to the load. Its provision is to enhance the automatic speed selector in regulating the speed of the fan should the automatic speed selector fails. The entire system, apart from the manual speed selector is powered by the power supply unit. The unit provides the DC source required by the various sub units of the system. IR transmitter is a separate entity and therefore powered separately by a battery.

1.1 OBJECTIVE OF THE PROJECT

i. To design and construct a remote controlled ceiling fan regulator.
ii. To use infrared technology to achieve the purpose of the design.

1.2 SIGNIFICANCE OF THE PROJECT

The study exposes one to the wonders of digital technology. One imagines how a single button pressed on a remote set, cause a whole system performance. The speed of a ceiling Fan is regulated at some notable distance away from the manual fan regulator. One can relax comfortably on the couch while sending an infrared light ray to select the speed of the fan as required. The knowledge acquired is capable of making one gain employment by customizing the design or going into large scale production and supply of home appliances fully utilizing the remote technology.

1.3 SCOPE AND LIMITATION OF THE PROJECT

The scope is basically for the purpose of presentation, the components used consist of capacitors, resistors, relays etc. these components make the construction work enormous, ordinarily a microprocessor based technology would reduce the size drastically.

It was difficult getting an infrared receiver module in market. It poses a lot of limitations since the option left was to go for fairly used components obtained from discarded television sets.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter deals basically with the historical background, characteristic behaviour, types and applications of the major components used for the design and construction of the remote control ceiling fan system.

2.1 REMOTE CONTROL BACKGROUND

The earliest example of remote control by radio waves was developed in 1898 by Nikola Tesla and described in his patent, U.S. Patent 613,809, named Method of an Apparatus for Controlling Mechanism of Moving Vehicle or Vehicles[1]. In 1898, he demonstrated a radio-controlled boat to the public during an electrical exhibition at Madison Square Garden. Tesla called his boat a "teleautomaton" [1].

In 1903, Leonardo Torres Quevedo presented the Telekino at the Paris Academy of Science, accompanied by a brief, and making an experimental demonstration. In the same time he obtained a patent in France, Spain, Great Britain, and the United States. The Telekino consisted of a robot that executed commands transmitted by electromagnetic waves. With the Telekino, Torres-Quevedo laid down modern wireless remote-control operation principles and was a pioneer in the field of remote control. In 1906, in the presence of the king and before a great crowd, Torres successfully demonstrated the invention in the port of Bilbao, guiding a boat from the shore. Later, he would try to apply the Telekino to projectiles and torpedoes, but had to abandon the project for lack of financing [2]

The first remote-controlled model aeroplane flew in 1932, and the use of remote control technology for military purposes was worked intensively during the Second World War, one result of this being the German Wasserfall missile.

By the late 1930s, several radio manufacturers offered remote controls for some of their higher-end models. Most of these were connected to the set being controlled by wires, but the Philco Mystery Control (1939) was a battery-operated low-frequency radio transmitter, thus making it the first wireless remote control for a consumer electronics device [3].

The idea of a TV remote control was first introduced by zenith in the early 1950's by Robert Adler [4]. They developed one in 1952, called "lazy bone", which was a long cable that was attached to the TV set. Pushing buttons on the remote activated a motor that would rotate a tuner in the set. In 1955, the Flash-o-Matic was invented. A flash light was shined toward light sensitive cells in each of the four corners of the TV; each corner had a different function. They turned the TV on and off, changed the channel, and controlled the volume. However, people often forgot which corner of the TV operated which control. Also if the set was in sunlight, the sun rays would affect the operation of the TV [4].

In 1957 a group of engineers developed the zenith space command, a wireless remote control using ultrasonic waves. The problem with the ultrasonic control was that clinking metal, such as dog tags could affect the TV set [5].

High frequencies sometimes also made dog barks. The ultrasonic remote was for two decades until engineers discovered a better way to operate TV's through the infrared remote control. On the infrared remote control each buttons has its own command, and is sent to the TV set in a series of signals. There is a digital code for each buttons, and in the TV there is a tiny sensor called a photo-detector that identifies the infrared beam and translates the code into a command.

Today, infrared remote controls now control almost every appliance in our homes. Commonly used in remote control of video cassette recorder, CD players, air conditioner. Infrared technology is also being used for control of personal computers and talking signs. Now, the infrared remote control shall be applied to ceiling fans. The design consists of discrete components which shall be discussed here.

2.2 Zener Diode

A zener diode is one which tends to have the same voltage drop across it regardless of the current passing through it. However, in practice there are limits to the variation of current which it can withstand. Zener diode is mainly used as voltage regulator diodes available in which the reverse breakdown voltage is in the range of about 4V to about 75V, the actual voltage depending upon the type of the diode.

The diagram below shows how the zener diode can be used as a voltage stabilizer to provide a constant voltage from a source whose voltage may vary appreciably. A resistor R is used to limit the reverse current through the diode to a safe value.

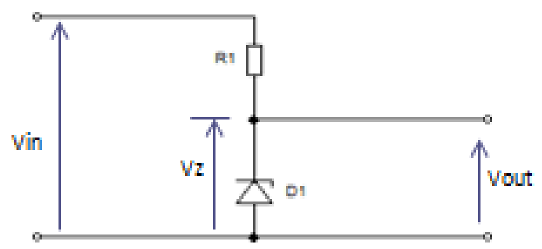

Fig. 2.1 Zener diode as a Voltage Stabilizer.

From the diagram, the input voltage V_{in} is a variable voltage source while the output voltage V_{out} remains constant irrespective of the varying input voltage. The voltage V_Z across the zener diode is the same as the output voltage V_{out} [6].

2.3 Infrared LED

An infrared light emitting diode is similar to the normal light emitting diode. The main difference is that while the normal LED gives out visible light out of varying colours, the infrared LED transmits invisible light rays which are invisible to the human eye but can be captured with the aid of a video camera. The frequency of such infrared light is in the range of 30 kHz to 66 kHz. The current through an infrared LED IS typically in the range of 100mA to 300mA.

Infrared LED is mainly used as infrared transmitter in remote controlled systems. They are also used as sensors in few applications [7]

2.4 Infrared Receiver

There are different types of receiver. Infrared receivers are used to sense infrared light signals transmitted by infrared LED. Infrared sensors are used in home appliances and electronics like television sets, video cassettes recorders, and digital video displays etc.

A common type of infrared receiver sensors used is the popular TSOP17 series receiver module(TSOP1730, TSOP1733, TSOP1736, TSOP1737, TSOP1738, TSOP1740, TSOP1756) with carrier frequency of 30KHz, 33KHz, 36KHz, 36.7KHz, 38KHz, 40KHz and 56KHz respectively. The diagram below shows the schematic of a typical TSOP17 series. The module series number is in most cases printed on the body of the receiver [7].

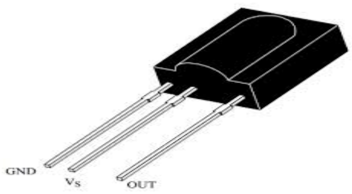

Fig. 2.2 Schematic of TSOP17 series

The TSOP17 series are actually miniaturized receivers for infrared remote control system. They are the standard infrared remote control receiver series, supporting all major transmission codes.

2.5 COUNTERS

A counter performs the job of counting events or periods or putting events in sequence. Counting circuits are formed by wiring flip-flops together. Counters function as frequency drivers and memory units. Counters could be synchronous (parallel) or asynchronous (serial) depending on the clocking pattern of the flip-flops [8].

In asynchronous counters the flip-flops respond one after another in a kind of rippling effect and hence, they are referred to as series or serially clocked counters. Example of serial or asynchronous counter is the ripple counter. In ripple counters the output of a flip-flop drives another flip-flop. In synchronous or parallel counters, the flip-flops are triggered in synchronous with the driving clock pulses simultaneously. An increase in operating speed is obtained.

2.5.1 THE DECADE COUNTER

Any counter that has ten (10) distinct states, no matter its sequence, is a decade counter. A decade counter counts in sequence from 0 to 9 and hence, referred to as a BCD counter because it uses only ten (10) BCD code groups (i.e. from 0000 to 1001). Each decoded output remains high until the arrival of another clock signal. An example of such decade counter is the versatile CD4017 shown in figure 2.3 below.

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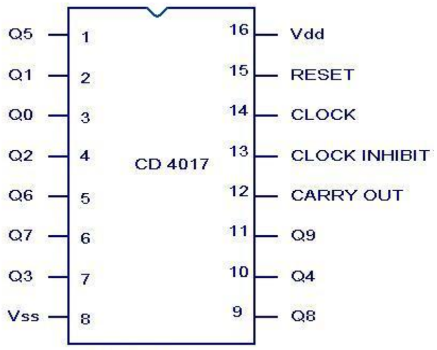


Fig.2.3 A CD4017 Decade Counter

This decade counter is also known as Johnson counter having 10 decoder outputs. Inputs include a CLOCK, a RESET and a CLOCK INHIBIT signal. Schmitt trigger action in the clock input circuit provides pulse shaping that allows unlimited clock input pulse rise and fall times. This counter advances one count at the positive clock signal transition and clock inhibits when the CLOCK INHIBIT Signal is high and hence, counting operation stops despite the transition of active clock pulses at its clock input. A high RESET signal clears the counter to its zero count[9].

The decoded outputs are normally low and go high only at their respective decoded time slot. Each decoded output remains high for one full clock cycle. A CARRY-OUT signal completes one cycle every 10 clock input cycles and is used to ripple-clock the succeeding device in a multi-device counting chain or frequency division [9].

2.6 SILICON CONTROLLED RECTIFIER

The Silicon Control Rectifier (SCR) consists of four layers of semiconductors, which form NPNP or PNPN structures [10]. It has three junctions, labelled J1, J2, and J3 and three terminals. The anode terminal of an SCR is connected to the P-Type material of a PNPN structure, and the cathode terminal is connected to the N-Type layer, while the gate of the Silicon Control Rectifier SCR is connected to the P-Type material nearest to the cathode as shown in the diagram below.

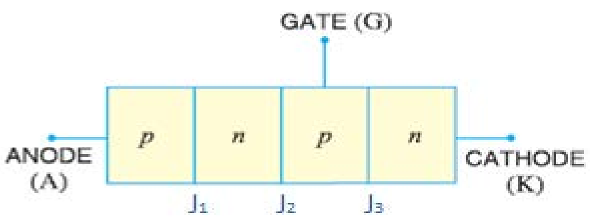


Fig.2.4 Diagram of a Silicon Controlled Rectifier

SCR operates in three modes namely:

I. Forward blocking mode (off state)
II. Forward conduction mode (on state)
III. Reverse blocking mode (off state)

I. Forward blocking mode

In this mode of operation the anode is given a positive potential while the cathode is given a negative voltage keeping the gate at zero potential i.e. disconnected. In this case junction J1 and J3 are forward biased while J2 is reversed biased due to which only a small leakage current flows from the anode to the cathode until the applied voltage reaches its breakover value at which J2 undergoes avalanche breakdown and at this breakover voltage it starts conducting but below breakover voltage it offers very high resistance to the flow of current and is said to be in off state[10].

II. Forward conduction mode

SCR can be brought from blocking mode to conduction mode in two ways - either by increasing the voltage across anode to cathode beyond breakover voltage or by application of positive pulse at gate. Once it starts conducting no more gate voltage is required to maintain it in on state. There is one way to turn it off i.e. Reduce the current flowing through it below a minimum value called holding current[10][11].

III. Reverse blocking mode

SCR are available with reverse blocking capability. Reverse blocking capability adds to the forward voltage drop because of the need to have a long, low doped P1 region. (If one cannot determine which region is P1, a labeled diagram of layers and junctions can help). Usually, the reverse blocking voltage rating and forward blocking voltage rating are the same. The typical application for reverse blocking SCR is in current source inverters[11].

CHAPTER THREE

3.0 DESIGN METHODOLOGY

This chapter centres on the design concept of a remote controlled ceiling fan. The basic design analysis, determination of circuit components, circuit diagrams and principle of operation are extremely discussed in this chapter.

3.1 DESIGN CONSIDERATIONS

a. The circuit under consideration is expected to demonstrate a high level of remote control operation.
b. The fan regulator should have provisions for automatic and manual operations. The operations should be such that the remote control operation should not interfere with the manual operations.

3.1.1 DESIGN ANALYSIS

Referring to the functional block diagram, the stages under the design work are as follows:

i. Infrared transmitter
ii. Infrared receiver
iii. Control logic/driver
iv. Speed control circuit
v. Display unit
vi. Power supply

3.1.2 DESIGN DIVISION

For the basis of analysis in design, the project work is divided into two parts after which they will be cascaded to achieve the desired goals and results. On this wise, the division is as follows:

a. Part one: control panel
b. Part two: switching/display panel.

The sections under the control panel include infrared receiver, control logic and driver and the speed selector circuit.

The sections under the switching/display panel includes infrared transmitter, display unit, power supply unit and all forms of switching operations.

3.2 CONTROL PANEL

The control section as stated earlier incorporates the followings:

a. Infrared receiver circuit
b. Control logic/driver circuit
c. Speed control circuit

3.2.1 Infrared Receiver Circuit

The main element of this circuit is the infrared receiver module TSOP1700 series. The specifications and limits of operation for using the TSOP1700 series receiver module as obtained from data book can be summarized in the table below.

Table 3.1 Basic Characteristics of TSOP1700 series

Parameter	Min	Max	Typical
Supply current (pin2)	0.4mA	1.5mA	0.6Ma
Supply voltage (pin1)	4.5V	5.5V	
Output voltage low (pin3)		0.25V	
Transmission distance			35m

The principle of operation of the TSOP1700 series receiver can be explained by considering an inverter as a light operated device as shown below in the figure below.

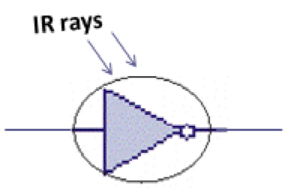


Fig. 3.1 Analog of TSOP1700 operation.

The not gate or inverter above is IR light dependent. Thus, when an infrared light is beamed at it, its output goes low and when there is no infrared light ray, the output remains high. That is how the TSOP1700 series operates.

For practical circuit application the general connection of the TSOP1700 series receiver module is illustrated below.

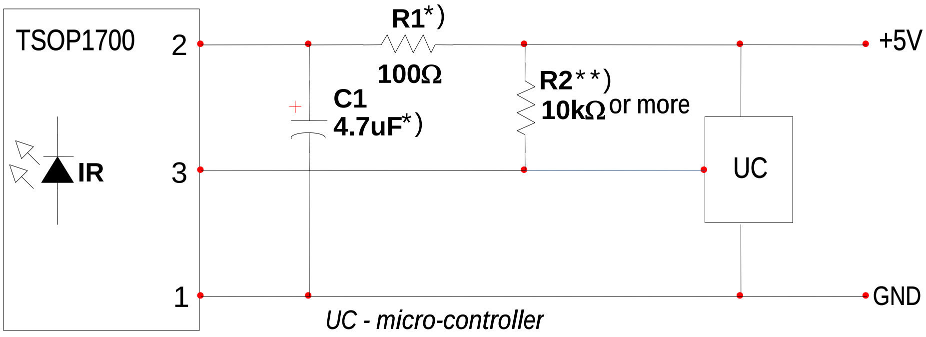


Fig 3.2 TSOP1700 series circuit application.

From the circuit,

IR = infrared receiver

μc = microcontroller

R1= 100Ω, R2=10KΩ

C1=4.7μF

Resistor R1 and capacitor C1 are recommended to suppress power supply disturbances while resistor R2 optional, but then the output voltage should not be held continuously at a voltage below 3.3v by the external circuit (microcontroller).

Based on the characteristics and circuit application of the TSOP1700 series considered so far, the design for the infrared receiver (IR) circuit of the control panel is shown in the figure below;

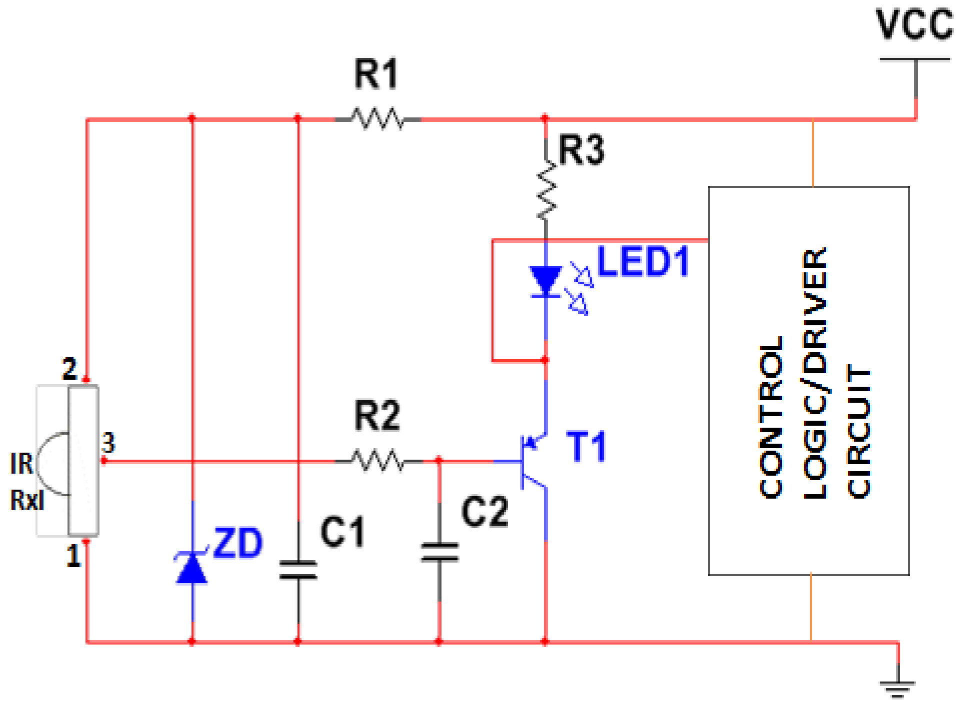


Fig3.3 IR receiver circuit

The zener diode Z_D ,ensures that the voltage at the supply voltage (pin 2) is maintained at 5 volts. R1 &C1 are for suppressing power supply disturbances, capacitor C2 is used to further remove any unwanted signal at the output (pin3). The light emitting diode (LED) is an indicator that glows whenever the infrared sensor is triggered by an infrared light from the transmitter. Transistor T1 is a pnp transistor which triggers or enables the control logic/driver circuit whenever it is forward biased via R2. Resistor R3 is a current limiting resistor for LED 1 and a pulling up resistor for the enabling line to the control logic and driver circuit. In this connection Vcc >5V since Z_D stabilizes the voltage supply to IR Rx1 at 5V.

3.2.2 CONTROL LOGIC/DRIVER CIRCUIT

This circuit consists of two basic integrated circuits: a decade counter and a 555 timer as shown in the figure below;

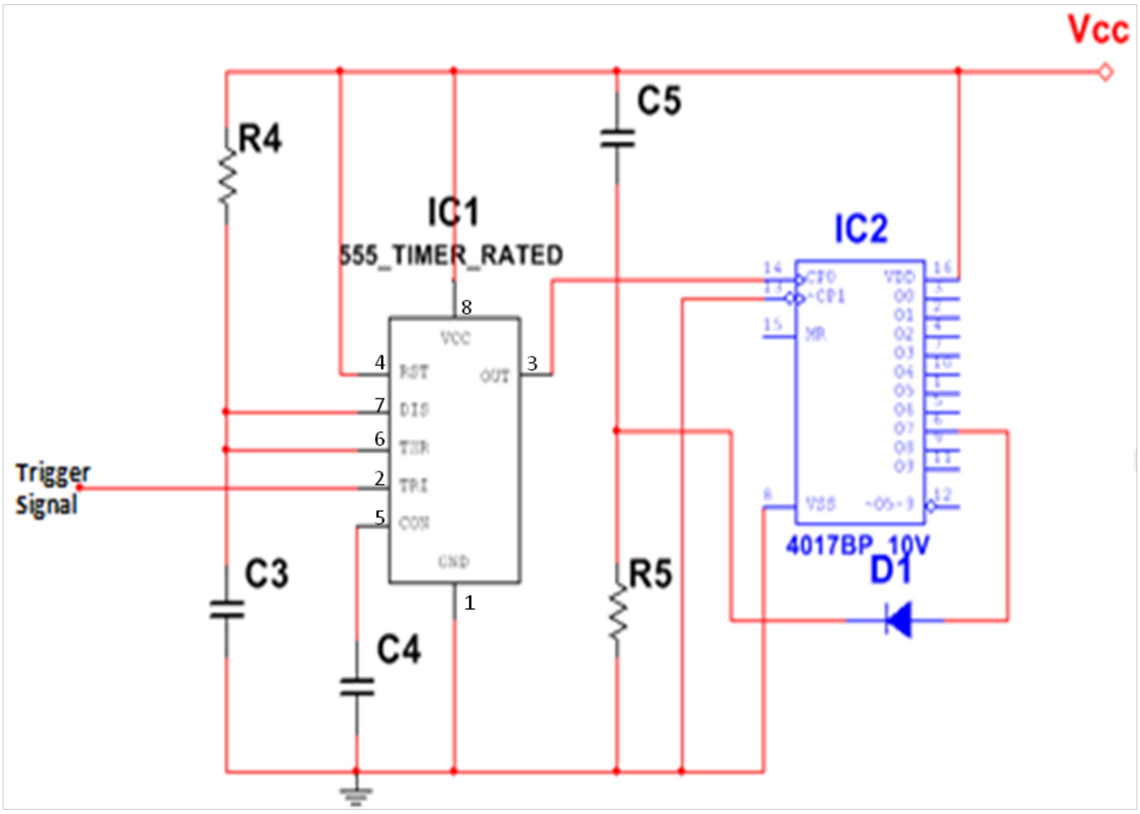


Fig. 3.4 control logic/driver circuit

The trigger signal is generated by the receiver circuit. The 555 timer IC1 is wired as a monostable whose output signal duration is determined by the rated values of the timing components R4 and C3. The output of IC1 is connected to the clock input (pin 14) of the decade counter IC2 (4017). Thus, the clock pulses required to drive the decade counter IC2 are generated by IC1.

The control operation is performed by the counting operation of the counter (IC2). IC2 is a decade counter, out of its ten counting outputs or states, only eight (from Q0 to Q7) are used for the control and driving operations which are as follows;

Q0 ⟶ Standby

Q1 ⟶ ON

Q2 ⟶ Speed 1

Q3 ⟶ Speed 2

Q4 ⟶ Speed 3

Q5 ⟶ Speed 4

Q6 ⟶ Speed 5

Q7 ⟶ Off / Reset

Reset is accomplished via diode D1, capacitor C5 and resistor R5.

3.2.3 SPEED CONTROL CIRCUIT

The design has five provisions for speed control. Thus, there are five speeds (1, 2, 3, 4 &5) that the circuit can select via the designated control outputs: Q2, Q3, Q4, Q5 and Q6. The speed selection mechanism is automatic and accomplished by a circuit design comprising of an arrangement of relays, diodes, transistors and logic gates. The operation is synonymous with the remote operations, exactly at the instance of pressing the remote handset; the various speed levels are selected and effected accordingly. The circuit diagram for the automatic speed selector is shown in figure 3.5 below.

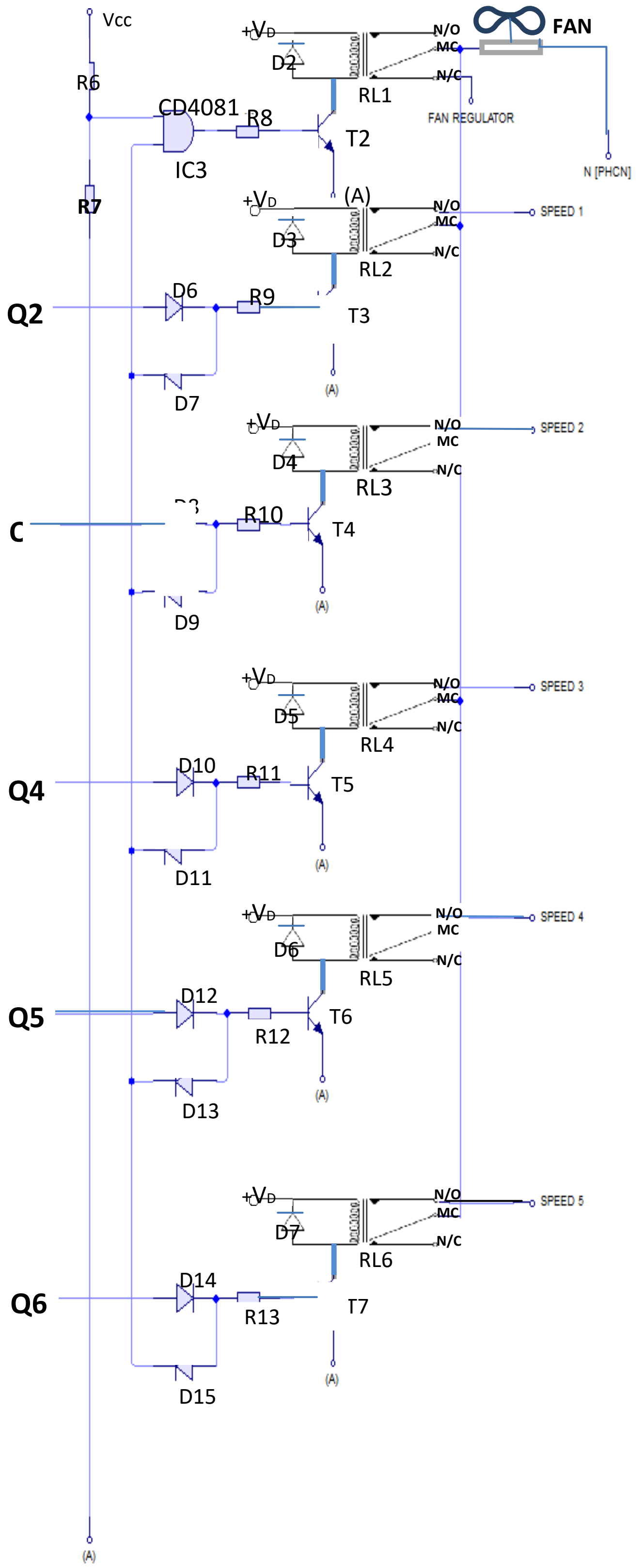


Fig. 3.5 schematic diagram of speed selector

All the grounds of the speed control circuits are tied together and connected to the anode (A) of SCR1 in the switching panel. Part of the speed selector circuit is the Automatic change over system. This circuit switches between the remote control and manual control of the fan regulator.

3.3 CALCULATION OF DESIGN COMPONENTS VALUE

3.3.1 INFRARED RECEIVER

Refer to fig 3.3 for details as obtained from data specification books, to suppress power supply disturbances:

R1 = 100Ω, $\frac{1}{4}$W

C1 = 4.7µF, 16V

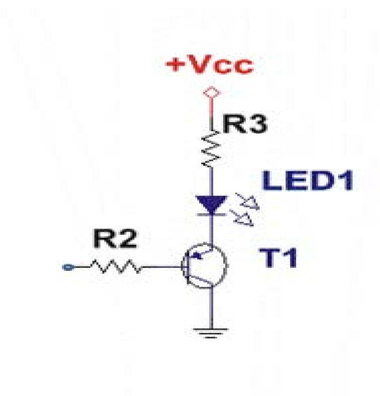
Now, supply voltage Vs, for the TSOP17 series infrared receiver is between 4.5V to 5.5V. Let the zener diode Z_D value be;

Z_D= 5.1V

Typically, for TV infrared operation, the receiver is either TSOP1736 or TSOP1738. Let IR Rx I =TSOP1738

To further suppress any unwanted noise signal from IR Rx I output pin3, let C2= 0.1µF ceramics

For the biasing of pnp transistor T1 and powering of the infrared signal indicator light LED1



Let T1 = BC558 (pnp)

LED1 = Yellow

Vcc = +9v

Let the current allowable through LEDI

$I_{LED1}= \frac{V_{CC}-V_{CE}-V_{LED1}}{R3}$

Hence, R3 = $\frac{V_{CC}-V_{CE}-V_{LED1}}{I_{LED1}}$

Where, $V_{CC} = 9V, V_{CE} = -77.3V, I_{LED1} = 18mA \;\; and \;\; V_{LED1} = 1.7V$

.: R3 = $\frac{9+77.3-1.7}{18m} = 4.7k\Omega$

Let R2 = 1.8KΩ

In summary, for the receiver circuit

R1= 100Ω,$\frac{1}{4}w$

R2 = 1.8KΩ, $\frac{1}{4}w$

R3 = 4.7 KΩ, $\frac{1}{4}w$

C1 = 4.7µF, 16V

C2 = 0.1μF

T1 = BC558 (pnp)

LED1 = Yellow

Z_{D1}=5.1V

IR R x I = TSOP1738

3.3.2 CONTROL LOGIC/ DRIVER

Refer to fig 3.4 for details. The triggering signal is generated by the receiver circuit. The control logic circuit consists basically of a 55 timer IC1 and a decade counter IC2. When the

555 timer IC1 is triggered via its pin 2, it releases its single high output signal. The duration of this signal is determined by R4 and C3, it is given by:

$T_{OUT} = 1.1R4C3$

Let T_{OUT} 1 sec, R4 =100KΩ

Therefore, C3 = $\frac{T_{OUT}}{1.1R4}$ = $\frac{1}{1.1\times100K} = 9.1\mu F$

Choosing nearest standard value C3 = 10 μF, 16V

After the seventh output of the counter Q7 is counted. The eight output Q8 is used to reset the counter via D1, C5 and R5. Let the reset time be 1 seconds.

Now, $t_r = R5C5$

Let R5 = 10KΩ, $\frac{1}{4}w$

C5 = $\frac{t_r}{R5} = \frac{1}{10K} = 100\mu F$

C5 = $100\mu F$, 16V

In summary, for the control logic/ driver circuit:

R4=100KΩ, $\frac{1}{4}w$ R5 = 10KΩ, $\frac{1}{4}w$

C3 = 10 μF, 16V C4 = 0.01μF ceramics

C5 = $100\mu F$, 16V D1 = IN4148

ICI = NE555 IC2 = CD4017

3.3.3 SPEED CONTROL CIRCUIT

This part of the design has provision for automatic change over. It ensures that the manual operation and the remote control operation of the ceiling fan regulator do no short.

Besides the enabled output of the counter in the control logic and driver circuit are used to select the speed one after the other accordingly by the remote control operation. The sequence is defined as follows:

Q2 ⟶ Speed 1

Q3 ⟶ Speed 2

Q4 ⟶ Speed 3

Q5 ⟶ Speed 4

Q6 ⟶ Speed 5

For the signal direction,

Let D6=D7=D8=D9=D10=D11=D12=D13=D14=D15=IN4148, R6 and R7 are voltage divider resistors.

Now, $V_{CC}= V_{R6} + V_{R7}$

Let V_{R6}= 3v, $V_{R7} = 6v,\ V_{CC} = 9v$

But, $V_{R7} = \frac{R7Vcc}{R6+R7}$

$$\frac{R7}{R6+R7} = \frac{V_{R7}}{V_{CC}} = \frac{6}{9} = \frac{2}{3}$$

Hence, 3R7 = 2R6 + 2R7

R7 = 2R6

Let R6 = 10KΩ

R7 =20KΩ

Let $T_2 = T_3 = T_4 = T_5 = T_6 = T_7 = C1568(npn)$

$R_{L1} = R_{L2} = R_{L3} = R_{L4} = R_{L5} = R_{L6} = 12V, 400\Omega\ relay$

To protect the relay switching transistors from damage resulting from surge effects, let $D_2 = D_3 = D_4 = D_5 = D_6 = D_7 = IN4007$ for biasing the switching

Transistors into saturation let $R_8 = R_9 = R_{10} = R_{11} = R_{12} = R_{13} = 1K\Omega, \frac{1}{4}w$

The ground of this circuit is connected to the anode of SCR1 in the switching panel of this project. In summary, for the speed control circuit;

R6 = 10KΩ, $\frac{1}{4}w$

R7 =20KΩ, $\frac{1}{4}w$

$R_8 = R_9 = R_{10} = R_{11} = R_{12} = R_{13} = 1K\Omega, \frac{1}{4}w$

D6=D7=D8=D9=D10=D11=D12=D13=D14=D15=IN4148

$D_2 = D_3 = D_4 = D_5 = D_6 = D_7 = IN4007$

$$R_{L1} = R_{L2} = R_{L3} = R_{L4} = R_{L5} = R_{L6} = 12V, 400\Omega\ Relay$$

IC3 = CD4081 (AND gate).

3.4 SWITCHING PANEL

This panel houses the basic switching operations.sub section of the panel include;

(a) Transmitter circuit
(b) Stand by circuit
(c) On circuit
(d) Off circuit
(e) Display circuit
(f) Power supply circuit.

3.4.1 TRANSMITTER SECTION

The transmitter section comprises the infrared remote controlled handset for the ceiling fan regulator. The transmitter utilizes the principle of operation of the infrared light emitting diode (IR LED1) in an oscillator circuit. The oscillator for the design is the versatile 555 timer Astable circuit. Fig 3.6 shows the schematic of the transmitter section.

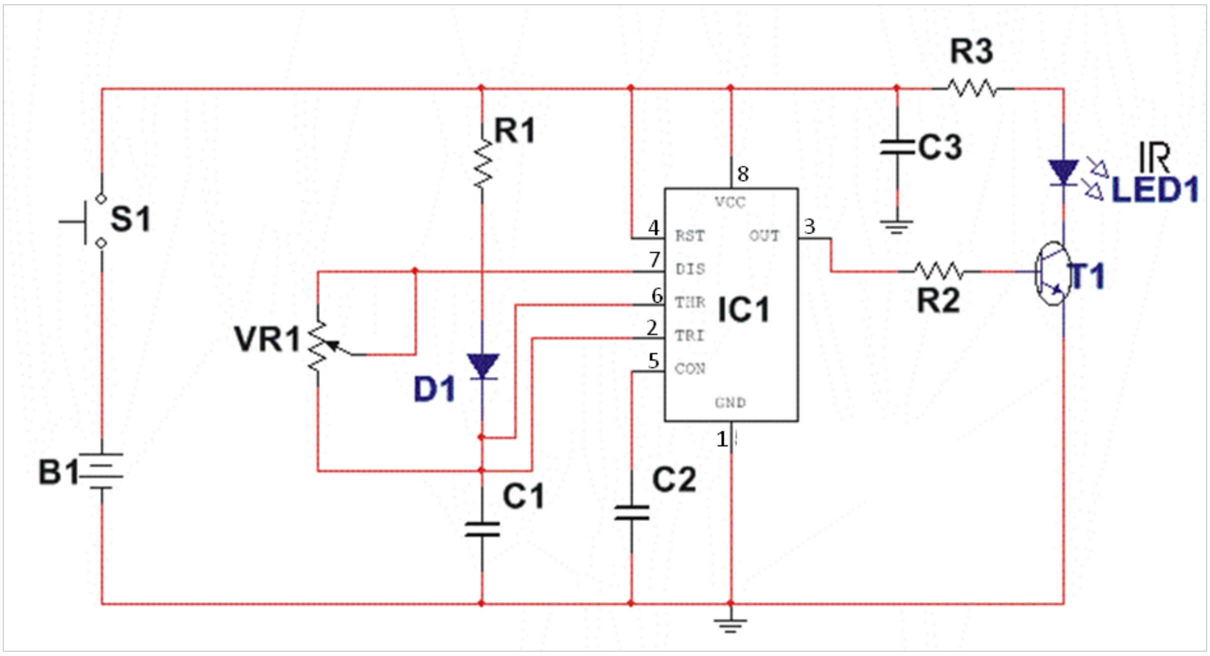


Fig 3.6 Transmitter section

With the momentary switch S1 pressed the Astable operation of the 555 timer IC1 commences. The output signal via pin 3 is further amplified and then converted into infrared light by the infrared light emitting diode IR LED1. Amplification of the oscillating output signal is accomplished by transistor T1 via R2. Capacitor C3 suppresses any disturbance from power supply. The oscillation frequency of the remote controlled transmitter is determined by VR1, R1, D1, and C1. The transmitter stops working when S1 is released.

3.4.2 STAND BY CIRCUIT

Referring to the general circuit diagram of fig 3.7 the stand by circuit is enabled at the powering of the receiver section via the ON/OFF switch S1. As the receiver is powered, the counter IC2 resets it's counting sequence consequently, output Q0 at pin 3 goes high enabling the stand by circuit. The circuit diagram of the stand by circuit is shown below.

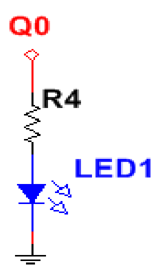


Fig3.7 stand-by circuit

LED1 is the indicator for the operation; it shows that the counter in the receiver section is set for its operation.

3.4.3 ON CIRCUIT

The ON circuit is activated by the next counter output Q1 of the counter in the control panel. This operation occurs at the first pressing of the remote controlled handset button. The receiver detects the infrared light signal from the remote control transmitter and acts accordingly, thereby enabling the counter, and the first count operation takes place. This operation actually switches on the entire receiver section. Fig 3.8 shows the circuit diagram of the ON circuit.

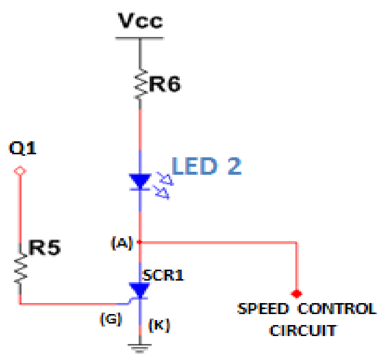


Fig. 3.8 ON circuit

The high output signal Q1 of the counter is used to fire the gate (G) of the SCR1. This action completes the ground path for the speed control circuit which was initially connected to the anode (A) and then connected to the cathode (K) when the gate is fired. LED2 is the indicator for the ON circuit.

3.4.4 OFF CIRCUIT

The OFF circuit is activated after selecting SPEED 5. By the next pressing of button on the remote transmitter, the eighth output Q7 of the counter is enabled high and this activates the OFF circuit. The OFF circuit automatically stops the operation of the receiver circuit. Fig 3.9 shows the schematic of the OFF circuit.

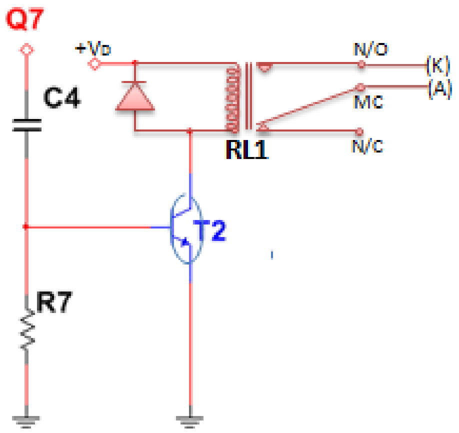


Fig 3.9 Schematics of OFF circuit

When the eighth output Q7 of the counter is enabled high the voltage drop across R7, thereby forward biasing transistor T2. Capacitor C4 then charges through R7 until the entire voltage is dropped across c4. When this happens the voltage at the base of t2 falls below 0.7v and therefore reverses biases.

During the forward biasing process relay RL1 is energized. As a result the main contact (M/C) moves to the normally open contact. The main contact is connected to the anode (A) of the SCR1 in the ON circuit, while the normally open (N/O) contact is connected to the cathode (K). Consequently, the relay action short circuits the anode and the cathode, thereby disconnecting the speed control circuit from the general circuit ground. Thus, the speed control circuit is switched off during the reverse bias process, the relay returns to its relaxation state. The relay is energized by the voltage source VD

3.4.5 DISPLAY UNIT

The display unit is concerned with the display of the five speeds. The unit is enabled by high signal from the anode of the silicon controlled rectifier. The circuit design for the display unit is shown in Figure 3.10. The enabling signal comes from the anode of the SCR but then triggered by the 555 Timer monostable IC1 with the associated circuitry, which acts as a clock pulse generator to drive the decade counter IC2 which then places the required digital codes at the input of the seven-segment display decoder IC3. The decoder used is active high while the seven segment used is common cathode

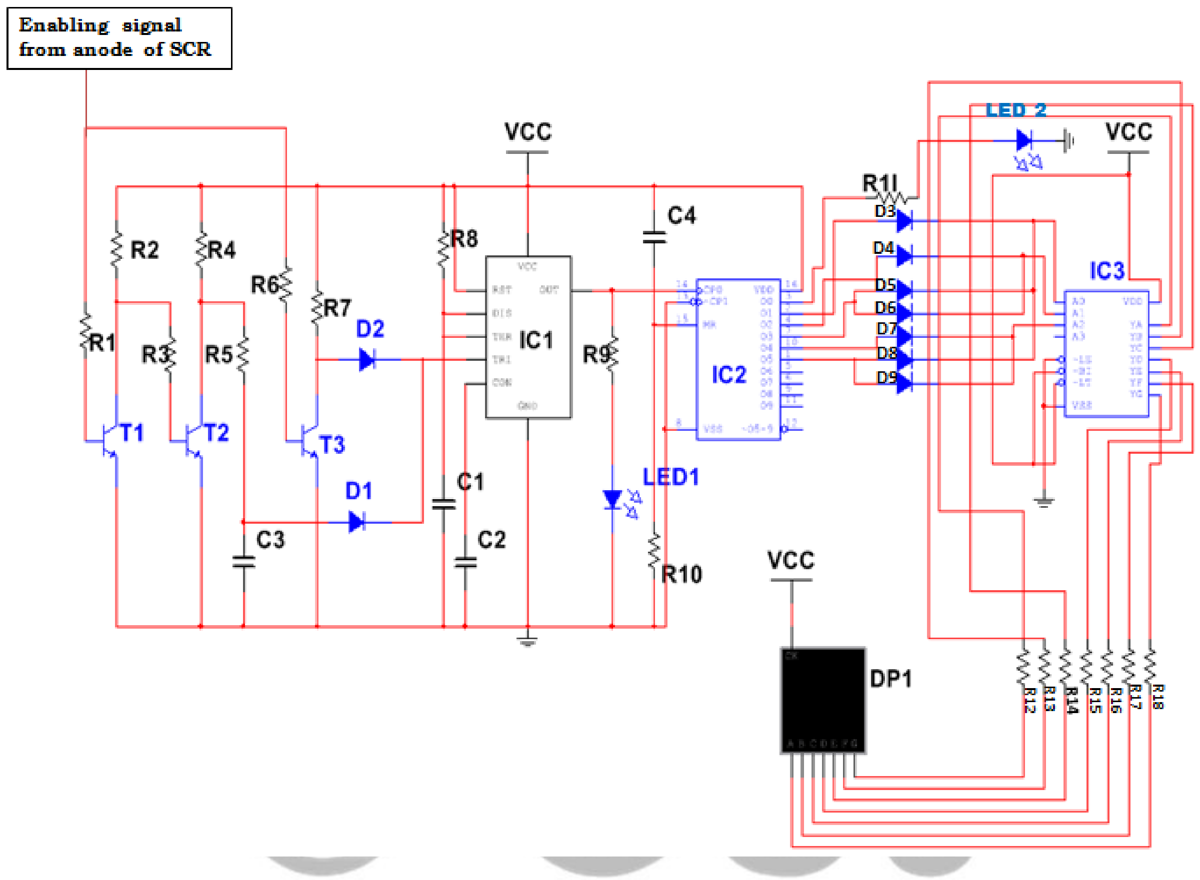


Fig 3.10 diagram of display unit

3.4.6 FAN REGULATOR

The fan regulator circuit is expected to be manually and automatically controlled. Manual control is achieved by turning the fan regulator usually fixed on the wall while the automatic control is aided by means of the infrared remote control handset. Fig 3.11 shows the general connection of the fan regulator.

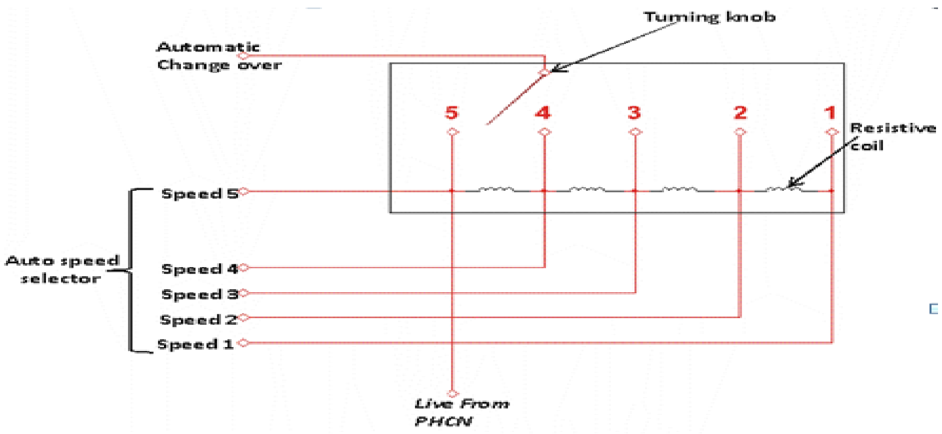


Fig 3.11 Fan Regulator Circuit

During the manual operation, the automatic change over operation disconnects the speed selection from remote control operations to the (manual) fan regulator. The turning knob can be set at any speed.

During the automatic speed selection, the auto-change-over circuit regulates the fan speed as the remote control handset is operated. Resistive coils are used to regulate the speed. The speed progression increases from 1 to 5, such that Speed 1is lowest and Speed 5 highest.

3.4.7 THE POWER SUPPLY UNIT

The power supply is mainly designed to provide the required DC power supply needed by the circuit. The circuit utilizes +9v DC and +12v DC. The +9v is for the general circuit operations while the 12v is to energize the 12v relay in the circuit. Fig 3.12 shows the circuit design for the power supply unit.

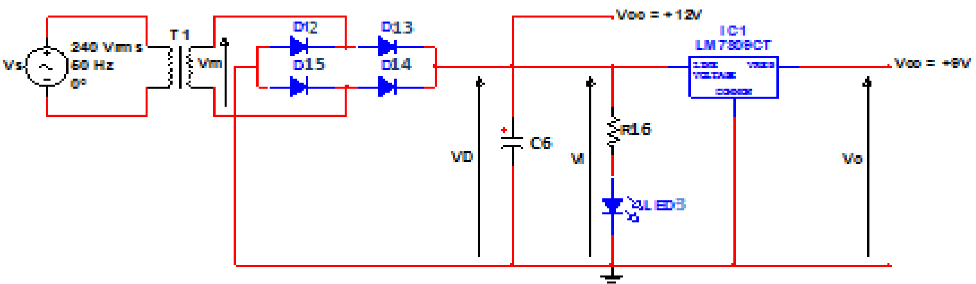


Fig 3.12 circuit diagram of power supply

The power supply unit consists of transformation stage, rectification stage, filtration and the regulation stage. The Transformation stage consist of a step down transformer, the rectification stage is made up of four rectifier diodes D12 to D15. The filtration stage is made up of capacitor C6 which removes the A.C ripples from the rectified power signal. At the regulation stage, the required 9v DC is produced and stabilized. The unregulated power VD =Vi, is used to energize the relays in the design.

3.5 CALCULATION OF RATED COMPONENTS VALUE

3.5.1 TRANSMITTER SECTION

Refer to fig 3.6 for details, the transmitter is expressed to transmit signals when frequency fall within the infrared frequency range, which is between 30 KHz and 56 KHz; typically 36 KHz or 38 KHz are the commonly used.

Let the oscillation frequency f_o of the transmitter or remote control transmitter be 38KHz. That is,

$f_0 = 38KHz$

The oscillation frequency is determined by VR1, R1, D1 and C1

Now, $f_0 = \frac{1}{T}$ where T= T1 +T2

T = 0.693(R1+RD1+VR1) C1

. : VR1 =$\frac{T}{0.693C1} - (R1 + RD1)$

Now, T= $\frac{1}{F_0} = \frac{1}{38K} = 26.3\mu s$

Let R1 = 1KΩ,$\frac{1}{4}$w ; C1=0.01μF ; D1=IN4148

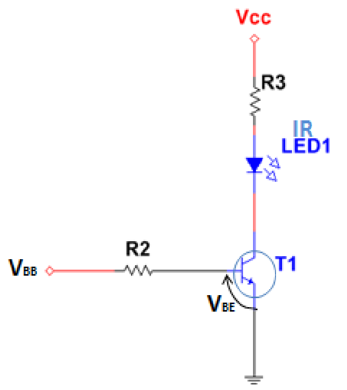
. : RD1 500Ω

Therefore, VR1= $\frac{26.3\mu}{0.693\times O.01\mu} - 1500 = 3.8k - 1.5k$

VR1=2.3kΩ (variable)

To allow swift tuning, let VR1= 4.7kΩ (variable)

Normally C2 = 0.01µF to avoid false triggered and noise. For the amplification of the transmitter signal and the conversion by the infrared LED1, consider the circuit below:



Vcc= $I_{IR}R3 + V_{IR} + V_{CE}$

R3 =$\frac{V_{CC}-V_{IR}-V_{CE}}{I_{IR}}$

Where Vcc = 9v; V_{IR} =1.7v, $V_{CE} = -2.3V$,$T1 = BC547$

$I_{IR} = 300mA$

$\Longrightarrow$R3 = $\frac{9-1.7+2.3}{300m}$ = 32Ω

. : R3 = 33Ω, $\frac{1}{4}$

$V_{BB} = I_B R2 + V_{BE}$

Where $V_{BB} = 9 - 1.7 = 7.3v$

$V_{BE} = 0.7v$

$I_B = \frac{I_C}{\beta}$

$I_C = 300mA$

$\beta = 180$

$I_B = \frac{300m}{180} = 1.67mA$

$\Longrightarrow$ R2 = $\frac{7.3-0.7}{1.67m} = 3.95k\Omega$

Let R2 =$3.95k\Omega$, $\frac{1}{4}$w

To suppress any disturbance from the power supply let C3=47µF, 16v.

In summary for the infrared remote control transmitter,

RI =$1k\Omega$, $\frac{1}{4}$w ; R2 =$3.95k\Omega$, $\frac{1}{4}$w ; R3 =$3.3k\Omega$, $\frac{1}{4}$w

VR1 = 4.7µF, 16v ; D1 = IN4148 ; C1 = C2 = 0.01µF

C3 = 47µF, 16v ; T1 = BC547 (npn) ; IC1 = NE5555

IR LED1 = infrared LED; B1=+9v DC Battery.

S1 = Momentary switch (remote button).

3.5.2 STAND-BY CIRCUIT

Refer to fig 3.7 for details. For the value of the current limiting resistor R4.

VQ0 = $I_{LED1}R4 + V_{LED1}$

R4 = $\frac{VQO-V_{LED1}}{I_{LED1}}$

Let $I_{LED1} = 20mA$ $V_{LED1} = 1.7v$ VQ0 = 9-1.7 = 7.3v

R4 = $\frac{7.3-1.7}{20m}$=280Ω

Let R4 = 430Ω, $\frac{1}{4}$w to further limit current flowing through LED1 to a safe and longest value. Thus, for the standby circuit;

R4 = 430Ω, $\frac{1}{4}$w

LED1 = RED.

3.5.3 ON CIRCUIT

Refer to fig 3.8 for details. For the silicon controlled rectifier action

VQ1 = $I_G R5$

Let the gate current I_G be about 120mA

R5 = $\frac{VQ1}{I_G}$ where VQ1 = 9 -1.7 = 7.3

R5 $\frac{7.3}{120m} = 61\Omega$

Let R6 = 430Ω, $\frac{1}{4}$w LED2 = BLUE

Thus for the ON circuit:

R5 = 62Ω, $\frac{1}{4}$w ; R6 = 430Ω, $\frac{1}{4}$w

LED2 = BLUE ; SCR1 = BT – 151

3.5.4 OFF CIRCUIT

Let the triggering time of capacitor C4 be 1.5sec refer to fig 3.9 for details

T_C =C4R7

Let C4 = 100μF, 16v

$T_C = 1.5$ Sec

. : R7 = $\frac{T_C}{C4} = \frac{1.5}{100\mu} = 15K\Omega$, $\frac{1}{4}$w

Thus for the OFF circuit;

R7 =$15K\Omega$, $\frac{1}{4}$w ; C4 = 100μF, 16v

D2 = IN4007 ; T2 = 2N2222 or C1568

RL1= 12V 400Ω relay.

3.5.5 DISPLAY UNIT CIRCUIT

3.5.5.1 TRIGGERING SECTION

The trigger circuit consists of three transistors T1, T2, T3 and the associated resistors, two diodes and a capacitor. The values as obtained in the previous calculation are as follows:

R1 = R3 = R6 = 4.7KΩ, 1/4W

R2 = R4 = R7 = 10KΩ, 1/4W

R5 = 10KΩ, 1/4W

C1 = 10μF, 16V

D1 – D2 = IN4148

T1 = T2 = T3 = BC547 (npn)

3.5.5.2 DIGITAL COUNTING

The counter IC2 is a decade counter. For the choice of decade counter in this project, CD4017 is been selected. To place the digital codes required by the seven-segment decoder IC3, signal diodes are used (D3 – D9).

Let D3 – D9= 1N4148

For the seven-segment display decoder, the versatile CMOS IC CD 4511 B is selected. This decoder is an active high type, therefore the appropriate LED seven-segment display type should be a common-cathode.

The value of each current limiting resistor (R12 – R18) can be determined as follows:

$$Rx = \frac{V_D - V_{LED}}{I_{LED}}$$

Where R_x = R12 – R18

$V_D = V_{cc} - 1.7V = 9 - 1.7V = 7.3V$

$V_{LED} = 1.7V$

I_{LED} (max) = 20mA

$$\Rightarrow \quad Rx = \frac{7.3 - 1.7}{30m} = \frac{5.6}{20m}$$

To further limit current through the LEDs, let

$R_x = 470\Omega$

$\therefore R12 - R18 = 470\Omega$

In summary for display:

C3 =10µf, 16v	;	T1 = T2 = T3 = BC547 (npn)		
C1=100µf, 16v	;	R12 – R18 =470Ω		
C1=0.01µf	;	R10 = 100KΩ		
C4=10µF, 16V	;	R11 = 470Ω	;	IC3 = CD 4511B
D1 - D9 =IN4148	;	R1 = R3 = R6 = 4.7KΩ, 1/4W		
R2 = R4 = R7 = 10KΩ, 1/4W	;	R8 = 91KΩ		
R5 = 10KΩ, 1/4W	;	IC1 = 555 Timer	;	IC2 = CD4017

DP1 = common – Cathode LED seven-segment display.

3.5.6 POWER SUPPLY UNIT

For the total load current $I_{.D.C} = 0.62\ I_{A.C}$ Where, $I_{.D.C}$ is the total d.c load in amperes drawn by the circuit at which regulation is to be maintained. $I._{A.C}$ is the A.C current capacity of the transformer.

To maintain regulation:

$$V_{r(peak)} \leq V_m - V_{i(\min)}$$

Let the required dc supply voltage be +9 volts. For positive IC regulator 7809:

$$V_{i(\min)} = 11.5V$$

From above for regulation to be maintained, then:

$$V_m \geq V_{i(\min)}$$

For the choice of transformer, let Vm= 12V

Since 12 > 11.5, regulation is possible

Hence, the size of transformer is 240V/12V, 500mA, 50Hz A.C.

The total load drawn by the circuit is given by $I_{.D.C} = 0.62\ I_{A.C}$

$I_{D.C} = 0.62 \times 500m = 310mA$

For the size of the filter capacitor

$$\Rightarrow V_{r(r.m.s)} = \frac{I_{.D.C}\cdot}{4\sqrt{3} fC6}$$

Also, $V_{r(r.m.s)} = \frac{V_{r(peak)}}{\sqrt{3}}$; but $V_{r\ (peak)} \leq V_m - V_{i(min)}$

Let $V_{r(peak)} = V_m - V_{i(min)}$

Where $V_m = 12V$; $V_{i\ (min)} = 11.5V$

$V_m - V_{i\ (min)} = 12 - 11.5 = 0.5V$

Hence,

$V_{r(peak)} \leq 0.5V$

Let $V_{r(peak)} = 0.5V$

From the above expression,

$\frac{V_{r(peak)}}{\sqrt{3}} = \frac{I_{D.C}}{4\sqrt{3fC6}}$ $\quad$ $where\ f = 50Hz$

$I_{D.C} = 310m$

C6 = $\frac{I_{D.C}}{4FV_{r(peak)}}$ since $V_{r(peak)} \leq 0.5V$

C6 = $\frac{300m}{4 \times 50 \times 0.5} = 3100\mu F$

. : C6 = 3100μF, 25v

For the power indicator LED3 $V_I = I_{LED3}R16 + V_{LED3}$

R16 = $\frac{V_I - V_{LED3}}{I_{LED3}}$

Let, $V_i = V_m - V_{r(peak)}$ = 12 – 0.5 = 11.5v

$V_{LED3} = 1.7$

$I_{LED3} = 15mA$

. : R16 = $\frac{11.5-1.7}{15m}$ = 653Ω

R16 = 680Ω, 2w

In summary, the list of rated component values for the power supply is;

Transformer = 240/12V, 500mA, 50Hz A.C

D12 – D15 = IN4001

C6 = 3100μF, 25V

R16 = 680Ω, 2W

IC4= IC Regulator 7809

LED3 =RED

3.6 GENERAL DIAGRAM OF REMOTE CONTROLLED CEILING FAN REGULATOR

By bringing the two parts of the project together, the general circuits showing the transmitter section and the basic receiver section are shown in fig 3.13 and 3.14

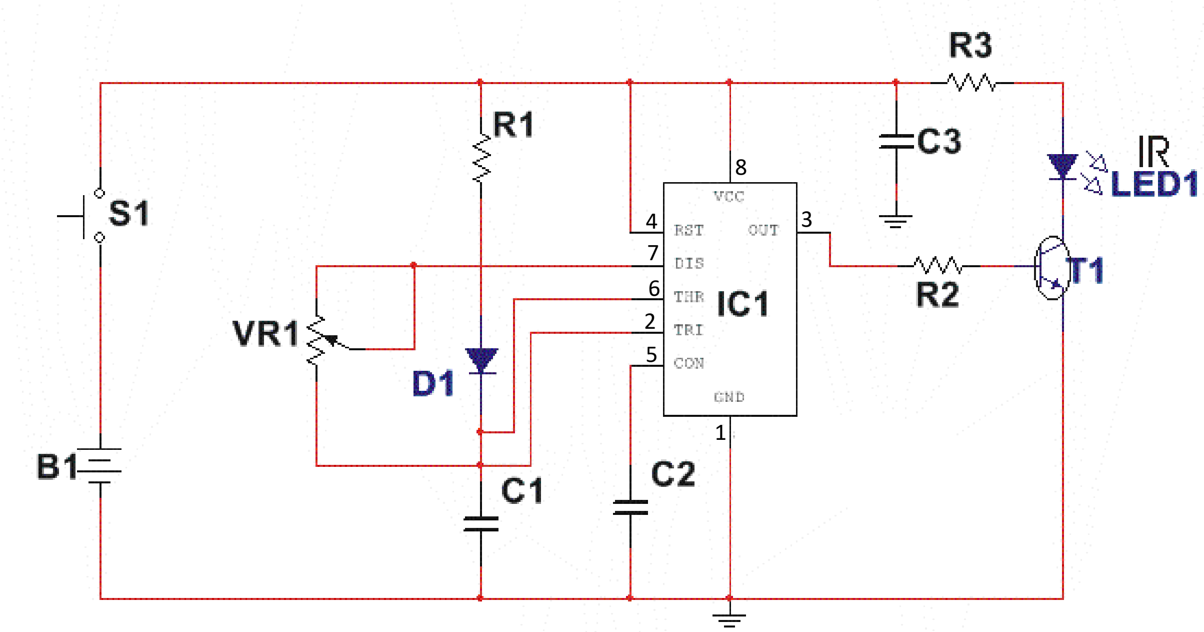


Fig 3.13 circuit diagram of infrared remote controlled transmitter

RI =$1k\Omega$, $\frac{1}{4}$w R2 =$3.95k\Omega$, $\frac{1}{4}$w

R3 =$3.3k\Omega$, $\frac{1}{4}$w VR1 = 4.7µF, 16v

D1 = IN4148 C1 = C2 = 0.01µF

C3 = 47µF, 16v T1 = BC547 (npn)

IC1 = NE5555 IR LED1 = infrared LED ; B1=+9v DC Battery.

S1 = Momentary switch (remote button).

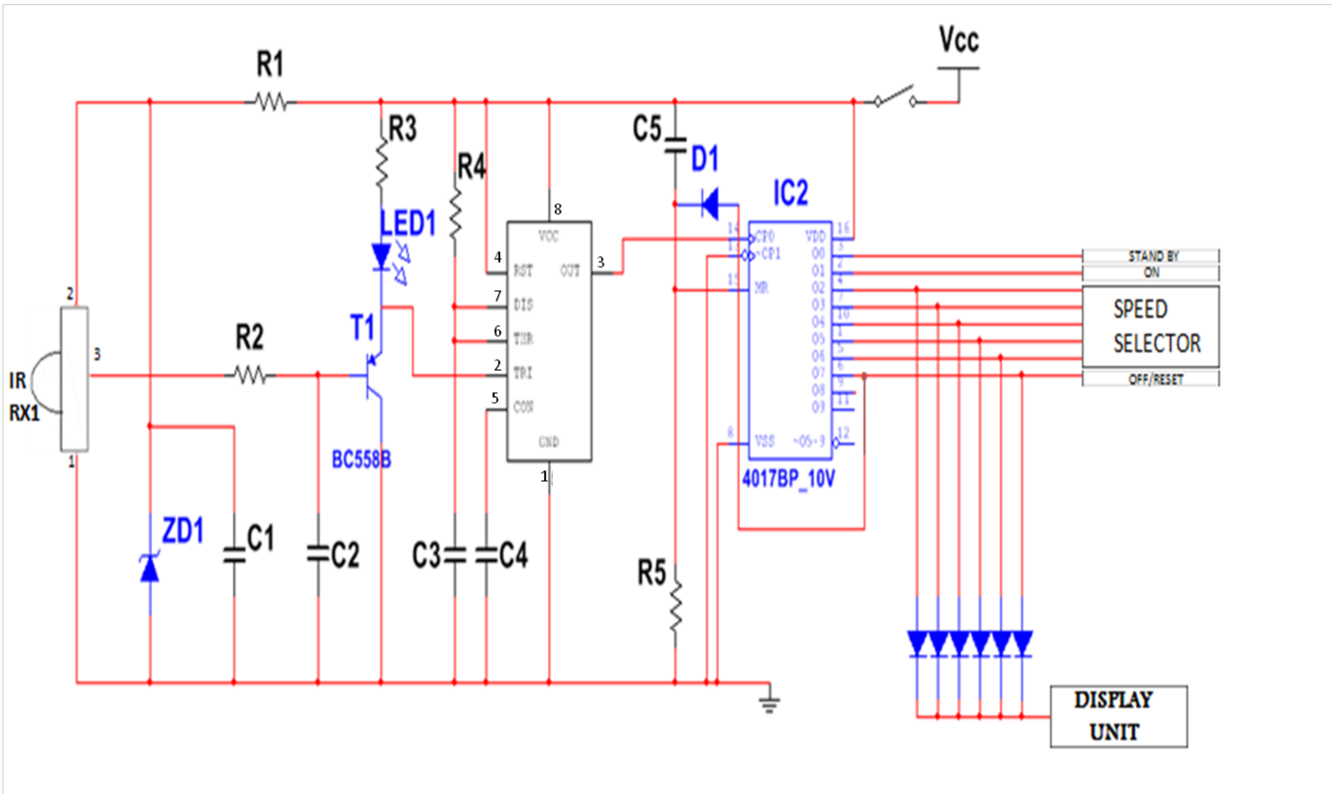


Fig 3.14 General circuit diagram of infrared receiver and control panel

R1 = 100Ω, $\frac{1}{4}w$

R4 = 100KΩ, $\frac{1}{4}w$

R2 = 1.8kΩ, $\frac{1}{4}w$

R5 = 10KΩ, $\frac{1}{4}w$

R3 = 4.7kΩ, $\frac{1}{4}w$

C1 = 4.7µF, 16v

C2 = 0.1µF

C3 = 10µF, 16v

C4 = 0.01µF

C5 = 100µF, 16v

D1 = IN4148

ZD1 = 5.1v

IR Rx1 = TSOP1738

LED1 = yellow

ICI = NE555

IC2 = CD4017

T1 = BC558 (pnp)

S1 = ON/OFF switch

PRINCIPLE OF OPERATION

The remote control handset is powered by a 9v battery and functions when the button is pressed. The receiver circuit (also known as the control panel) is powered by 9v regulated power from a DC power supply unit and functions when the ON/OFF switch S1 is pushed on (*refer to* fig 3.14).

At the instance of switching on the control panel via S1, the decade counter IC2 resets by means of R5 and C5, and standby the LED shows red. The rest of the operation occurs when the remote button is pressed (*refer to* fig 3.15).

At the first press of the remote control button, the automatic speed selector is activated and speed (1) is selected. At the same time, the standby LED changes to blue, to show that the circuit is in dynamic operation mode. The next pressing of the remote control button selects speed (*2*) and so on until speed (5). After the fifth speed is selected, any press of the remote button puts the circuit on standby and this will once again be indicated by the light emitting diode (LED) which then changes from blue to red. Any further press of the remote button repeats the working principle again.

For the manual operation, the automatic change over operation disconnects the speed selection from the remote control operations and connects it to the (manual) fan regulator. Manual control is achieved by turning the fan regulator usually fixed on the wall (refer to fig 3.11). The remote operations and manual operations do not conflict at any point. When the remote handset is used, the manual regulator is isolated from the system. Similarly, when the manual fan regulator is engaged, the remote is isolated from the system.

CHAPTER FOUR

4.0 CONSTRUCTION AND PERFORMANCE ANALYSIS

Having completed a thorough work on the design aspect of the project, implementation and construction follows immediately. Implementation takes various forms which include;

a) Circuit simulation.
b) Functional unit block bread boarding.
c) Vero-boarding exercise.

The final construction presents the project as a finished and packaged product including the mounting and installation diagrams.

This chapter thus discusses these implementation stages, the results obtained, the challenges or problems encountered, the wiring, packaging and installation diagrams, and finally the cost of the project work.

4.1 CIRCUIT SIMULATION

As part of the implementation exercise, some parts of the design work which carries out major functions were simulated by means of circuit maker software (multisim). The major parts subjected to simulation were the control logic/driver circuit of the control panel, the display unit and the remote control transmitter. The results obtained are discussed under performance analysis of this chapter.

4.2 BREAD BOARDING EXERCISE

By the modular technology, this project was divided into functional unit block diagrams at the earlier chapters. At this stage, each block diagram, representing a particular design, is subjected to an exercise known as bread boarding. This is a common practice in implementation and construction.

Bread boarding refers to the act of mounting a particular circuit design on equipment called a breadboard for the purpose of testing, evaluation and general performance analysis. The circuit components are mounted on the bread board temporarily by means of the leads of each component and jumper wire. No form of soldiering is done at this stage. The bread board (Fig. 4.1) actually consists of internally connected copper or aluminium plates, arranged serially to form a special matrix.

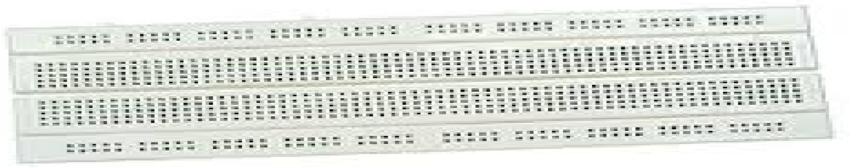


Fig. 4.1 Picture of a Breadboard

4.3 VERO BOARDING EXERCISE

Having observed the performance and behavior of each component by the bread boarding process, all necessary adjustments, corrections and modification would have been done to obtain the desired results. Thereafter, each confirmed circuit design is transferred to another board known as Vero board. On this board, the circuit components are finally soldered firmly. The circuit design of each unit block of the general functional block diagram of the project is mounted on a Vero board. In this exercise, mounting of circuit components is only by soldering, of course soft soldiering. Connecting wires (jumpers) are used were necessary.

At this state, every work is permanent. A high degree of carefulness is needed since it involves heating. Some components are very delicate and fragile. Such components were handled carefully. They are mainly integrated circuits, light–emitting diodes and some transistors. IC sockets were used while light soldering was applied. The Vero board has a perforated surface which supports the mounting of the components and a base lined by copper to enhance continuity and connectivity.

Test on continuity was carried out at various stages to ensure components connectivity. Cascading of the various unit functional blocks was done and the final stage and a general performance test conducted to know if desired results were obtained.

Some of the procedures taken in the Vero boarding exercise are outlined as follows;

i) Cleaning of the Vero board's surface thoroughly with sand paper so as to increase the surface area for the soldering action.

ii) Mounting of the components of each functional unit block just according to the circuit design.

iii) Applying soft solder to achieve the purpose of neatness and lightness.

iv) Cleaning of the bit of the soldering iron after each successful soldering to avoid the formation of oxides.

v) Cutting off any excess components leads after soldering is completed to further enhance neatness and avoid chances of short circuit.

vi) Limiting the heat applied on the components to avoid damage of the components.

4.4 PERFORMANCE TEST

The following steps were taken in carrying out a performance test on the various functional blocks:

a) Continuity and connectivity tests were taken using a millimetre while the circuit was not powered.

b) The soldered work was tested block by block applying the modular approach.

c) The measurement of capacitance, current, resistance and voltage were taken accordingly and compared with design values.

d) The power of the infrared remote transmitter was varied at various distances to actually ascertain how far the remote control can be operated.

e) The infrared transmitter remote button was pressed down, while setting the transmitter frequency to synchronize with the infrared receiver module, bearing in mind that the operation is strictly on tube-of-sight.

f) Light emitting diodes (LEDs) were used frequently to monitor the output of time delay and clock generating circuits, as well as the counter circuit.

4.5 RESULTS

The major results obtained are summarized as follows:

a) Remote control operating Frequency $\cong$ 38.4KHZ

b) Remote control maximum Operating distance $\cong$ 10 meters

c) Switching time of control logic and driver circuit $\cong$ 1.2 seconds

d) Simulation results of remote control transmitter

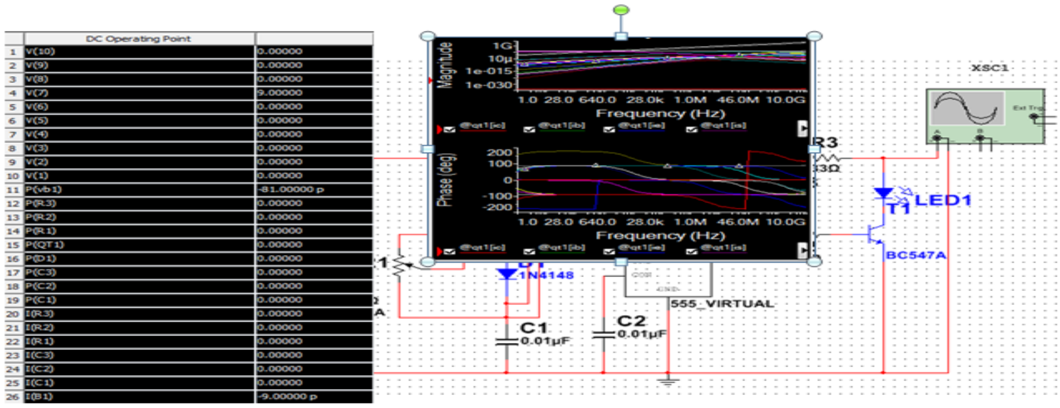


Fig. 4.2 Simulation results of remote control transmitter

From the graph shown above it was observed that the signal tends to oscillate. Also because of the size of C1 (very small) the frequency becomes very high causing the LED to be steady, which was the same result achieved during testing

e) Simulation result of control logic and driver, and display unit;

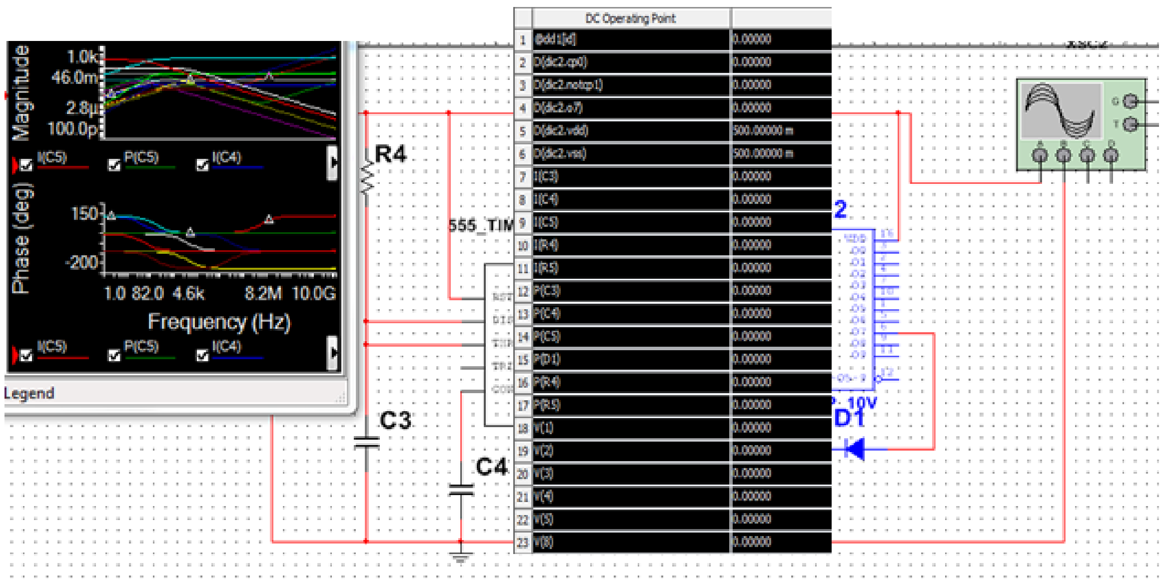
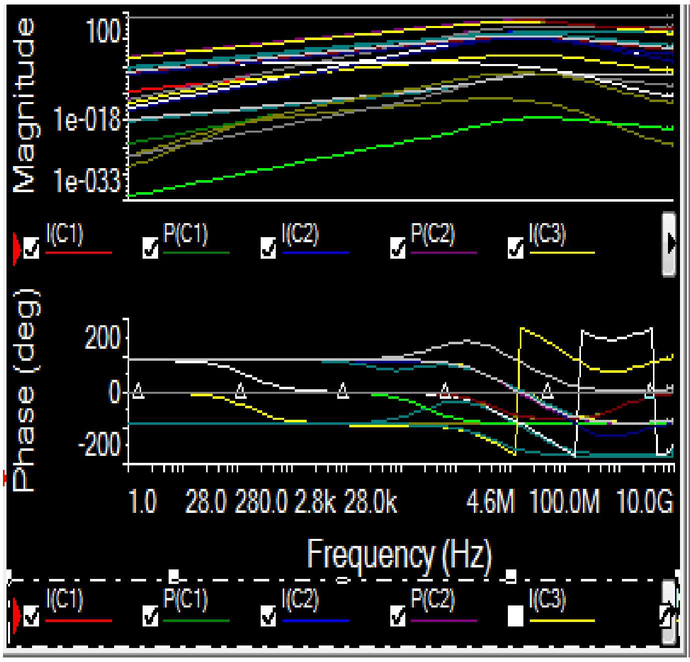


Fig. 4.3 Simulation results of control logic

During the simulation of the logic circuit it was observed that the frequency fluctuates because in the control logic the 555 timer was monostable.



	DC Operating Point	
1	V(vcc)	5.00000
2	V(42)	5.00001 n
3	V(41)	5.00000
4	V(40)	5.00000
5	V(39)	5.00000
6	V(38)	5.00000
7	V(37)	5.00000
8	V(36)	5.00000
9	V(35)	0.00000
10	V(34)	5.00000
11	V(33)	5.00000
12	V(32)	5.00000
13	V(31)	5.00000
14	V(30)	5.00000
15	V(29)	5.00000
16	V(27)	0.00000

Fig.4.4 Simulation result of display circuit

During the simulation of the display circuit, results obtained showed that the voltages at each node were constant as shown in the table above.

4.6 PROBLEMS ENCOUNTERED

Major problems encountered include the following;

a) Use of fairly used components in the absence of brand new components. Resulting to slight difference between the calculated design values and the actual or practical circuit values.

b) Difficulties in setting the infrared transmitter frequency to synchronize with the infrared receiver module TSOP1738, reception frequency.

4.7 PACKAGING AND INSTALLATION

The completed work was packaged and cased in portable containers. The remote control transmitter was separately cased in a manner to make its use handy and portable. The control panel was also packaged separately and made portable as much as possible. The installation wiring diagram is shown below.

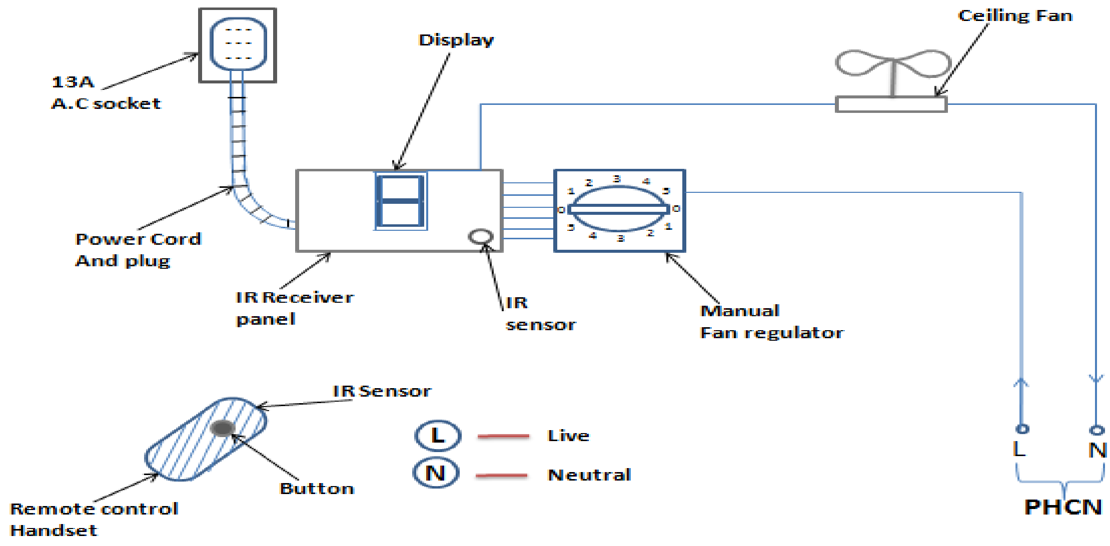


Fig. 4.5 Installation wiring diagram

4.8 COST ANALYSIS

A summary of the cost of the project work is given in table 4.1

Table 4.1: Cost of component

S/No	Components name	Unit price (N)	Quantity	Amount (N)
1	Resistors (1/4W) Resistors (2W) Variable resistor	20 30 50	30 1 1	600.00 30.00 50.00
2	Ceramic capacitors Electrolytic capacitors (Small) Electrolytic capacitors (Big)	50 30 50	5 4 2	250.00 120.00 100.00
3	Signal diodes Rectifier diodes	30 20	24 9	720.00 180.00
4	NE555 timer IC	50	2	100.00
5	CD 4017 IC	50	2	400.00
6	Transistors	50	7	350.00
7	Zener diode	30	1	30.00
8	IR LED TX	100	1	100.00
9	IR receiver module	300	1	300.00
10	LED	30	4	120.00

11	4511 IC (Decoder)	500	1	500.00
12	Seven – segment display	150	1	150,00
13	12V relay	100	5	500.00
14	AND Gate CD 4081	400	1	400.00
15	SCR (BT – 151)	1500	1	150.00
16	Switches	50	2	100.00
17	9V battery	100	1	100.00
18	500MA Transformer	350	1	350.00
19	9V regulator IC	80	1	80.00
20	Ceiling fan	3500	1	3500.00
21	Jumper wire	300		3000.00
22	Solder	300		3000.00
23	Casing	300		300.00
24	A/C power cord	200		200.00
25	Miscellaneous	2,000		2,000.00
	Total			**12,280.00**

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The design and construction of a remote controlled ceiling fan regulator was a success. It was tasking to obtain the required design and the associated concepts. However, a functional and workable design was conceived, implemented, actualized and finally constructed.

One of the primary aim and objective of an engineer is to Endeavour to deliver the best product or the most efficient services at the lowest cost to the end users. The system has been tested and was found to meet the expected results.

The aim of this project was to design and construct a remote control for a fan regulator, and the system has thus accomplished that. The remote control device sends an infrared beam, which is received by the infrared sensor on the regulator; the display on the regulator indicates a change in fan speed and the fan also increases in speed.

5.2 RECOMMENDATION

The remote controlled fan regulator was developed using infrared. This posed a lot of difficulties which actually introduced some limitations. The infrared sensor could not effectively filter out surrounding bright light. The circuit works better in darkness and fairly under bright light.

Engineers trying to improve on this work should focus on this aspect and ensure that the infrared receiver sensor filters out bright light, clearly distinguishing infrared beam from light. This will mean adding a filter section. This will concentrate and focus only the infrared rays to be incident on the infrared sensor.

The power supply could also be improved such that a step down would not be used, thereby reducing the entire size of the control panel. More so, micro soldering could be used in order to further reduce the size of the equipment.

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