DESIGN AND CONSTRUCTION OF A TEMPERATURE SENSING FAN REGULATOR WITH SPEED SETTING REMOTE CONTROL

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SEPTEMBER 2003.

DECLARATION

I hereby declare that this project is an original concept wholly carried out by me under the supervision of Engr. MUSA D. ABDULLAHI of the department of Electrical and Computer Engineering, Federal University of Technology, Minna.

.... 22/10/2003

Date

DEDICATION

This project work is dedicated to GOD the father ALMIGHTY for his infinite mercy and protection during all my life.

CERTIFICATION

This is to certify this project title "Design And Construction Of A Temperature Sensing Fan Regulator With Speed Setting Remote Control" is carried out by Akut Emmanuel Masai under the supervision of Engr. M. D. Abdullahi and submitted to Electrical and Computer Engineering Department, Federal University of Technology, Minna in partial fulfillment of the requirement for the award of Bachelor of Engineering (B. Engr.) degree in Electrical and Computer Engineering.

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ACKNOWLEDGEMENT

My greatest thanks go to God Almighty for sustaining me through the thin and thick of my educational life.

My reserved gratitude goes to my father, Mr. Lucius Akut and my mother Mrs. Magdalene Akut for their love, care and support.

I admired the patience and understanding of my brothers and sister; Fr. Basil, Florence, Pedro, Austin and Damian,

Worthy of note is the immense technical contribution of my supervisor

Engr. Musa D. Abdullahi, Msc (Eng.), FA Eng., FIEE, FNSE, who always shed light on me in the event of my project.

Greater thanks to Mrs. Felicia Obako who has been much more of a mother to me, and to her family at large who I will always love and remember, for their care and support.

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I equally remain very much grateful to my Aunt, Mrs. Victoria Ooji, who has put in much effort to see that I was healthy during my school days. I prayed that God would continue to do his good works in her.

Lastly, I acknowledge my colleagues in academic, Andrew Habila and David Nmadu for their fraternal love and support.

ABSTRACT

This project highlight the designed and construction of a Temperature Sensing Fan Regulator with Speed Setting Remote Control. During construction, the circuit was divided into two major parts

Temperature Sensing Circuit - *The technique employed was based on the* comparism of inputs voltage to a quad comparator IC. The non-inverter input of the comparator was fed through a thermistor, whose resistivity varies with change in temperature and subsequently varied the voltage. The inverter input is to be manually adjust, using a variable resistor

An NPN transistor, which was introduced, to act as a switch to the relay that is to power the next section of the circuit, is control by the output of the comparator. Once switch ON, the relay triggered and power the receiver circuit with 12V D.C..

The Transmitter - Receiver section - The transmitter designed, basically uses the astable multivibrator (555 timer) to generate pulses at a frequency of 36.7KHz, this signal is to be amplified by a circuit network consisting of transistors, capacitors and resistors so as to make the signal travel a distance of up to 10m away from the mobile handset (Remote control) transmitter

In the receivers circuit, the receiver module receive and filter the message (pulses from the transmitter), which is fed into the Counters' (4-bit) IC. The output of the counter is fed into the BCD to decimal and BCD to seven segments LED, which decoded the output of the counter. The BCD to decimal IC fed the transistor logic array, which controls the relays connecting the speed setting, the BCD to seven segments LED control the seven segments display.

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CHAPTER ONE

1.1 INTRODUCTION

In tropical Africa where there is a sharp temperature rise before the spring and in the summer, life generally seem to be difficult. Though light plane objects are used to blow off heat from the body.

The introduction of the electrical fan has brought much comfort and luxury to mankind. This is due to it's economical value and it's easy maintenance, but most of all because there is no longer human or mechanical energy required to drive the fan. The electrical energy supply to the motor rotates the rotor at a speed that is proportional to the input voltage. The rotor rotates the fan blade, which in turn blow air, with a force that is proportional to the blade's speed.

Since users have different desire at which the fan should rotate depending on the temperature rise, the fan regulator is there to give free choice of desired speed of the fan blade by regulating the input voltage, which is proportional to the speed of the blade rotation

Temperature – sensing fan regulator is a device that provide economic plus comfort and convenient in the home or working environment. It automatically switches on an electric fan as the ambient temperature exceeds any limit you select and then off again as the temperature fall below this limit.

To increase its comfortability, the introduction of a remote control into the system will allow you to lie on your bed or sit and select the speed level you desired

This is great for use, to switch on your attic fan to vent hot, trapped air that causes your home or shop to be warmer than it has to be during heat season, then off when the weather gets cold.

Its other practical applications include its use to control a stove exhaust fan, a soda - fountain - type overhead fan or a greenhouse ventilation fan.

1.2 LITRETURE REVIEW

In this project, the regulator is to be technically improved using the LM339 quad comparator circuit, which will compare the voltage input. The first input varies with temperature change and the other is fixed base on the setting made. The output of this circuit will switch a biased transistor, which will trigger the relay that switches the receiver's circuit ON via a power regulator.

Also the speed setting remote control consists of a transmitter receiver circuit, which transmits an infrared pulse modulated wave (PMW). The speed level will also be display for you, using a 7-segment LED. This is made possible by using an arrangement of IC's circuit that will receive pulses from the receiver's module and convert it to speed level and produce the level on LED.

This IC's include the 74LS93, a 4 bit binary ripple counter that will determine the number of pulses in binary form and send it to the 4028.

The 4028 IC is a BCD to decimal decoder (4-10 lines), this will decode the binary message from the 74LS93 and convert it to decimal and then pass the information to CA3046 through a resistor to optimize the level of current flowing to the Transistor Logic Array

The CA3046 is a transistor logic array which will trigger the relay that correspond to the message been receive from the 4028.

The 74LS47 is a BCD to seven-segment decoder. It also decode signal from the 74LS93 and send it to the LED via a resistor in order to reduce the current to minimum level.

The Transmitter circuit is control by the 555 TIMER IC in an astable mode. The circuit is to be power by a 9V dry cell. It will use an infrared LED to send signal at a frequency as high as 36.77KHz

CHAPTER TWO

DETAIL OF COMPONENTS

2.1. POWER SECTION

2.1.1. TRANSFORMER

A transformer changes (transforms) an alternating voltage from one value to another. It consist of two coils, called the primary and secondary windings, which are not connected electrically, the winding are either one on top of the other or are side by side on an iron, iron-dust or air core.

In this work, a 240V/12V center tap, step down transformer is used. The figure is as shown below.

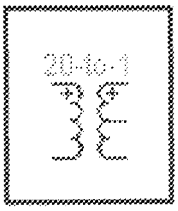


Fig 2.1.1 Transformer

2.1.2 RECTIFIER

In most power supply unit a transformer step down the a.c. main from 240V to the required low voltage. This is then converted to d.c. Using one or more junction diodes as a rectifier circuit. A simple full wave rectifier circuit is shown below.

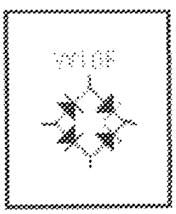


Fig.2.1.2. Full wave rectifier

2.1.3 CAPACITOR

A capacitor stores electric charge. It does not allow direct current to flow through it. In its simplest form it consist of two parallel metal plates separated by an insulator called the dielectric. In this thesis it is used in the power section to smooth the rectifier wave output to a level more suitable for the components.

2.1.4. REGULATOR

This is an integrated circuit chip built with the capability of clipping a voltage level so as to enable a constant and regulated output voltage. The commonly used are the 78-series; 7805,7810,7812,7815 e.t.c. Others include the LM-series. In this project the AN 7812 was used to regulate the sensing circuit and the AN 7805 was used to regulate the receiver circuit.

2.1.5. TRANSISTOR

Transistors are the most important devices in electronics today. Not only are they made as discrete components but also integrated circuit (ICs) may contain several thousands on a tiny slice of silicon.

They are three terminal devices, used as amplifier and switches. Non-amplifying components such as resistor, capacitors, inductors, and diodes are said to be passive; transistor are active components. The same identification code is use as for diode, but in the American system, transistors always start with 2N followed by a number, e.g. 2N2222.

Arrangement of two transistors as shown in fig.2.15, is used in this project to double up current in the power section. This type of arrangement is called the Darlington pair.

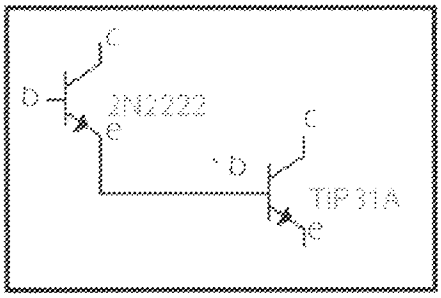


Fig.2.1.5. Darlington pair

2.1.6. THE DIODE

A semiconductor or junction diode consist of a p-type and n-type material formed in the same piece of silicon or germanium. The p-type forms the anode while the n-type forms the cathode. When the anode is made positive with respect to the cathode, the junction will have very little resistance, it is said to be forward bias. On the other hand, if the cathode is made positive with respect to the anode, the junction resistance becomes high and no current flows. This is called the reverse bias. Small voltage is usually required to forward bias the junction before a current flows. This is approximately 0.6V for silicon and 0.2V for germanium. The reverse bias potential of silicon is about 1200V and for germanium 300V. The diode breaks down in the reverse bias voltage is exceeded or if the current rating is exceeded.

In this project, the ordinary diode and the light emitting (infrared emitter) diode were used.

2.2 TEMPRATURE SENSING CIRCUIT

2.2.1 ZENER DIODE

In an ordinary junction diode if the reverse bias is increase until the depletion layer breaks down, the diode suffers permanent damage. A Zener diode is made to be used in breakdown region so long as resistors limit the current. It looks like a rectifier diode, the cathode often being marked by a band. Its symbol is given in fig 2.2.1

To limit the reverse current at breakdown and prevent overheating, the power rating of the diode should not be exceeded. For example, a 500mW (0.5W) zener diode with a breakdown voltage of 5.1V can pass a maximum

Current I_{max} given by:

$$I_{max} = \frac{Power}{Voltage} \text{ (Since power = voltage X current)}$$

$$= \frac{0.5W}{5.1V} = 0.1A = 100mA$$

If the diode is being used, for example, to supply a constant voltage of 5.1V from a 12V dry battery (whose voltage falls with use), the maximum voltage V to be dropped across R is (12 to 5.1)=6.9v The value of R is therefore given by.

$$R = \frac{V}{I_{max}} = \frac{6.9V}{0.1A} = 69\Omega$$

A simple schematic diagram is as shown below.

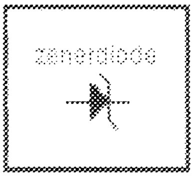


Fig.2.2.1 zener diode

2.2.2 THERMISTOR

A thermistor or thermal resistor is a semiconductor transducer whose resistance changes markedly when its temperature changes. In this project the disc shape thermistor type is used.

The resistance of most Thermistors decreases as their temperature increases. These are called the negative temperature coefficient (n.t.c) types and are made from oxides of nickel, manganese, copper, cobalt and other materials. They are used for temperature control and measurement and are heated either externally from the surroundings or internally by the current flowing through them. Resistance changes cause current or voltage changes, which supply the input to the electronic system where they are processed.

With Thermistors positive temperature coefficient (p.t.c) the resistance increase as the temperature increases. They are base on barium titanate and are used mainly to prevent damage in circuit that might experience a large temperature rise. This could happen, for example, to a much-overloaded electric motor.

2.2.3 OPERATIONAL AMPLIFIER AS A VOLTAGE COMPARATOR

The Operational amplifier has one output and two inputs. The non-inverting input is marked (+) and the inverting input is marked (-) as shown in fig.2.2.3

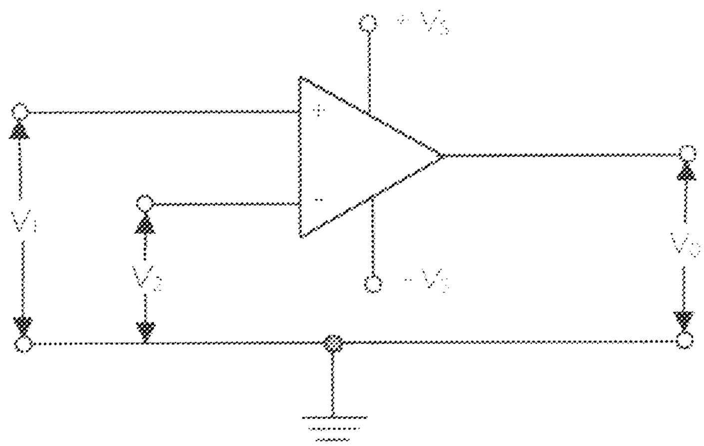


Fig.2.2.3 Comparator

Operation is most convenient from a dual balance d.c power supply giving equal positive and negative voltages $\pm V_s$ in the range $\pm 5V$ to $\pm 15V$. If the voltage V_2 applied to the non-inverting (+) input is positive relative to the other input, the output voltage V_0 is positive, similarly if V_2 is negative V_0 is negative i.e. V_2 and V_0 are in phase.

At the inverting input (-), a positive voltage V_1 relative to the other input causes a negative output voltage V_0 and vice versa, therefore V_1, and V_0 are in antiphase.

If both inputs of an operational amplifier are used simultaneously, the output voltage will be giving by the equation

$$V_0 = A_0 \times (V_2 - V_1)$$

Where V_1 is the negative input (inverting)

V_2 is the positive input (non-inverting)

A_0 is the open loop gain.

The voltage difference between the inputs terminals i.e. (V_2-V_1) is amplified and appear at the output. However A_0 is so large that if (V_2-V_1) exceeds about 100µV, the operational amplified saturates.

If $V_2 > V_1$, V_0 rises to a steady value close to the positive supply voltage $+V_s$, when $V_1 > V_2$, V_0 falls to near $-V_s$. The operational amplifier is then behaving as a two state, digital device with V_0 switching from 'high' to 'low'.

In this thesis, it is used as a comparator to compare voltages.

2.2.4 RELAYS

A relay is a switch worked by an electromagnet. It is useful if we want a small current in one circuit to control another circuit containing a device such as a lamp or electric motor which requires a large current, or if we wish several different switch contacts to be operated simultaneously.

When the controlling current flows through the coil, the soft iron core is magnetized and attracts the L-shaped soft iron armature. This rock on its pivot and opens closes or changes over, the electrical contacts in the circuit being controlled-in fig.2.2.4. It closes the contacts

The current needed to operate a relay is called the pull-in current and the dropout current is the current in the coil when the relay just stops working. If the coil resistance of a relay is R, and its operating voltage V_s, the pull - in current I is giving by:

$$I = \frac{V}{R}$$

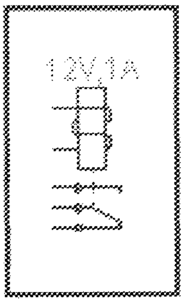


Fig.2.2.4 Relay

2.3 RECEIVER CIRCUIT

2.3.1 PHOTODIODE

It consists of a normal p-n junction in a case with a transparent window through which light can enter. A photodiode is operated in reverse bias and the leakage current increases in proportion to the amount of light falling on the junction. This effect is due to the light energy breaking bonds in the crystal lattice of the semiconductor and producing electrons and holes.

Photodiode are used as fast counters or to read holes in punched tapes and cards when they generate a pulse of current every time a beam of light is interrupted. In this thesis they are used to receive signal from the LED in the transmitter circuit.

2.3.2A COUNTERS

Counters are widely used in electronic systems to determine, for example, the number of object passing on a conveyor belt or the number of operations performed in a digital computer. They consist of flip-flops (master-slave) connected so that they toggle when pulses to be counted are applied to the clock input. Counting is done in binary code, the 'high' and 'low' states represent the bits 1 and 0 respectively. There are two main types of counter, ripple and synchronous.

2.3 2B FOUR- BIT BINARY COUNTER ICS.

The low power schottky TTL 74LS93 is a ripple counter, triggered on the falling edge of a clock pulse. FF_0 is a separate flip flop with its own clock input CK_0 and output Q_0, it is a modulo-2, divide-by-2 counter FF_1, FF_2 and FF_3 form a divide-by-8, modulo-8 counter with clock input CK_1 and three output Q_1, Q_2 and Q_3 (m. s.b). The lines above the clock input indicates that the IC is falling edge triggered.

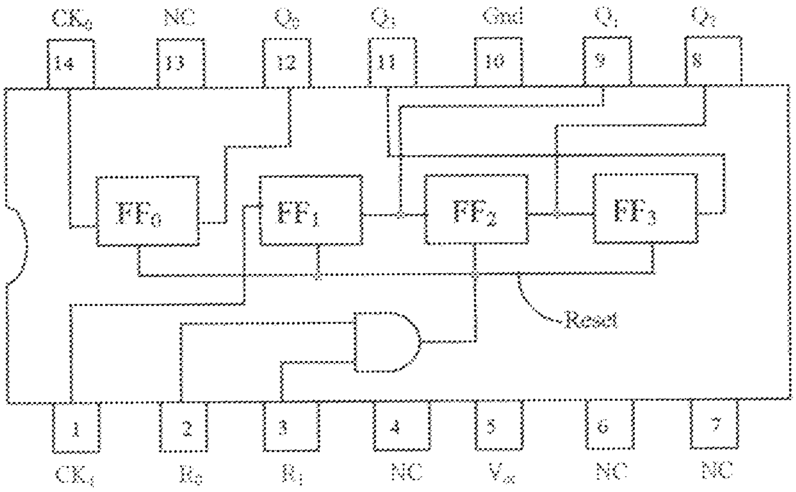


Fig.2.3.2 (a) 4-bit ripple counter

Modulo	Outputs				R_0 To	R_1 To
	Q_3	Q_2	Q_1	Q_0		
3	0	0	1	1	Q_0	Q_1
5	0	1	0	1	Q_0	Q_2
10	1	0	1	0	Q_1	Q_3

Fig.2.3.2 (b) Modulo table

Both counters can be used as a four-bit, modulo 16 counter if Q_0 is joined to CK_1 and clock pulses are entered at CK_0, at least one of the reset input R_0 and R_1 being 'low'. Resetting to zero occurs when both R_0 and R_1 are 'high'. Other modulo counters are obtained if R_0 and R_1 are connected to different outputs, as shown in the table of fig. 2.3.2(b). For example, linking R_0 to Q_0 and R_1 to Q_2 gives a modulo-5 counter since, when the count is 0101 (decimal 5), Q_3=0, Q_2 =1, Q_1 =0 and Q_0=1 and the output from the AND gate in the IC (fed by R_0 and R_1) goes 'high', so resetting the counter to zero.

2.3.3 BCD TO DECIMAL DECODER

The 4028 IC is a BCD to decimal or binary – to – octal decoder. It consists of four inputs, decoding logic gates and 10 outputs buffered. A BCD code applied to the four inputs A, B, C and D results in a high level at the selected 1 – 10 decimal decoded outputs. Simple, a 3 – bit binary code A, B and C is decoded in octal at outputs 0 – 7. A high level signal at the D input inhibits octal decoding and courses outputs 0 – 7 to go low. All inputs are protected against static discharge damage by diode damps to V_{CC} and V_{SS}.

The 4028 IC has a supply voltage range of 3V to 15V, noise immunity of 0.45 V_{CC} and good TTL compatibility power, with fan – out of 2 driving 74L or 1 driving 74LS. The 4028 decoder IC pin – out are as illustrated below.

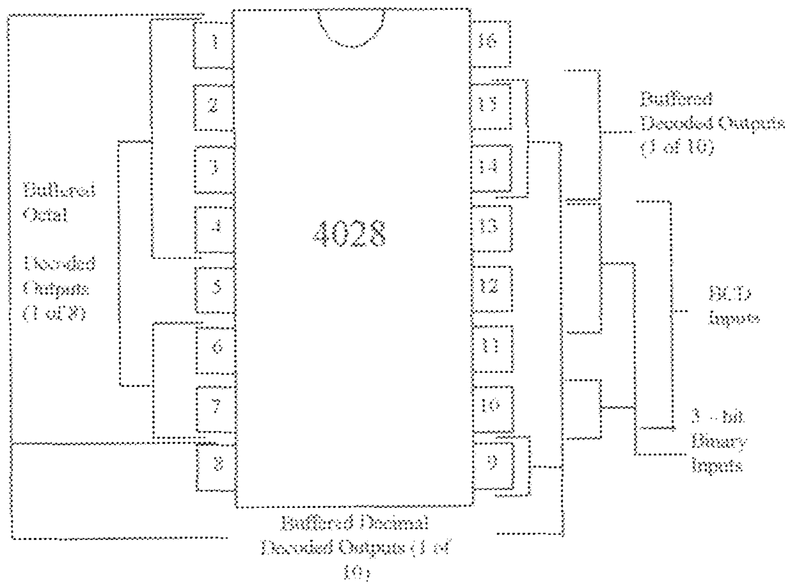
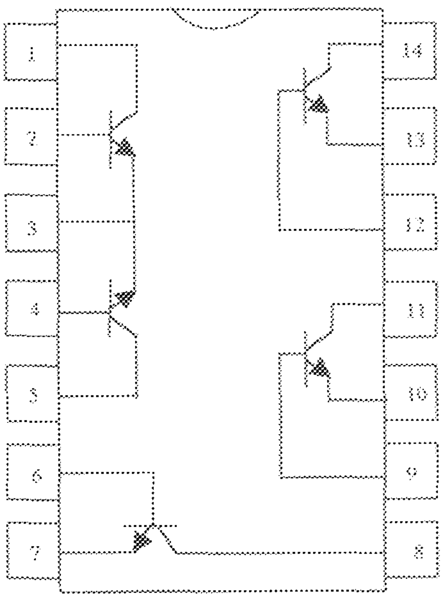


Fig. 2.3.3 BCD *to decimal decoder*

2.3.4 TRANSISTOR LOGIC ARRAY

The CA3046 consist of five silicon NPN transistors on a common monolithic substrate in a 14-lead dual-in-line plastic package. Two transistors are internally connected to form a differential amp. The transistors of the CA3046 are well suited to low noise general purposes and to a wide variety of applications in low power system in the DC through VHF range. They may be use, as discrete components in conventional circuit, in addition provide the very significant inherent integrated circuit advantages of close electrical and thermal matching.



Rating

$V_{CEO} = 15V$

$V_{CBO} = 20V$

$V^{CIO} = 20V$

$V_{EBO} = 5V$

$I_C = 500mA$

Total power dissipation

$T_A = 55^oC$ 300mW

Fig 2.3.4 Transistor Logic Array

2.3.5 BCD TO 7 – SEGMENT DECODER

The 74LS47 is a 7 – segment decoder which accepts 4-bit BCD code as input and produce the appropriate outputs for selection of seven segments in a 7- segment matrix display use for representing the decimal number 0 – 9. the outputs (a, b, c, d, e, f and g) of the decoder selects the corresponding segment in the matrix as shown below.

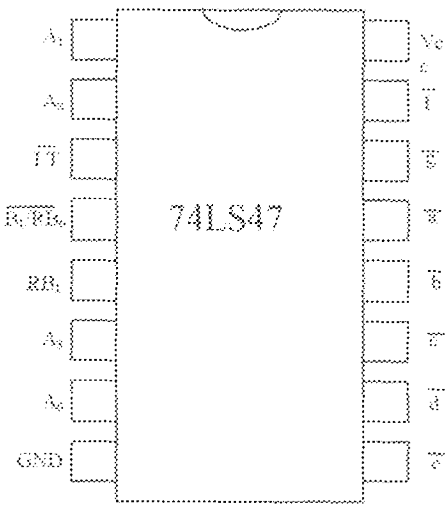


Fig. 2.3.5 BCD *to 7-segment decoder*

2.3.6 SEVEN SEGMENTS DIGITAL DISPLAY

This is an IC unit consisting of seven rectangular LEDS. Each LED is called a segment because it forms part of the character being displayed. It is capable of displaying digit from 0 to 9 and capital letters A, C, E and F plus lower case letter b, d. they are classified as other common Anode or common Cathode. See figure below for the 7-segment display types.

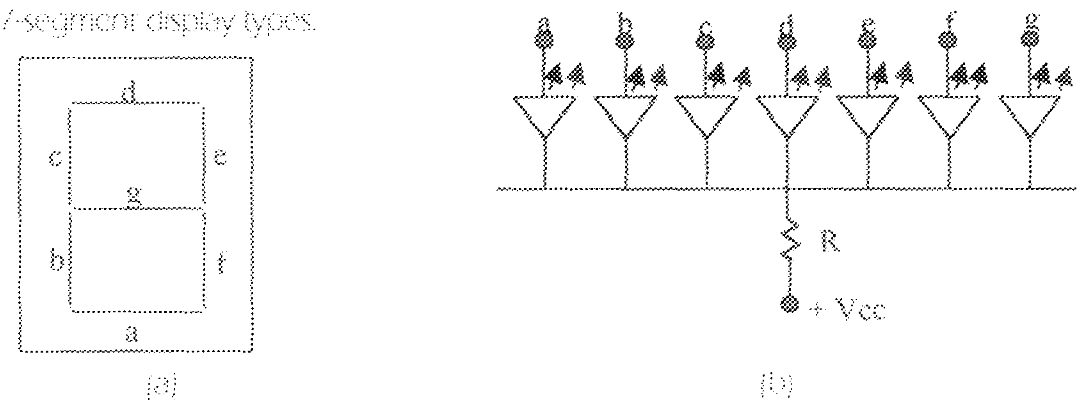


Fig. 2.3.6. Seven segment display. (a) Internal structure. (b) Display IC unit.

2.4 TRANSMITTER CIRCUIT

2.4.1 THE 555 TIMER IC

The 555 timer is a popular analogue-digital integrated circuit. It's simplicity in conjunction with it's ability to produce long time delays in a variety of applications has made the 555 timer easier to apply in modern electronics, instead of mechanical timer, op-amps and various discrete circuits.

The timer's success can be attribute to several inherent characteristics foremost for which are versatility, stability and low cost.

The block diagram is as shown below.

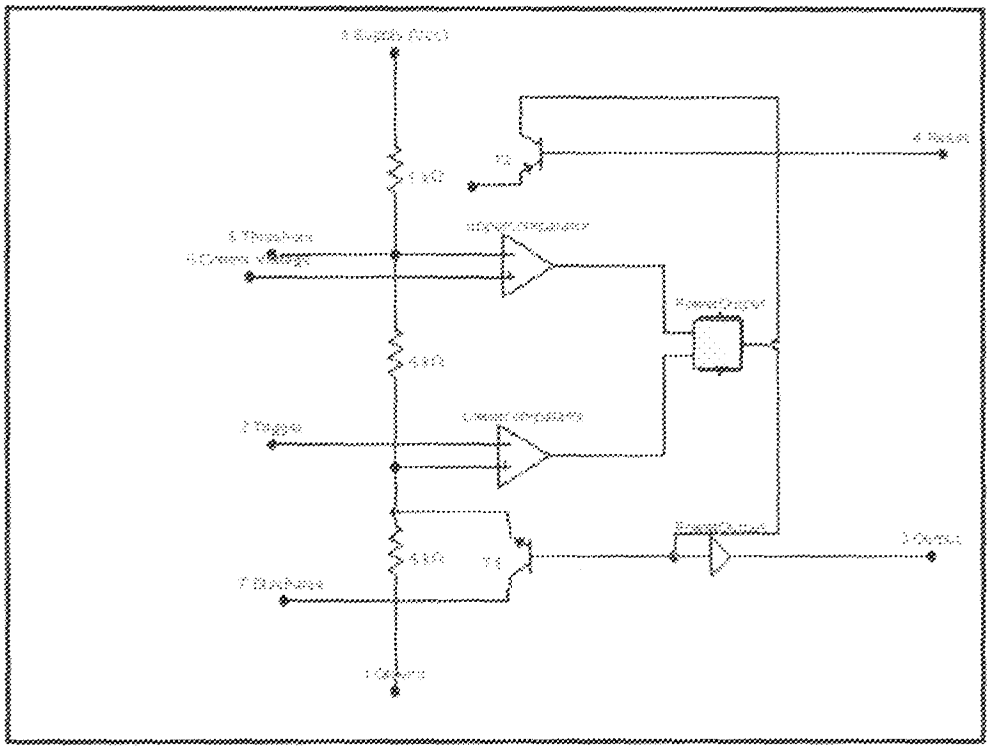


Fig.2.4.1A. The block diagram of a 555 Timer

The 555 IC consist mainly of (2) voltage comparators, a bistable flip-flop, a discharge transistor and a resistor divider network, all in built.

The Resistor – Divider Network is used to set the comparator levels and the three (3) resistors are of equal value (5K).

The Threshold Comparator is referenced internally at ⅔ of supply voltage (Vcc) while the trigger Comparator is referenced at ⅓ of the supply voltage. The outputs of the comparator are tied to the bistable flip-flop.

When the trigger voltage is move below ⅓ of the supply, the comparator changes state and set the flip-flop driving the output to a high state. The threshold pin normally monitors capacitor voltage of the RC network. When the capacitor exceeds ⅔ of the supply, threshold comparator resets the flip-flop, which in turn drives the output to a low state.

When the output is in a low state the discharge transistor is 'ON' thereby discharging the external timing capacitor. Once the capacitor is discharged, the timer will await another trigger pulse. This signifies the end of a complete cycle.

Some of the more attractive features of the 555 timers are, the supply voltage is between 4.5 and 18 volts, supply current up to 3mA, and Rise/Fall time is 100 nano seconds.

The timer comes in two packages, either the round metal case type called the T- Package or the most familiar 8-pin type called the V-Package. The 556 are a dual 555 timer, in a 14 pin dual in line (DIL) package. The 558, which are a quad version of the 555 timers, also of 14 pin DIL are available. For the benefit of this project, the 8 pin V-package was used.

The 555 timer IC pin-out is as shown below

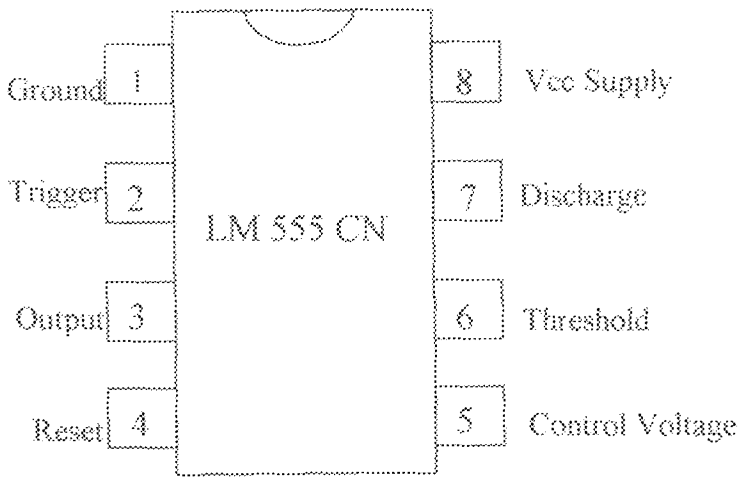


Fig.2.4.1B. The 555 Timer IC package

The 555 timer is used for a variety of applications including: -

- Precision Timing
- Time delay generator
- Sequential timing
- Linear ramp generator
- Pulse generator
- Pulse width modulation
- Pulse position modulation

The timer lends itself to three basic operation modes: -

- ✓ Mono stable (One short)
- ✓ Astable (Oscillator)
- ✓ Time delay

The Astable Multivibrator: - this has only one stable state. It can be made to change to it other state by the application of suitable triggering pulse but it then return to it stable state after a time interval determined by the circuit RC values.

The stable multivibrator - this has two states, which are momentarily stable. This circuit switches between these two states.

Time delay: - the RC circuit determines the values of the time delay.

2.4.2 BATTERIES

A battery consists of two or more cells connected together to produce a higher voltage or more electrical energy. Sometimes the term is used for a single cell. Batteries fall into two main groups, the primary and the secondary cell. In this project a 9V primary cell is used to power the transmitter circuit.

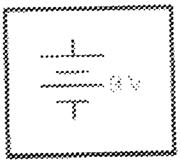


Fig.2.4.2 A 9V Battery

CHAPTER THREE

DESIGN ANALYSIS AND WORKING PRINCIPLE

3.1 POWER CIRCUIT

Most of the electric components, especially the ICs, required to be powered from a dc supply before they can perform the function they are designed to. This can either be directly supplied from battery or from main (240V) ac. Since the temperature sensing circuit need 12V to power it, there is need to design a power section that will supply a constant and filtered power with a slightly higher current to power the circuit and to drive the relay switch.

The block and circuit diagram is shown in figure 3.1.1 and 3.1.2 respectively.

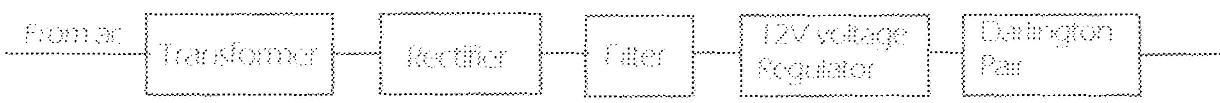


Figure 3.1.1 Block diagram of Power Section

To achieve this, a 240V/12V transformer was used to step down the ac voltage to 12V ac. The output of the 12V transformer was rectified using W10F chip. To get a smooth filter voltage, two capacitors were connected in parallel, capacitor C_1 with high value 2000µF is to smooth the wave and C_2 to further smooth it. The voltage acquired at this stage is slightly higher than the required 12V as shown in the calculation below

Transformer output = 12V

Peak-Peak voltage = $12 \times \sqrt{2} = 16.97V$

Peak full wave rectifier voltage at the filter point

$V_p = 16.97V - 2 \times 0.7V = 15.57V$

$$V_{dc} = \frac{V_p}{1 \quad \frac{1}{4FCR}}$$

$$= \frac{15.57V}{1 \quad \frac{1}{4 \times 60 \times 2000.22 \times 10^{6} \times 82}}$$

$= 15.18V$

Where $C = C_1 + C_2$

R = Regulator's resistance

This voltage is regulated by the 7812 to give a steady 12V. The output of the regulator is connected to a Darlington pair in order to double the current; the TIP-31A low frequency transistor with heat sink is used to dissipate the heat that might be generated by the pair. The current obtained is as calculated below

Current gain by 2N2222 = hFE_1

Current gain by TIP-31 = hFE_2

Overall current gain $hFE = hFE_1 \times hFE_2$ (typically 10^3).

The high gain means that only a tiny input current is needed to obtain a certain output current.

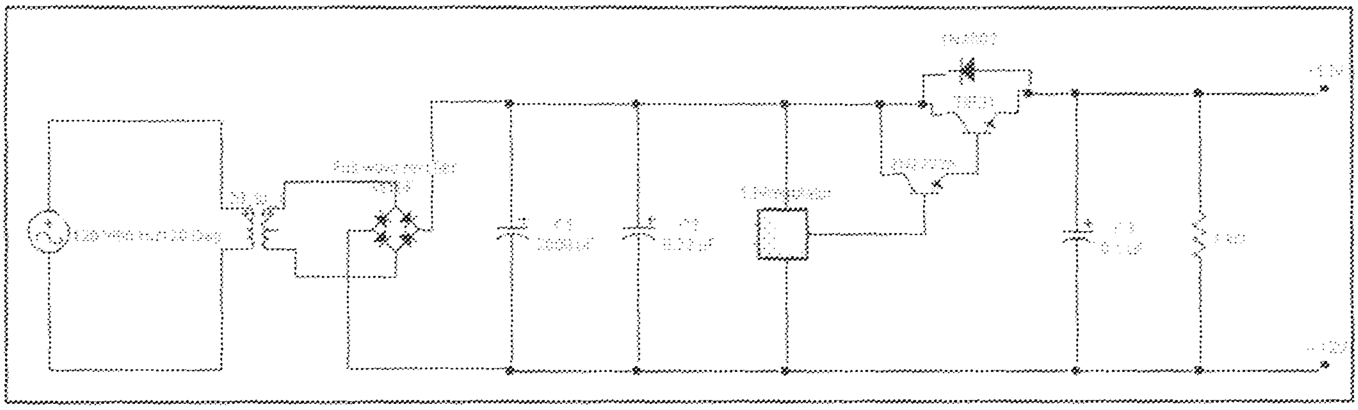


Fig.3.1.2 Circuit diagram of Power Section

3.2 Temperature sensing circuit

The temperature sensing circuit was designed to compared the +ve voltage input of a comparator which varies with temperature (this is cause by the thermistor), and the constant –ve voltage input which depend on the settings made, using the variable resistor.

The block diagram is shown in figure 3.2.1 below

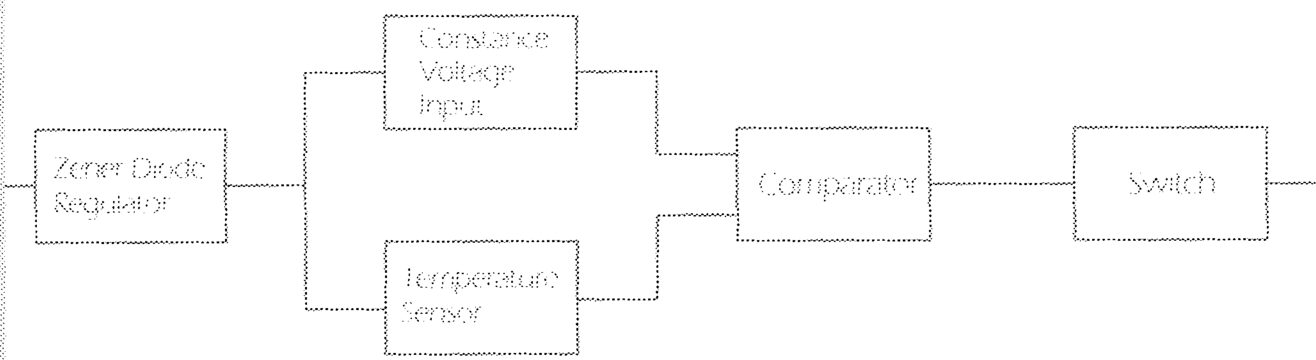


Fig 3.2.1 diagram of sensing circuit

The 12V output of the power section feed the sensing circuit. A zener diode of 5.1V is used to regulate the voltage that goes into the inputs of the comparator. At the temperature sensor two resistors were connected in parallel to check excess current that will go into the input of the comparator and to also reduce the voltage drop by the thermistor, since they are connected in series with the thermistor.

The –ve input of the comparator is control by the temperature limit adjust, which varies from 0Ω to 50KΩ.

Suppose at room temperature when the thermistor resistance is reading 320Ω at about 26°C. The calculation below shows the position the adjustment pointer should be, in order to switch ON or OFF at room temperature.

$$R_{2,3} = \frac{R_1 R_2}{R_2 + R_3}$$

$$= \frac{220 \times 10{,}000}{220 + 10{,}000}$$

$$= 215.3\Omega$$

$$\therefore V_{2,3} = \frac{R_{2,3}}{R_1 + R_{2,3}} . V$$

$$= \frac{215.3}{320 + 215.3} \times 5.1$$

$$= 2.05V$$

This is the voltage going into the +ve input of the comparator, to have equal voltage going into the - ve input, assuming the variable resistor is divided into two as shown below.

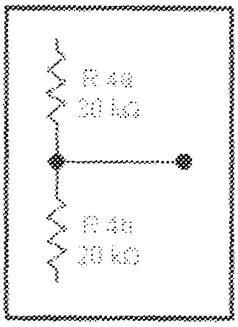


Fig.3.2.2

$$V_{4b} = \frac{R_{4b}}{R_{4a} + R_{4b}} . V$$

$$2.05V = \frac{R_{4b}}{R_{4a} + R_{4b}} \times 5.1V$$

$$0.4 = \frac{R_{4b}}{50{,}000} \qquad \text{Since } R_{4a} + R_{4b} = 50{,}000\Omega$$

$$R_{4b} = 0.4 \times 50{,}000$$

$$= 20.1K\Omega$$

Therefore for the circuit to trigger at 260C, the variable resistor should point at 20.1kΩ. Temperature marking has been made on the variable resistor. The comparator's output is fed back through the positive input so that differential output will be large enough to switch ON the transistor. This transistor will then trigger on a relay that supply 12V output to the receiver's circuit.

When the current in the coil of a relay falls to zero, a large voltage is induced in the coil due to its inductance, this voltage can damage any transistor used to control the current in the coil. To check this problem, a diode 1N4002 was connected in reverse bias so as to offer an easy path to the induced voltage and stop it from building up to a high value.

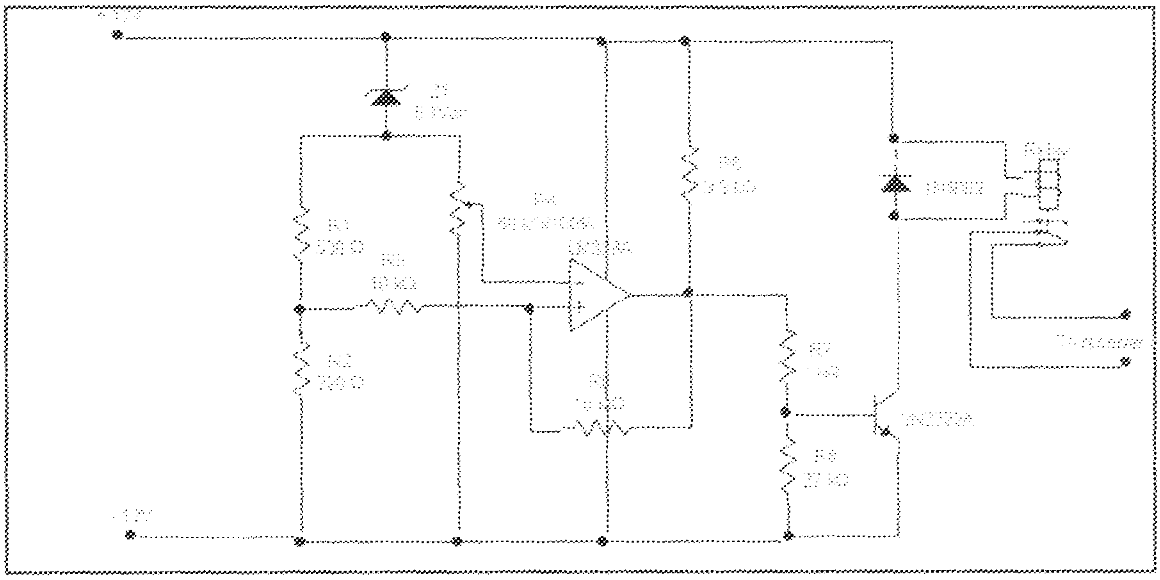


Fig.3.2.3 Diagram of sensing circuit

3.3 RECEIVER CIRCUIT (INFRA-RED CONTROLLED CEILING FAN REGULATOR).

The 12V dc output of the sensing circuit relay is fed into a 7805 5V regulator to power the receiver circuit.

The infrared diode in the receiver circuit receives the pulses from the transmitter circuit which is then filter through a combination of capacitors in the receiver module. The filtered pulse is then send to the four bits binary counter (see fig 2.3.2) through the clock input pin 14.

The four flip flop outputs are send to the 4028 BCD to decimal decoder and the 74LS47 BCD to seven segment decoder (see fig 2.3.3 and fig 2.3.5 respectively)

The buffered decimal decoder output of the 4028 is fed into the base of the transistor in the CA3046 transistors logic array (see fig.2 3.4). The emitter's output pins are connected to diode D_0 to D_4 and then joint with the collectors pin-out to avoid bi-directional flow of power. These combinations are then connected to relays R_0-R_4 as shown in fig. 3.3.3.

The out puts of the 74LS47 are connected to the 7 segment LED inputs via a series of 470k ohms resistor so as to reduce voltage to minimal level.

The connection of the relay switches from the CA3046 to the changing tap transformer and the transformer connecting terminals circuit are shown below:

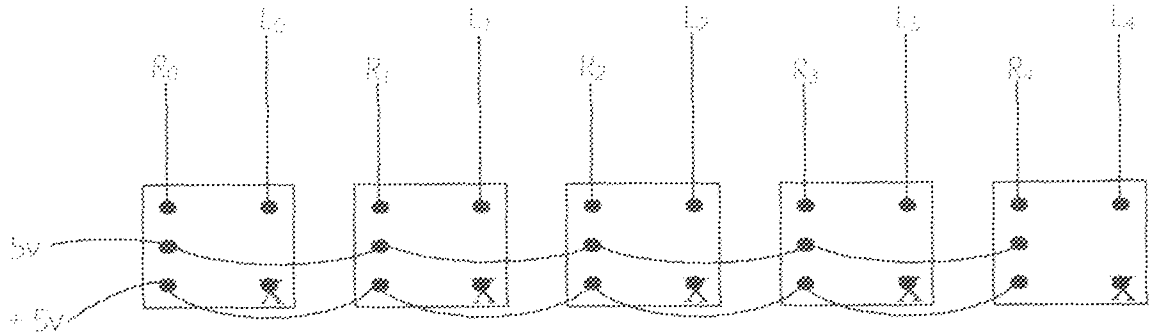


Fig. 3.3.1 the relays connecting terminals

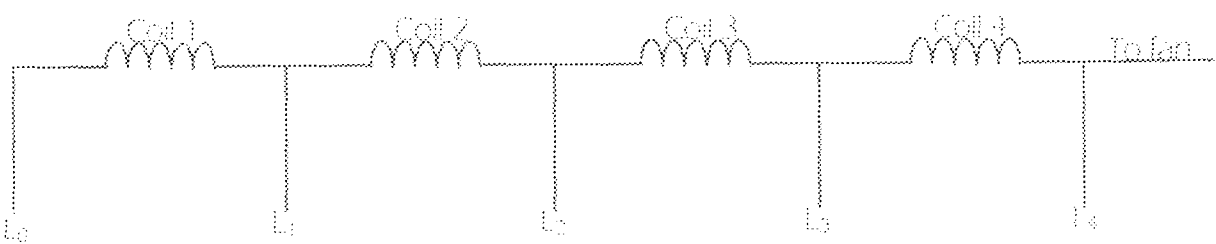


Fig. 3.3.2 A simplified tap changing transformer showing connecting terminals.

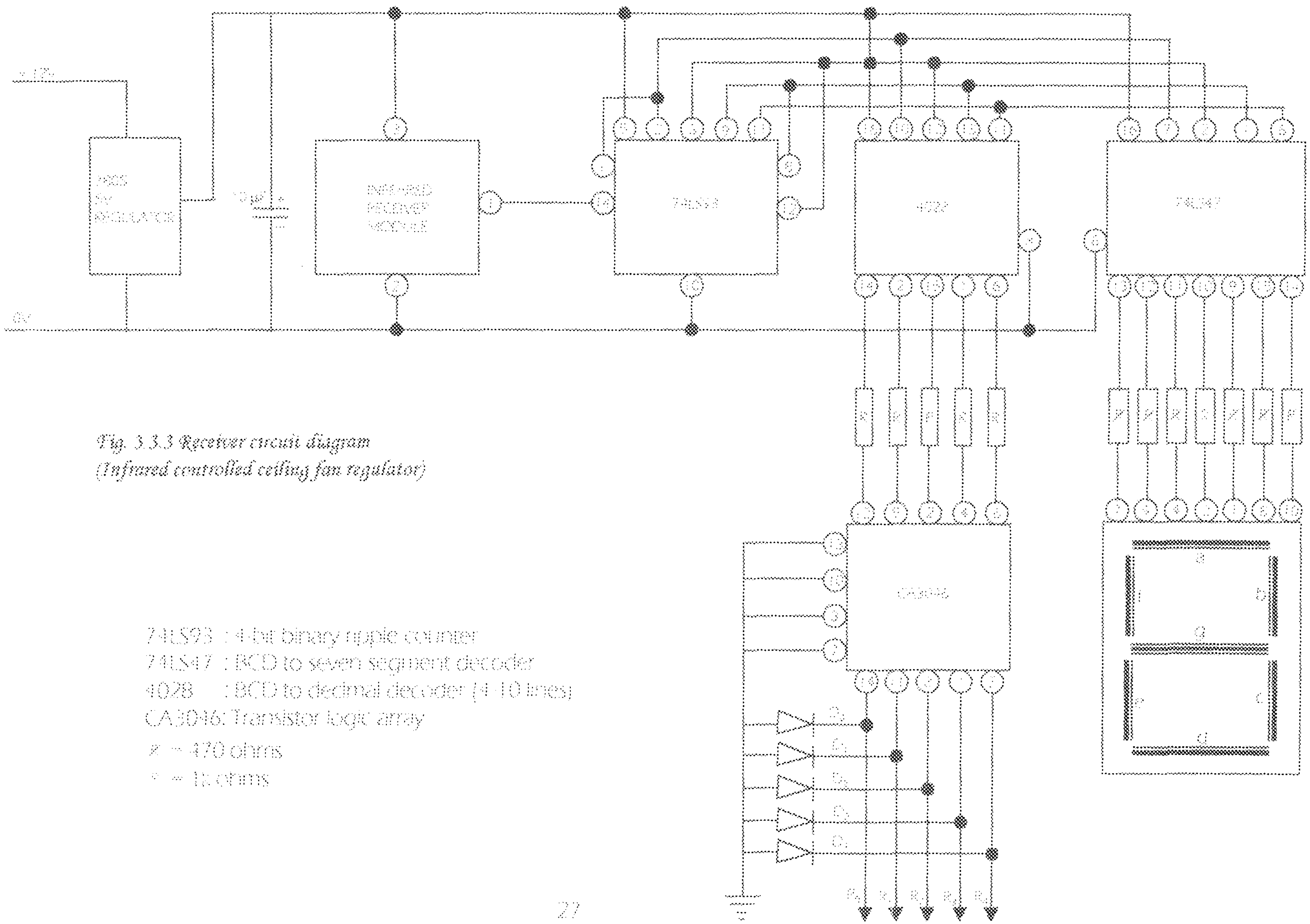


Fig. 3.3.3 Receiver circuit diagram
(Infrared controlled ceiling fan regulator)

74LS93 : 4-bit binary ripple counter
74LS47 : BCD to seven segment decoder
4028 : BCD to decimal decoder (4-10 lines)
CA3046: Transistor logic array
R = 470 ohms
r = 1k ohms

3.4 TRANSMITTER CIRCUIT

The pulse massage generated by the transmitter through which the user passes instructions in coded form to the system. The transmitter section is a mobile handset, it derived its power from a low power battery 9 volts battery source. The message sends in the form of an analogue (continuous) signal on which switching operation is performed in form of a command

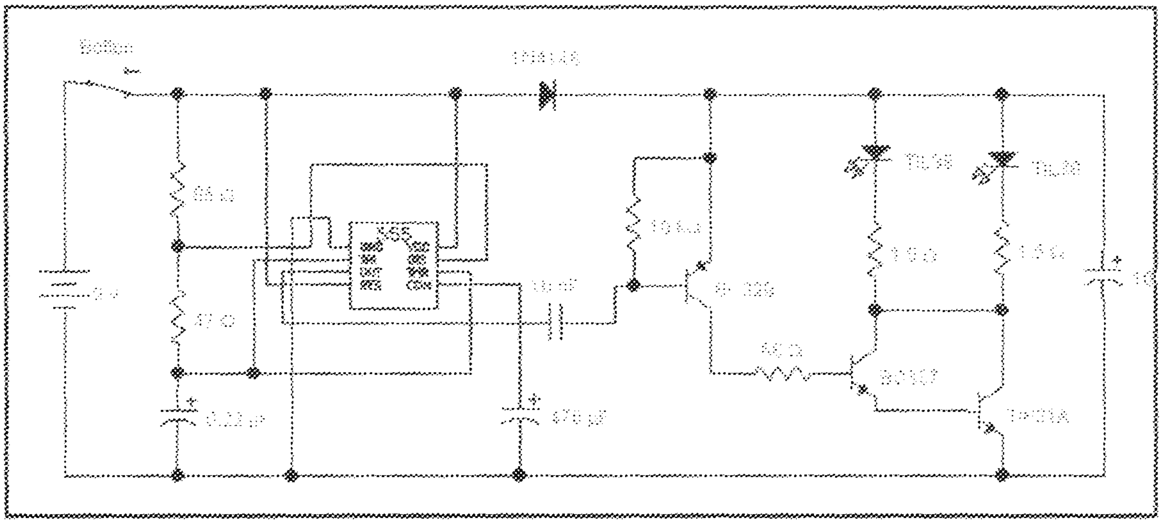


Fig. 3.4.1 Transmitter circuit

The 555 timer IC use in this thesis (as been describe in section 2.1) uses various resistors and capacitors with a transmitter as been attached to the compartment to increase it's performance. The transmitter circuit is configured to generate a frequency range of 35 – 40KHz (maximum frequency range of infra-red light)

The transmitter designed uses the 555 timer in the astable mode (see fig. 2.4.1). The output is couple to a circuit consisting of transistors, capacitor and resistors to limit interactions between timer input and output of the infra-red emitter and also to filtered white light. Bearing the operation of the 555 timer in mind, the computation of the time intervals between when the output is high and low is determined as follows:

$T_{(high)} = 0.694\ (R_1 + R_2)\ C_1$

$T_{(low)} = 0.694\ (R_2 C_1)$

The total period $T = T_{(high)} + T_{(low)} = 0.693\ (R_1 + 2R_2)\ C_1$

The frequency of a stable circuit is giving by.

$$F = 1/T = \frac{1.44}{(R_1 + 2R_2)C_1}$$

Duty cycle (D), which is the ratio between when high and low, is given by:

$$F = 1/T = \frac{1.44}{(R_1 + 2R_2)C_1}$$

For the circuit employed in this project:

$R_1 = 85\Omega$ and $R_2 = 47\Omega$; $C_1 = 0.22\mu F$

Therefore,

$T_{(high)} = 0.694\ (85 + 47) \times 0.22 \times 10^{-6}$

$= 20.15 \times 10^{-6}$ secs

$T_{(low)} = 0.694 \times 17 \times 0.22 \times 10^{-6}$

$= 7.18 \times 10^{-6}$ secs

$T = T_{(high)} + T_{(low)} = 27.33 \times 10^{-6}$

$F = 1/T = 36.6KHz$

$$D = \frac{R_2}{(R_1 + 2R_2)} \times 100\%$$

$$= \frac{47}{85 + 2 \times 47} \times 100\%$$

$= 26.3\%$

CHAPTER FOUR

4.1 DISCUSSION OF RESULT

The target goal of this project work is to design a regulator that is portable in size. The receiver – transmitter maximum distance should at least be of considerable length of about 10m, but up to 80% of this distance has been sensed by the receiver – transmitter circuit that is considerable okay.

The temperature sensing circuit that has perfectly work after the construction and testing of the circuit as prove that the design goal of this thesis has been achieved.

4.2 CONCLUSION

One of the primary objectives of an engineer is to endeavor to deliver the best product or the must efficient service at the lowest cost to it's consuming public.

The aim of this project is to design and construct a Temperature Sensing Fan Regulator With Speed Setting Remote Control. This has been achieved after solving problems encountered during the designing, construction and connecting stages, the system was tested and found to meet the expected results considering all the experimental error.

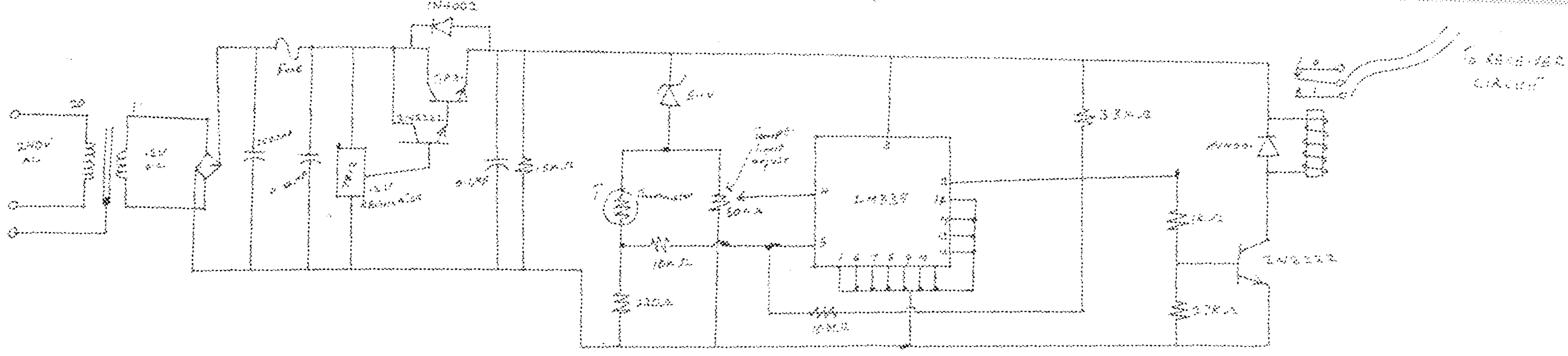
This project work can be use to set the ambient temperature limit that will switch the fan ON or OFF and the user can stand a distance of eight to ten meter (maximum) to control the speed setting when ever the receiver circuit has been power ON by the sensing circuit. It is therefore confirmed that a reliable and maintainable unit for regulating fan can be constructed using readily available components.

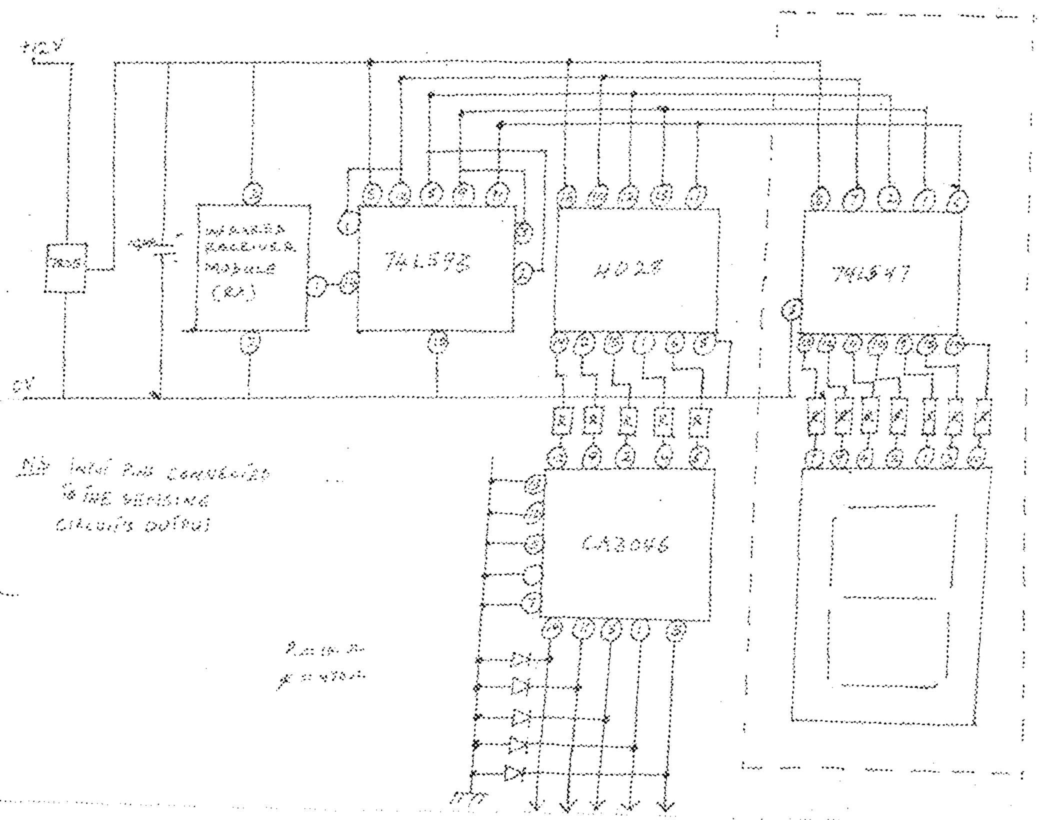
4.3 RECOMMENDATIONS

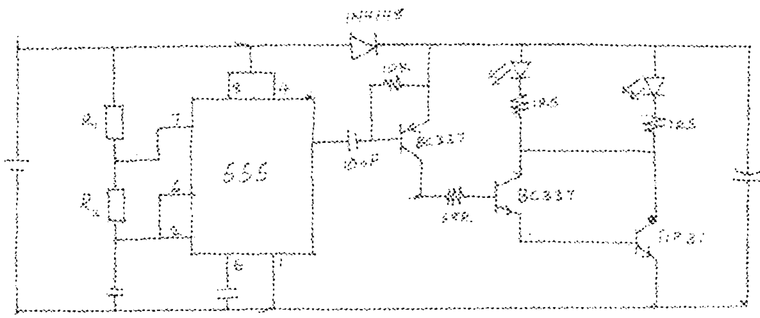
There is always room for improvement. It is therefore recommended that an improvement be made specifically on the casing size of the project, which is bigger than the standard commercial size of fan regulator. Work is also recommended to the future engineers on the receiver's circuit so that it can perfectly filter the white light that interfered.

Lastly, a good project should be exhibited to the general public to boost intellect of the students and lecturers alike. This will also act as source of income for the student, department the society as a whole.

COMPLETE CIRCUIT DIAGRAM







TRANSMITTER

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