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Design and Construction of Fire Detector and Alarm System

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Abstract

In this study, self monitoring fire detector and alarm system device was designed and constructed. The device comprises of four modules: Power supply module, fire and fault detector module, alarm sounder module and system reset module. The power supply module produces 27 VDC regulated output from 24V step-down transformer, bridge rectifier and smoothing capacitor of 4700uf/63V. There are two 12V batteries which serve as power back up. The fire and fault detector module incorporates by design; smoke detector which is made up of a phototransistor and an infrared LED. Under normal condition the detector sends a low current signal to the fire and fault circuit, upon detection of fire it sends a high current signal to the same circuit while during a fault condition the detector sends no current signal to the circuit causing an open circuit. The fire and fault detector circuit is implemented with three transistors-T4, T5 and T6, the latter two are connected as master and slave transistors. T4 is used to trigger the fire alarm by monitoring the high current signal of the detector while T5 and T6 are used for monitoring the low current signal and open circuit signals from the detector and therefore monitor both the normal and fault condition of the detector respectively. The sounder circuit was implemented using an LM555 TIMER IC and frequency elements-resistor and capacitor. The sounder circuit generates two distinguishable tones, low frequency tone of about 0.48Hz for the fault alarm and higher frequency tone of about 75Hz for the fire alarm. Finally the system reset circuit comprises of press button switch, a relay and a diode used to reset the fire detector and alarm circuit to normal working condition after an activated alarm condition have been rectified. The device has been tested and the result was very successful.

Introduction

Every hostile fire event is a race. Fire itself is one competitor, initially small and localized. The speed at which fire develops will depend upon the combustion characteristics of the fuels present, the physical arrangement of those fuels and the availability of an adequate air supply. The fire's ultimate objective is to consume all the fuel within its reach. Human beings are other competitors in this race. Our chances of winning the race will depend on when fire is detected, how quickly the alarm is sounded and how well we are equipped to achieve the ultimate goal of putting water on the fire.

Let's take a look at our adversary when a fire develops involving traditional building materials and contents such as wood products, cotton and other cellulosic materials and contents as well as noncombustible material such as metals, there is generally 10 to 15 minutes between the time of first open flame and full room involvement. However a serious threat to persons in the room may exist within about 5 minutes of ignition. As part of safety precautions, it is necessary to install detecting devices in buildings in order to have the best opportunity for early fighting of fire by the application of water to the fire.

The fire detector and alarm system is one of such devices which detects visible smoke and announces its presence through an alarm system. It is an active fire protection system designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general a fire alarm system is either classified as automatic or manually activated or both. The basic modern system consists of a dependable primary power, a secondary or backup power supply, one or more initiating devices and notification appliances. Automatic fire alarm systems can be used to notify the occupants of a building or structure of the need to evacuate in the event of a fire or other emergency, to summon emergency forces aid, and to prepare the building and its systems to control the spread of fire and smoke.

Design and Construction

The circuit design of the fire detector and alarm system is configured in modular scheme, which are, Power supply module, Fire and fault detector module, Sounder alarm module, and System reset module,

Power Supply Module

The power supply module consists of the Transformer, Rectifier, Smoothing capacitor and Voltage regulator. Also incorporated are power supply line separation unit and power supply failure detector unit.

In this design, a 220/24 volts 2000mA step down transformer is used to step down the supply voltage to suit the requirements of the fire detector and alarm system. It also provides isolation from the supply line which is an important safety consideration.

A full-wave bridge rectifier circuit, implemented with four diodes is used to convert the AC voltage into a pulsating DC voltage. The circuit diagram is shown in Fig.1 below.

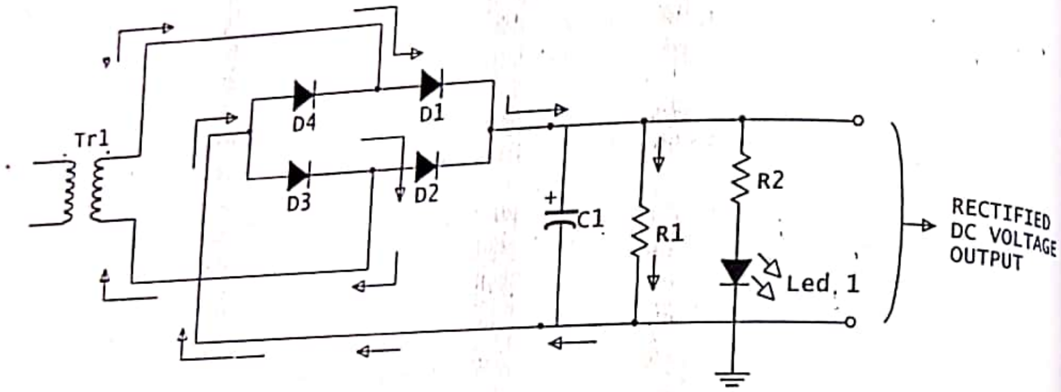

Fig.1: Schematic circuit diagram of the power supply module.

The four diodes rectify both halves of the AC voltage. It is necessary to note that only two diodes in the network conduct simultaneously. During the positive half-cycle of the secondary voltage of the transformer, diodes D_1 and D_3 are forward biased and current passes from the positive to the negative end of the load. The conduction path is shown in the circuit above. Considering voltage drops across the diodes D_1 and D_3 (Usifo, 2001);

$V_{out} = V_2 - 2V_B$ 1

Where: V_{out} = rectified DC voltage

V_2 = secondary winding voltage of the transformer (24VAC)

V_B = Voltage drop across each diode = 0.7V

The rectified DC voltage appears at the output of the bridge rectifier. The same is true when diode D_2 and D_4 are forward-biased during the negative half-cycle of the secondary winding voltage of the transformer. The peak value of the transformer secondary voltage is given as (Usifo, 2001):

$V_P = V_{rms} \times \sqrt{2}$ 2

Where: V_{rms} = Root mean square voltage of the secondary transformer winding.

Therefore, $V_P = 24 \times \sqrt{2} = 33.94$ VAC.

The peak inverse voltage (PIV) of the diode must be greater than 33.94 VAC, so the value of IN5394 was chosen for diodes D_1-D_4 which has a PIV rating of 200 volt. The rectified DC voltage is: $V_{out} = V_2 - 2V_B = 22.60$ VDC

While the peak full-wave rectified voltage is

$$V_{out\,(peak)} = 33.94 - (2 \times 0.7) = 32.54 \text{ VDC}$$

The capacitor C_1 after the bridge rectifier is an electrolytic type and serves the function of smoothing (i.e. filter) the pulsating voltage from the bridge rectifier into a steady direct current. The smoothing apacitor C_1 value is given as (Usifo, 2001):

$C_1 = I \div (V_r F_r)$ 3

here: I = DC load current

V_r = Allowable ripple voltage

F_r = Frequency of ripple voltage

For a full-wave bridge rectifier, frequency of ripple voltage is given as (Ezenwora, 2010):

$$F_r = 2 \times \text{line frequency} \qquad 4$$

$= 2x\ 50Hz = 100Hz$

For an allowable ripple of 5.0V and DC load current of 2000mA, minimum value of capacitance C required will be: $C = (2000 \times 10^{-3}) \div (5.0 \times 100) = 0.004F = 4000\mu F$.

The minimum voltage V_C of the capacitor is given as (Usifo, 2001):

$$V_C \geq \sqrt{2} \times V_P \qquad 5 \qquad \geq$$

$1.414 \times 32.54 \geq 46.02\ V$

The value of 4700µF/63V was chosen (All components values are shown in the appendix). Led current is typically between 5mA -20mA, therefore the current limiting resistor R_1 to the light emitting diode is given as (Warnes, 1998):

$$R = V_P \div I_d \qquad 6$$

$$= 32.54 \div (6 \times 10^{-3}) = 5423.33\Omega$$

A standard value of 5600Ω was used.

The next element of the power supply unit is the IC voltage regulator; the circuit is shown in Fig. 2 below. The purpose of the regulator is to provide an output voltage with little or no variation. Regulator senses changes in output and compensate for the changes. Regulator may also be designed to regulate the current flow in a circuit.

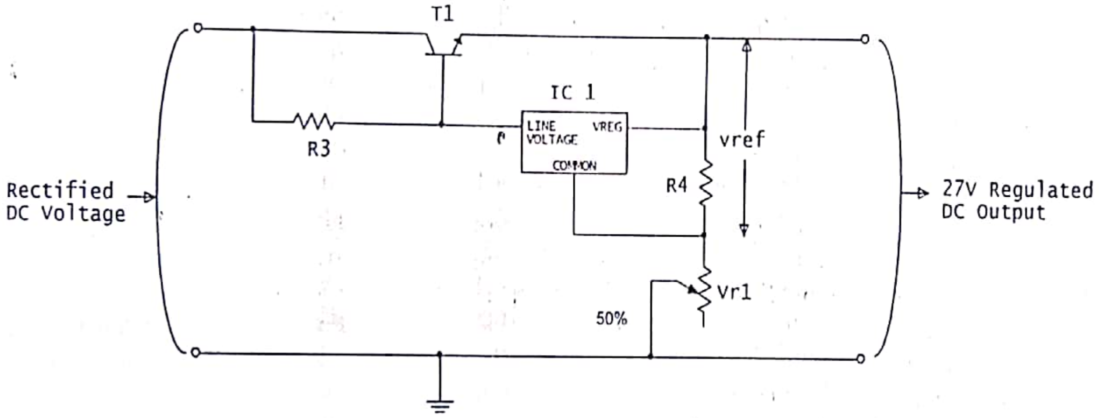

Fig.2: Schematic circuit diagram of LM317 voltage regulator IC.

The LM317 IC voltage regulator is used in this circuit. It is a very popular, low current and adjustable output voltage three terminal regulator. It requires little more than an external potentiometer for an adjustable output range from 5 to 37 volt at up to a current of 1A. The LM317 regulator develops a steady 1.25V reference (V_{ref}) between the V_{reg} and common terminals and by connecting R_4 between these terminals; a constant current is developed, governed by the equation (Mimms, 1987).

$$I_4 = V_{ref} \div R_4 \qquad 7$$

Both I_4 and a 100µA error current, I_2, flow through Vr_1, resulting in an output voltage that is regulated. Any voltage between 1.2 and 37 may be obtained with a 40 volt input by changing the ratio of Vr_1 to R_4. Hence the regulator is set via Vr_1 to provide an output of 29VDC. The maximum current output from the LM317 IC voltage regulator is insufficient to operate the load; therefore, a discreet power transistor- TIP2955 is connected to increase the current capability. The regulator draws current through the base-emitter junction, causing the transistor to conduct. The IC output voltage is unchanged by the transistor because the collector is connected directly to the IC output (sense point). Any increase in output voltage is detected by the IC regulator, which shuts off its internal pass transistor, and this stops the boost transistor base current.

Power supply line separation unit

The final element in the power supply stage is network of 3 diodes D_5-D_7, a resistor R_5 and a capacitor C_2 as shown in Fig.3 below. This circuit is used to supply two separate power supply voltage and is also used to synchronize power supply from the battery into the circuit.

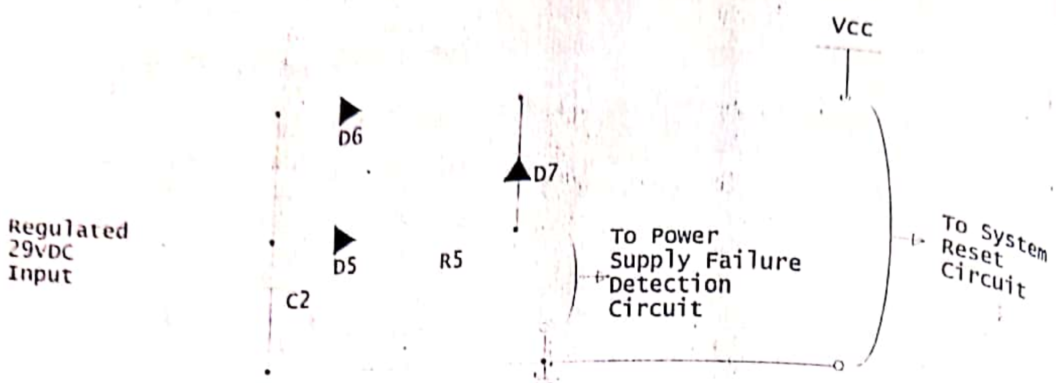

Fig.3.Schematic circuit diagram of power supply line separation unit.

The capacitor C_2 provides an extra smoothing of the regulated DC voltage. The network of diodes D_5-D_7 is use to supply separate DC voltage from the regulated DC voltage to: The battery as a charging voltage (through the power supply failure detector circuit), the fire detector and alarm circuit,(through to system reset circuit) and from the battery to the fire detector and alarm circuit. Diode D_5 which is connected in series with resistor R_5 is used to show one of many flexible applications of the LM 317 IC voltage regulator. By connecting in series D_5 and R_5 between the regulator output and the positive terminal of the battery, the voltage regulator is changed into a constant current regulator that is capable of charging the two 12 V/7.2 AH batteries. Design equation is given below (Gerrish and Dugger, 1989):

$$V_{ch} = V_{reg} - V_{ref} - V_d \tag{8}$$

The batteries have a combined nominal voltage of 27V/7.2 AH (as displayed on the batteries) and the standard charging current for a battery is 1/10 of it's AH rating.

Therefore the required charging current = (1/10) x 7.2 = 0.72Amps. Thus,

$$V_{ch} = 29 - 1.25 - 0.7 = 27.05V$$

Now the highest current loading that the transformer, rectifying component and the regulator can experience is a summation of the charging current and the current (I_p) required to power the fire detection and alarm circuit is (Gerrish and Dugger, 1989):

$$I_{supply} = I_{ch} + I_p \tag{9}$$

For simplicity,

$$I_{supply} = 2I_{ch} \qquad \text{as } I_p < I_{ch}$$
$$= 2 \times 0.72 = 1.44 \text{ Amps}$$

Therefore, this explains why a 230/24 Volt 2000mA (2A) step-down transformer is used and it also explain why IN5394 which has a current capacity of 3 amps is chosen as the value of diodes $D_1 - D_7$. Diode. D6 supply a DC voltage (0.7V less than the regulated DC voltage) from the IC voltage regulator directly to the fire detector and alarm circuit. This voltage drop is caused by the passage of current through D_6. Diode, D_7 links the battery power supply to the fire detector and alarm circuit but with a voltage drop of 0.7V across D_7.

In summary, diodes D_5 and D_6 is used to isolate and provide separate DC voltage supply to the battery and the fire detector and alarm circuit respectively. While diode D_7 is used to synchronize the DC voltage from the battery (which serves as a back-up power supply) to the fire detector and alarm system.

ower supply failure detector unit

he schematic circuit diagram of this stage is shown in Fig.4 below:

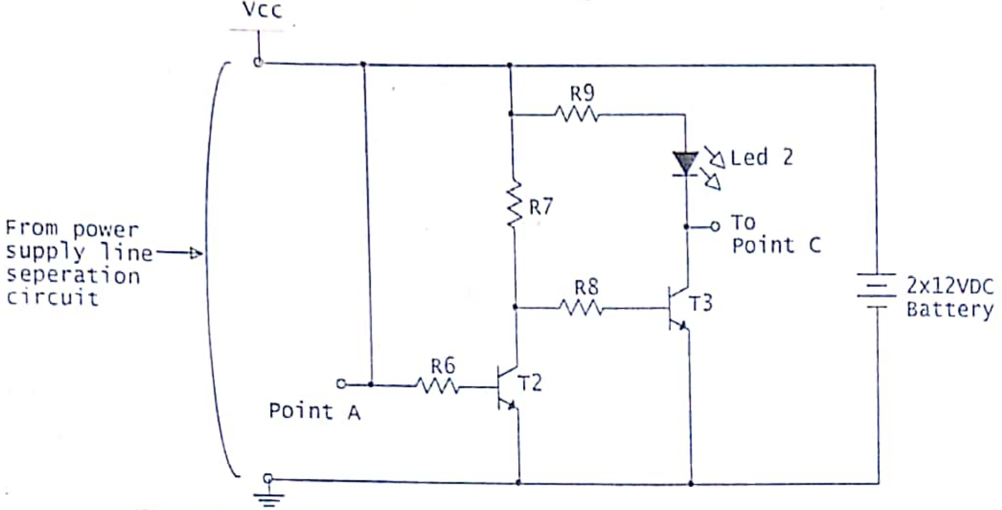

Fig.4: Schematic circuit diagram of the power supply failure detector unit.

The circuit consist basically of two transistors T_2 and T_3, and are used as a switching application, with T_3 being a slave to T_2 (i.e. transistor T_2 controls the "on" and "off" state of transistor T_3). The operation of this circuit is such that when there is a positive voltage signal at point A, transistor T_2 is forward-biased because of the presence of the base current and this will enable a much larger flow of current from the collector to emitter thus robbing transistor T_3 of it's base current and transistor T_3 is said to be cut-off. However if there is a power failure causing the voltage regulator to produce no voltage signal, T_2 is cut-off which therefore makes a voltage signal to flow from the battery positive terminal through resistor $R_7$and R_8. With transistor T_3 being forward-biased, voltage signal appears at the collector which switches on the light emitting diode, LED 2, and also give its signal to point C which is connected to the buzzer alarm. The coming on of LED 2 is used to indicate that there is a power failure.

Fire and Fault Detection Module

This is the circuit that monitors the voltage signal that is being sent from the smoke detector and translates the voltage signal to be either a fault or a fire condition from the detector. The detector has two signal sources; automatic smoke detector and manual call point.

Automatic smoke detector

Optical smoke detector type which depends upon the absorption or scattering of visible or near-visible light by the combustion products is used in this work. It consists of optical chamber, cover, photo diode, infra-red LED and case. When use as a smoke detector it includes a lens to coordinate the light beam from the infra-red LED, and the photodiode or other photo electric sensor, at right angles to the beam as a light detector. In the absence of smoke, the light passes in front of the detector in a straight line. When smoke enters the optical chamber into the path of the light beam, some light is scattered by the smoke particles and some of the scattered light is detected by the sensor which then sends electrical signal to the fire detector and alarm unit to activate the fire alarm (Wikipedia, 2008).

Manual call point

Electrical fire alarm may be manually operated by any person in a building who becomes aware of a fire. Operation is usually effected from a manual call point which takes the form of a box with a spring-loaded switch mounted in it. This is held in its non-alarm position and protected from accidental operation by a cover, usually frangible material. Breaking the cover releases the switch to an alarm position which then activates the fire alarm.

Each of these two fire call control points operates under normal condition as an open circuit while under fire condition they operate as a close circuit. A third element that is added to the control points is a resistor which serves to limit the current flow in the circuit and it is placed as an end of line component as shown in Fig.5 below:

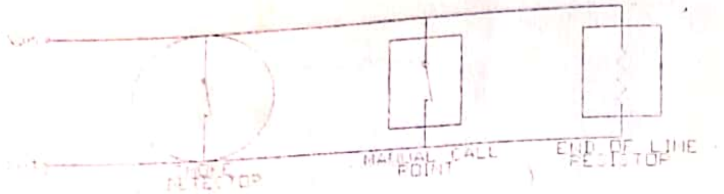

Fig.5.Block diagram of the fire call control points.

The end of line current limiting resistor also known as the end of line resistor (EOL resistor) serves the function of maintaining a small or limited amount of current in the detector circuit. This limited current is what is use to maintain a continuous flow of current in the detector circuit but is not enough to activate a fault alarm. It is this small amount of current produce by the resistor that is used for monitoring of open circuit by the fault detector circuit.

The fire alarm is only activated when either the automatic smoke detector is activated or the manual call point is operated. The operation of either or both control points causes a short circuit across the EOL resistor thereby causing a very large amount of current to flow to the fire detector circuit which causes the activation of the fire alarm and once activated it cannot stop until the removal of the fire that brought about the alarm. The schematic circuit diagram of the fire and fault detector circuit is shown in Fig.6 below:

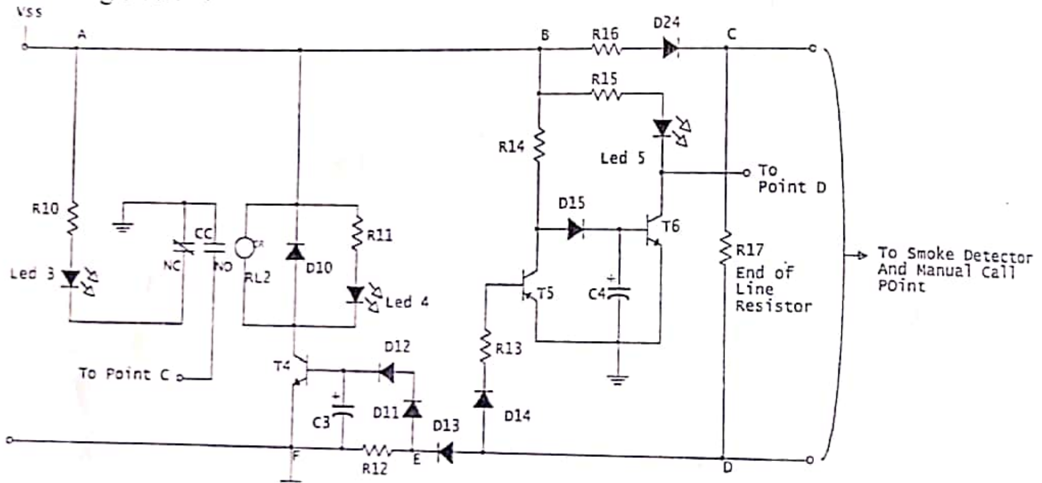

Fig.6: Schematic circuit diagram of the fire and fault detector module.

The circuit is powered by the output of the voltage regulator via the system reset unit. Transistor T_4 and other components around it is used for fire detection in the circuit while the transistor T_5 and T_6 connected as master and slave unit together with the components surrounding them are used for the fault detection in the circuit.

The operation of this circuit is such that the conductors connected between the fire and fault detector circuit and the fire call control points is a "closed circuit". The call control points being open circuit are wired in parallel to the EOL resistor. The values of the EOL limiting resistor, R_{12}, R_{16} and R_{17} were carefully chosen to ensure that the correct current flows in the circuit during the various condition of fire and fault alarm. Under normal condition, the current flowing into the circuit at "point D" is sufficient to hold the low-current (fault) sensing transistor T_5 which therefore keeps transistor T_6 off. but is insufficient to operate the high-current (fire) sensing transistor T_4 due to the presence of diodes D_{11} and D_{12} at the base of the transistor. Considering R_{16}, D_{24}, R_{17}, D_{13} and R_{12} together with the power supply as a close loop circuit with points from A to F as represented in the circuit diagram of Fig.7 below:

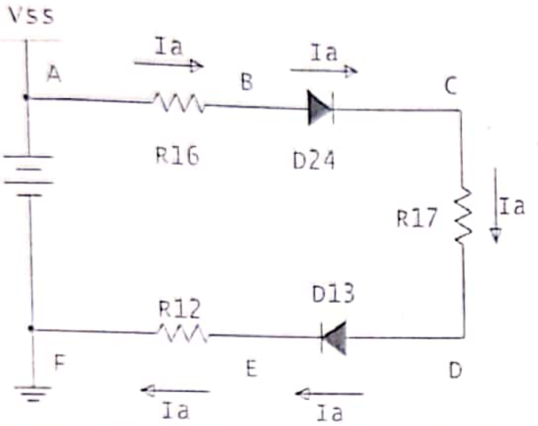

Fig.7: Schematic circuit diagram of the Kirchoff voltage analysis of the normal working condition of the fire detection module.

Using KVL around the loop A-B-C-D-E-F-A. we have (Boylestad. 1987):

$$27 - V_{(R16)} - V_{(D24)} - V_{(D13)} - V_{(R12)} - V_{(R17)} = 0 \qquad 10$$

Where:

$V_{(R12)}$ = Voltage across R_{12}
$V_{(R16)}$ = Voltage across R_{16}
$V_{(R17)}$ = Voltage across R_{17}
$V_{(D13)}$ = Voltage across D_{13}
$V_{(D24)}$ = Voltage across D_{24}

Since voltage across a diode is always 0.7V and V = IR, then

$$V_{(R12)} = IaR_{12}, \quad V_{(R16)} = IaR_{16}, \quad V_{(R17)} = IaR_{17},$$

Thus.

$$27 - IaR_{12} - 0.7 - IaR_{16} - 0.7 - IaR_{17} = 0$$
$$27 - 1.4 - Ia(R_{12} + R_{16} + R_{17}) = 0$$
$$25.6 = Ia(R_{12} + R_{16} + R_{17})$$
$$Ia = [25.6] \div [R_{12} + R_{16} + R_{17}]$$

Where, $R_{12} = 470\Omega$, $R_{16} = 1000\Omega$, $R_{17} = 10{,}000\Omega$ (see appendix)

$$Ia = [25.6] \div [470 + 1000 + 10{,}000]$$
$$= 0.00223A$$
$$= 2.23mA$$

Voltage at point E = $V_{(R12)}$ and;

$$V_{(R12)} = IaR_{12} \text{ (Warnes, 1998)} \qquad 11$$
$$= 2.23 \times 10^{-3} \times 470$$
$$= 2.05V$$

This explains why the high current (fire) sensing transistor T_4 is cut-off because the two diodes D_{11} and D_{12} connected to the base of transistor T_4 further drops down the voltage between point E and the base of transistor T_4 by 1.4V which therefore makes it insufficient for transistor T_4 to operate. While for point D, its voltage will be:

$$V = V_{(R12)} + V_{(D13)} \text{ (Boylestad, 1987)} \qquad 12$$
$$= 2.05 + 0.7$$
$$= 2.75V$$

The 2.75V at point D is enough to forward bias the low-current (fault) sensing transistor T_5, this therefore makes transistor T_6 to be cut-off thereby keeping off the fault indicating light emitting diode LED 5. A fault signal is only initiated when there is a broken connection (open circuit) within the loop causing the interruption of current Ia in the circuit thereby releasing the low-current (fault) sensing transistor T_5 and so transistor T_6 comes on providing power to light up the fault LED to indicate that there is a fault in the system.

For the activation of the fire alarm, the smoke detector causes short-circuit across the EOL resistor resulting in an increase in current which is sufficient to turn-on the high-current (fire) sensing transistor T_4. Consider the Fig.8 below:

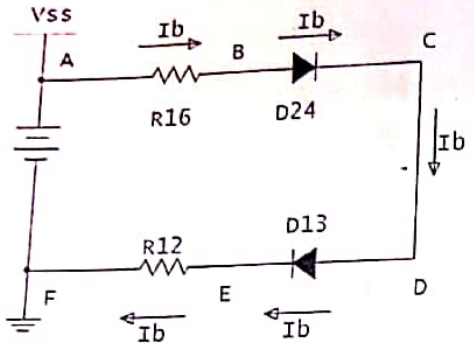

Fig.8: Schematic circuit diagram of the Kirchoff voltage analysis of the fire working condition of the fire detection module.

Again, using the Kirchoff Voltage Law (KVL), we have

$$27 - V_{(R16)} - V_{(D24)} - V_{(D13)} - V_{(R12)} = 0$$
$$27 - I_bR_{16} - 0.7 - 0.7 - I_bR_{12} = 0$$
$$27 - 1.4 - I_b(R_{12} \div R_{16}) = 0$$
$$25.6 = I_b\,(R_{12} - R_{16})$$
$$I_b = [25.6] \div [R_{12} \div R_{16}]$$
$$= [25.6] \div [470 \div 1000]$$
$$= 0.01742A = 17.42mA$$

And voltage at point E = $V_{(R12)}$

$$= I_bR_{12}$$
$$= 17.42 \times 10^{-3} \times 470$$
$$= 8.19V$$

It will be observed that there is an increase in current at point E due to short-circuit caused by the smoke detector and this also results in an increase in the voltage at point E. This voltage (i.e. 8.19V) is enough to turn –on transistor T_4 even after passing through diode D_{13}, D_{11} and D_{12} respectively. Transistor T_4 then turns on relay RL_2 making the relay contact switch to be between the common contact "cc" and the normally open contact "no", this therefore supplies through diode D_9 (see Fig.9) a voltage that is fed to two OP-AMPS which supply a permanently high voltage of about 20V to resistor R_{26} that is connected to the base of transistor T_8. As a result, transistor T_8 is forward-biased thereby turning on relay RL_3 which is the fire alarm relay used to turn on the sounder alarm as shown in Fig. 9 below.

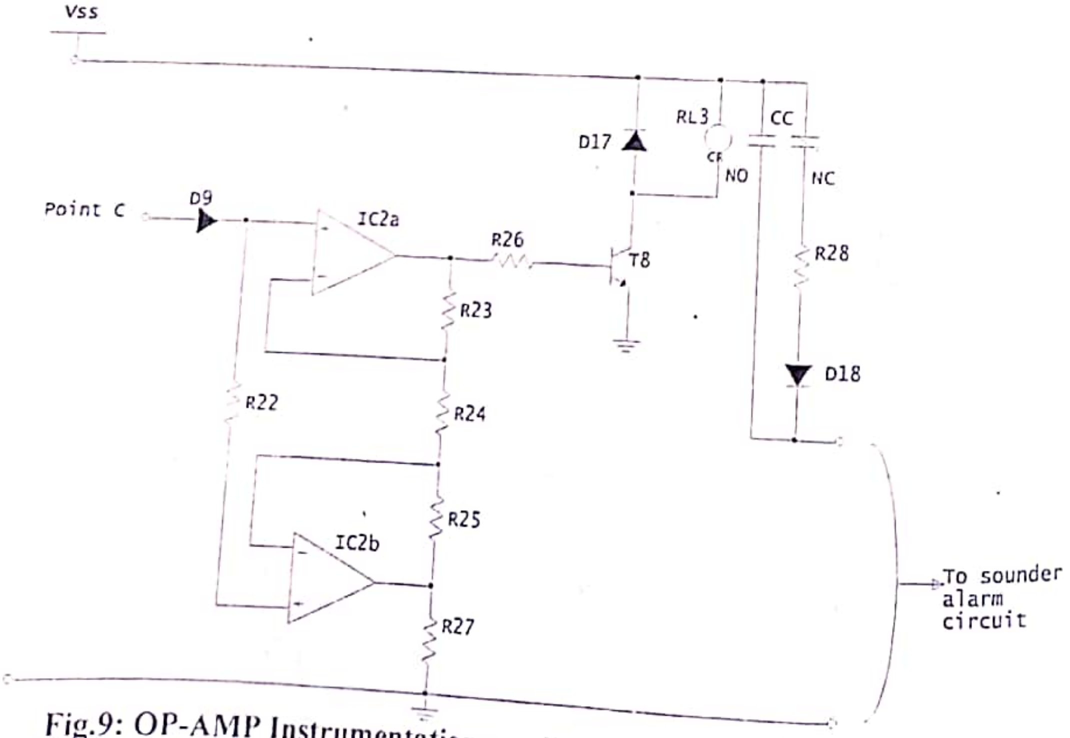

Fig.9: OP-AMP Instrumentation amplifier circuit.

Sounder Alarm Module

The sounder alarm module comprises the electronic sounder (external sounder alarm) and its fault detection circuit, buzzer alarm circuit and the sounder silence circuit. The fault detector circuit of the sounder alarm module is used to detect if there is a fault of either an open-circuit or a short circuit along the conductor connected to the external sounder alarm. The schematic of the fault detector circuit of the sounder alarm module is shown in Fig. 10 below. It is similar to the circuit of Fig.6 and therefore uses the same principle of operation to detect either an open circuit or a short circuit.

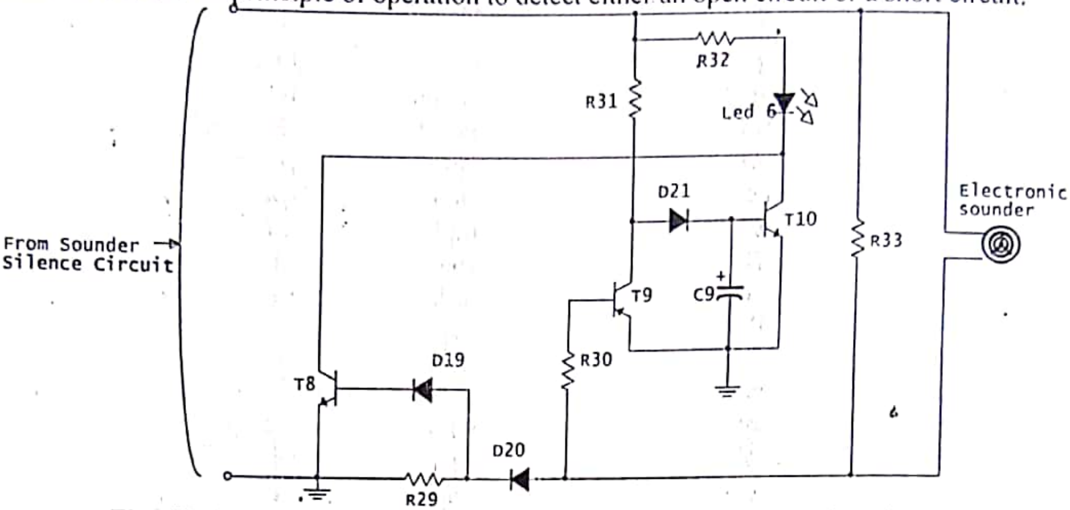

Fig. 10: Schematic diagram of fault detector circuit of sounder alarm module.

Buzzer alarm unit

It is important to note here that each time a fault indicating light emitting diode is turn-on; the buzzer alarm is also turn-on. The buzzer is implemented with the very popular and versatile 555 TIMER IC connected as an astable multivibrator to provide a rectangular wave that is used to drive the buzzer that beeps about every 2 seconds. Fig.11 below is the schematic circuit diagram of the 555 TIMER IC operating as an astable multivibrator. At power switch on, the voltage across capacitor C_5 is zero, the output is "HIGH" and the transistor T_7 is turn-on to power up the buzzer. The voltage across capacitor C_5 immediately begins to rise as it charges through the resistors R_{18} and R_{19}. At the instance the voltage across capacitor C_5 reaches ⅔ of supply voltage, the internal transistor switch closes and capacitor C_5 discharges through resistor R_{19} and pin 7 of the 555 TIMER IC. The output (pin 3) goes "LOW" thereby switching off transistor T_7.

The output remains "LOW" as the voltage across C_5 falls to ⅓ of supply voltage, when the internal transistor turns-on and the output goes "HIGH" once again and transistor T_7 is turn-on and the capacitor charges once more through R_{18} and R_{19}. The cycle repeats itself with the capacitor charging and discharging between ⅓ and ⅔ of the supply voltage to give a train of rectangular waves.

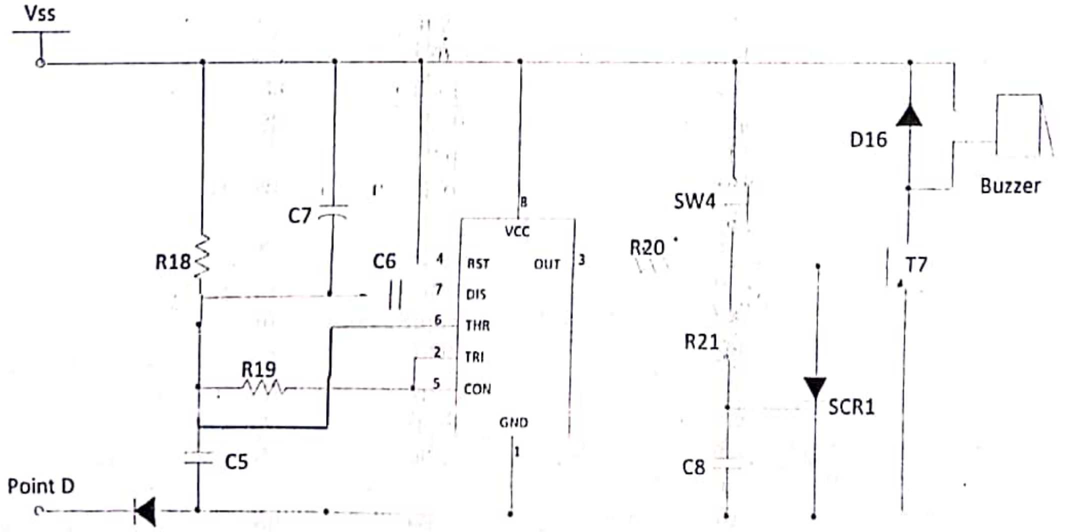

Fig.11: Schematic circuit diagram of 555 TIMER IC as an astable multivibrator.

For the 555 timer as an astable multivibrator, the charging time $T_{1(mark)}$ equation is:

$$T_{1(mark)} = 0.693\,(R_{18} + R_{19})\,C_5 \text{ (Ezenwora, 2010)} \qquad 13$$

Putting $R_{18} = 100K$

$R_{19} = 100K$

$C_5 = 10\mu F$

$$= 0.693(100{,}000 + 100{,}000)10 \times 10^{-6}$$
$$= 1.4 \text{ seconds}$$

Then, the discharging time through resistor R_{19} is:

$$T_2(\text{space}) = 0.693R_{19}\,C_5$$
$$= 0.693 \times 100{,}000 \times 10 \times 10^{-6}$$
$$= 0.7 \text{ seconds}$$

The period of oscillation T is:

$$T = T_1 + T_2 \text{ (Abdulahi, 2004)} \qquad 14$$

$$= 1.4 + 0.7$$
$$= 2.1 \text{ seconds}$$

The frequency of oscillation f is:

$$f = 1 \div T \text{ (Abdulahi, 2004)} \qquad 15$$

$$= 1 \div 2.1$$
$$= 0.48 \text{ Hz}$$

The purpose of the resistor R_{20} is to limit the current through the transistor T_7 to prevent it from being damaged by drawing too much current and overheating. A small capacitor C_6 is used to suppress extraneous noises while the big electrolytic capacitor C_7 is used to decouple the power supply as the current drawn changes from 1mA or less to 100mA or more.

Thyristor SCR1 together with SW4 and resistor R_{21} is used as the buzzer silence circuit. It functions in the same way just as the sounder silence circuit does.

Sounder silence unit

The sounder silence circuit is used to silence the sounder alarm. Its circuit is shown in Fig.12 below.

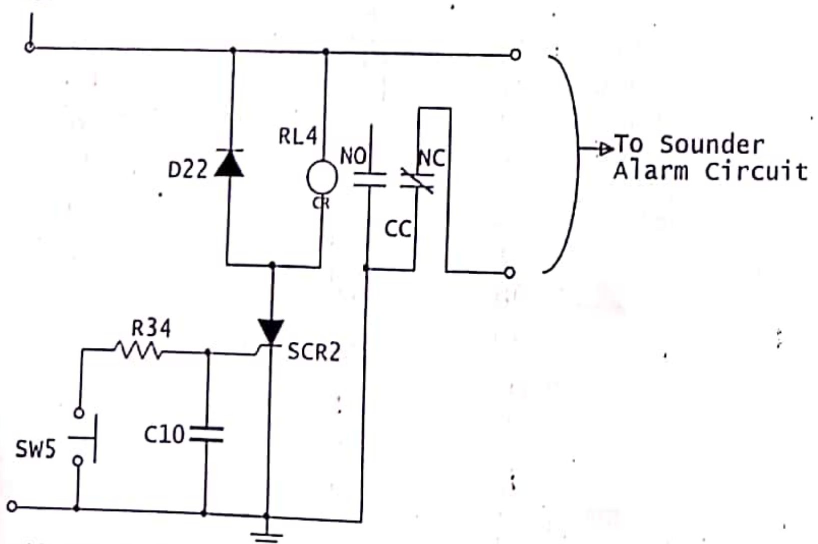

Fig. 12: Schematic circuit diagram of sounder silence unit.

By operating the press button switch SW5, thyristor SCR2 is turn on and remains permanently on even after releasing switch SW5. This then turns on relay RL4 which cut-off voltage supply to the sounder circuit. Thyristor SCR2 can only be turn-off by operating the reset push button switch SW2(see Fig.13) which momentarily cut-off power supplies to the fire detection and alarm circuit.

System Reset Module

The system reset circuit is used to reset the fire detector and alarm circuit to normal working condition after a fire or fault condition that have been detected by the system is rectified. The circuit is made up of a relay- RL1, press button switch- SW2 and a diode- D_8 as shown in Fig.13 below.

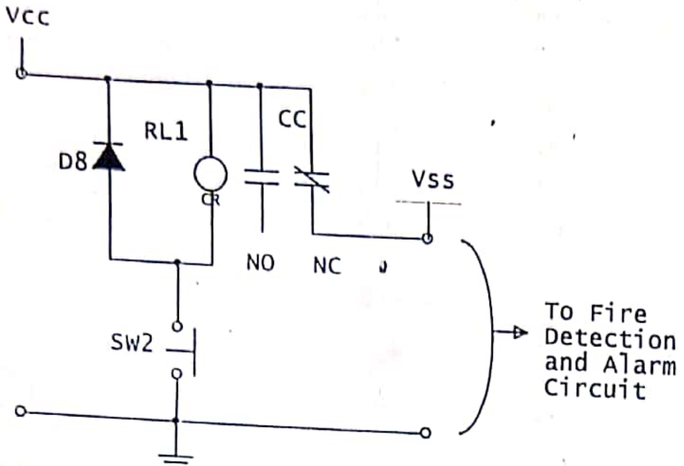

Fig.13.Schematic circuit diagram of the system reset module.

The system reset circuit is actually the link that connects the power supply stage to the fire detection and alarm circuit. By pressing the push button switch SW2 the relay RL1 is activated and the relay contact switch will be between the common contact "cc" and the normally open contact "no"; this therefore cut-off the power supply to the fire detection and alarm circuit thereby switching off everything including the fire and fault alarm indicators and sounder alarm that may have been activated. When the press button switch SW2 is released, it returns back to its original position, hence the relay is de-activated, it's contact switch would now be between the common contact "cc" and the normally close contact "nc" thereby supplying power to the fire detector and alarm circuit. Diode D_8 is connected across the relay coil to damp the inductive spikes that occur when the relay coil field collapses.

The complete circuit diagram of the fire detector and alarm system is shown in Fig. 14 below.

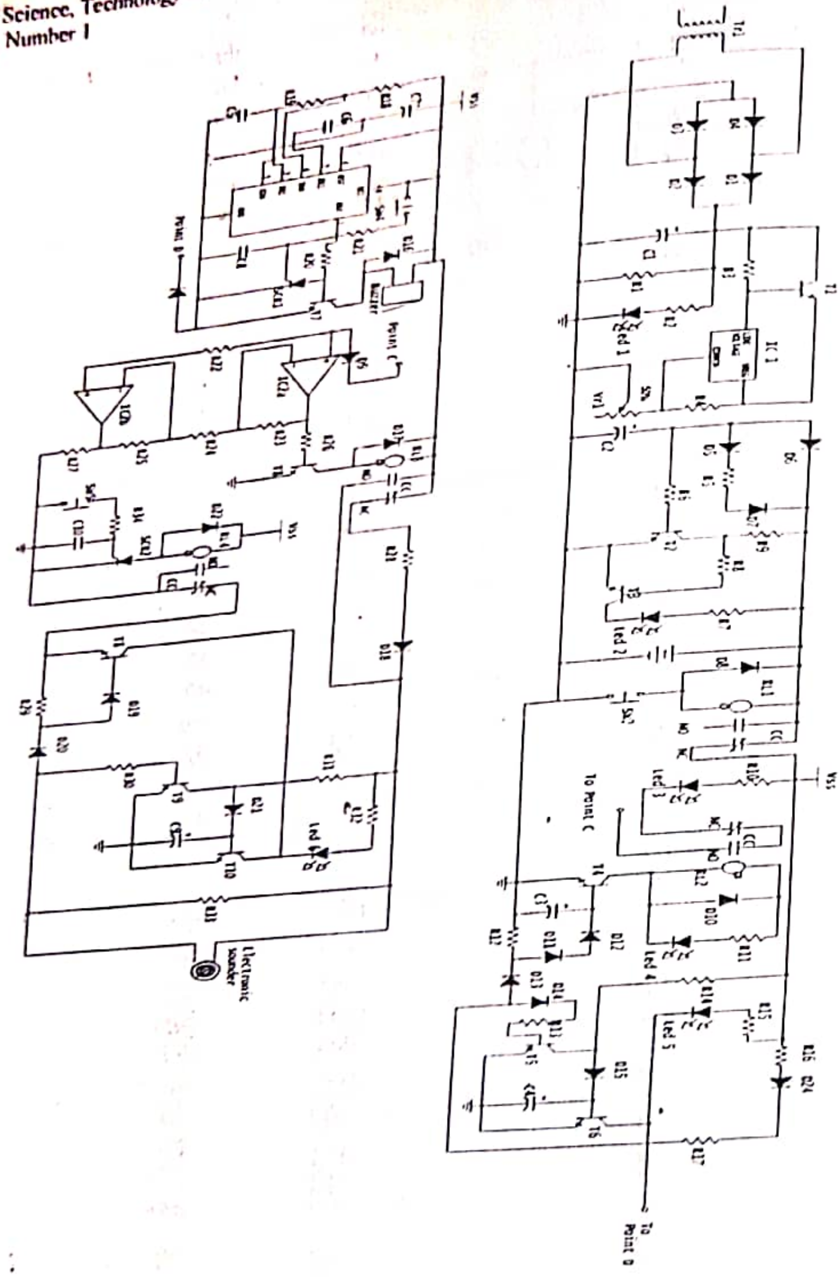

Fig.14 Complete circuit diagram of the fire detection and alarm system

Test and Conclusion

The system was tested with lighted papers placed about 40cm away from and on the path of the sensor and the alarm sounded immediately it picked smoke from the burning papers.

Fire detector and alarm system using smoke sensor was successfully designed, constructed and tested in this research work. Other sensors that respond to other two manifestations of combustion- heat and flames can also be used. The technology is simplified and can easily be reproduced for commercial purposes.

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