FIRE ALARM AND ALARM DIALER

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DECEMBER, 2000.

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A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY,

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.

DECEMBER, 2000.

DECLARATION

I ***BALOGUN EDAMISAN WILSON*** hereby declare that this thesis is an original work of mine, and that it has never been presented in any form for the award of either Diploma or Degree Certificate anywhere.

All informations obtained from both published and unpublished works have been acknowledged.

Signed **:**__________________________________

Date : 20:12:2000

DEDICATION

I dedicate this project to Almighty God for being my shepherd throughout my research that finally culminated in this feasible work - piece, may his grace continue to be my strength. (Amen).

ACKNOWLEDGEMENT

With all honour and deep sense of appreciation, my gratitude goes to Almighty God for his protection over my life before, during and after the completion of this project work, his inspiration has continued to be my strength.

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I wish to thank God for giving me the best parents in the World in person of late Chief Simeon Mebaghonwoto Balogun And Chief Mrs Emily Balogun for the sound academic back - ground they gave to me with all respect, I will like to appreciate the following brothers and sisters whose contributions to my success today can be described as unquantifiable; (1) Chief P. O. Balogun. Mrs Obebe Morenike. Chief Ayo Balogun, Mr & Mrs Balogun Femi, Mr S.C. Akinlosotu, Bro. Ola, Aunty Dupe, Kunle, Rotimi, Olu and Oladunni. Credit is also given to the bearer: my project partner Adewumi Salako, Ola, and numerous friends and many other family members whose name, pen and paper will not permit me to write.

With all honour, I will also like to appreciate my beloved "FIANCEE" in person of Lady Lydia Adepoju (LEE) for her spiritual and fervent backings whenever I so desire, may God reward you abundantly.

Credit is hereby given to all staff of Glory Computers and specifically Lady Uche Sunday for her concern to seeing to the realisation of this work, May God reward you all (Amen).

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BALOGUN E. WILSON

CERTIFICATION

We certify that we had supervised, read and approved this project work. We had also found it to be adequate in scope, and quality for the partial fulfilment of the Award of a Bachelor's Degree in Electrical and Computer Engineering (B. Eng.)

MR. PAUL ATTAH
SUPERVISOR

SIGN/DATE

DR. Y.A. ADEDIRAN
HEAD OF DEPARTMENT

SIGN/DATE

EXTERNAL EXAMINER

17/1/01
SIGN/DATE

TABLE OF CONTENTS

CHAPTER THREE: CONSTRUCTION, TESTING AND RESULTS

CHAPTER FOUR: RECOMMENDATION AND CONCLUSION

CHAPTER ONE

GENERAL INTRODUCTION:

A fire detection and alarm dialer is basically a circuit designed to alert human beings of impending dangers of fire in our vicinity.

Generally, alarm system has been acknowledged globally as an effective way of sensitizing the public of the commencement of an event, alert people of unseen dangers and for many other purposes both at homes and industries.

For the purpose of this project, the safety of human being is highly considered and will be based on the fire alarm.

The most important security is the fire safety system. At the turn of the century, a great fear of fire existed, especially in large towns and cities where the threat to destruction was inherent. better methods of providing fire safety were gradually changed from 1900 to 1920, the need was to "SAVE THE CITIES", from 1920 to 1950, it was "SAVE THE BUILDING", and from 1950 to 1970 "SAVE THE FLOOR" and from 1970 it became "SAVE THE PERSON". With the concept of "SAVE THE PERON" came the awareness of the need to contend with "SMOKE" which is deadly because it prevents escape of fire victims by reducing the visibility and dulling the senses in addition to eliminating oxygen from the abundant one's provided by nature.

In fact, recent studies indicate that 65% of all five death or accidents result from SMOKE more than those caused by burns, falls, explosions, heart attacks and all other causes combined related to fire.

Firemen are hampered or helpless in their rescue attempts by smoke which makes it difficult to locate and effectively fight fire. The deadly toxic gases that are released during fire migrate to upper floors in tall buildings thereby endangering other lives and aiding the spread of the fire outbreak.

1.1 LITERATURE REVIEW

It cannot be overly stressed that detection and communication systems must be fully integrated in home and offices as it will be occupied by human beings at the initial stages of design. Each fire that is detected must be immediately reported to the nearest fire fighting station .

Ideally, reporting should be through electrical means, communication should not have to rely on human intervention, even though authorities contend the human nose is one of the best detectors yet developed . when even seconds count, the slightest delay in fire fighters response cannot be pardoned.

The building occupancy plays a major role as to the type of detection system to be used. Smoke detectors have proven very effective in sensing fires in their early stages.

The photo electric detectors respond quickly to smouldering fires. A light source which sends out a light beam is interrupted by smoke entering the detectors, and the circuit is closed.

The ionization detector responds more quickly to fast burning fires. A radio-active element inside the ionization detector changes the air inside the chambers and makes it a conductor of electricity. Any smoke entering the detector slows or blocks the current, and the circuit is closed.

Manual pull boxes may be used in reporting fires, but they are useless when the building is unoccupied people have a built in fear of pulling a fire alarm box and many times will wait until the fire is fully developed before turning on the alarm.

Heat-sensing elements, such as fusible links, react very slowly to fires and require high temperatures before they can melt. These devices should not be used where quick response, such as smoke control, is more desirable.

It is becoming more evident that the solution to the fire and life safety problem is a design solution, not a prescription of hardware systems.

Until recent years, the method of preventing personnel injury and death in building fires was by shielding the occupants from the smoke and heat. However, the late sixties and early seventies saw several major buildings fires in which people who died were first removed from the immediate fire area. The smoke and toxic gases from fires were causing more deaths than the direct effects of the smoke and heat. To add to the problem, most of the buildings which burned were not conforming, and violations of building codes could not be blamed.

Authorities attributed the problem to the increasing use of plastics. The toxic gases given off during the thermal decomposition of these new plastic materials was far more deadly than those given off by traditional materials.

Today 80% of deaths in buildings fires are caused by smoke inhalation. A few breaths of some toxic gases will completely immobilise a person, with death following in a matter of minutes. The victim are often dead before the fire ever reaches them.

From the analysis of the damages that fire can cause, it is clear that fire affects not only property but more importantly life, hence early warning of outbreak of fire must be provided in dousing the fire and preventing it from advancing into other areas.

In this project work, emphasis is placed on early detection and communication of the outbreak of fire incidents and the early preventive measures that are interfaced to the fire service stations and other relevant rescue bodies.

1.2 FIRE DETECTION SYSTEMS

A good fire alarm system is a key point of the overall fire protection system designed into any building whether it is residential, industrial, offices, manufacturing or any other type of occupancy. A properly designed and installed alarm system can do much to limit both the life and property loss in the event of fire outbreak.

Since approximately 80% of fatalities caused by fire occur in buildings, the use of early-warning fire alarm system in buildings can have profound effect on the reduction of this figure. The system themselves can take many forms, ranging from one single-station, smokes in a small single-family detached dwelling to a complex computerised high rise building system handling incoming number of independent actions on a function of input data. Emergency communications in high rise buildings can be very effective in preventing panic and allowing orderly evaluation of the endangered portions of the building as well as direction of fire fighting operation within the building.

A general overview of the fire alarm and communication equipment normally used in buildings would be a necessary prerequisite in order to provide a better understanding of the function of this equipment.

1.3 DETECTORS

These are devices in a fire alarm system which informs the control unit, of the presence of fire in a building. Automating fire alarm initiating devices are actualised by heat, smoke or other aspects of devices.

1.4 HEAT DETECTION

Heat detectors are the oldest type of automatic fire detection device. They are the least expensive fire detectors, have the lowest false-alarm rate, of all fire detectors, but are also the slowest in detecting fire. Heat detectors are best suited for fire-detection in small confirmed spaces where rapid fires with high heat output are expected and in other areas where ambient conditions would not allow the use of other fire detection device on where speed of detecting life safety are not a consideration. One of this would be low-valued protection where fire could cause minimum damage to the structure or contents. Heat detectors may be thought of as detecting fires within minutes of ignition.

1.5 SMOKE DETECTION

Smoke detectors are costlier than heat detectors but provide considerably faster detection time and subsequently higher false-alarm rates due to their increased sensitivity. Smoke detectors are very effective for life safety applications but also more difficult to locate, in that air current which might affect the direction of smoke flow must be taken into consideration.

Smoke detectors should be used in areas where the value of protection is high hand in areas where life safety and fast response times are desired smoke detectors can operate within seconds of fire ignition.

Fig 1(a)

TABLE SHOWING THE SUMMARY OF DETECTOR AND APPLICATION CONSIDERATIONS.

DETECTOR TYPE	RESPONSE	FALSE ALARM RATE	COST	APPLICATION
Heat	Slow	Low	Low	Confined space
Smoke	Fast	Medium	Medium	Open or confined spaces
Particle Counter	Fast	Medium	High	Open space high value

1.5 ALARM DIALLING CIRCUIT

An alarm dialling circuit is basically a circuit that is designed to sensitise or inform would-be users of any type of signal as may be desired by the designer and user.

Protection of personnel property is an ever growing concern throughout the world, with more people than ever before installing burglar alarms, smoke or heat sensing alarms in their houses. Most of these alarms are of the local type. If any illegal entry is made, a bell on the premises rings and hopefully the noise will scare the burglar away.

Unfortunately, the burglar may just disable the bell instead, hence the need for the interface of this project to a telephone line where dual purpose is achieved. There are other times one might like to be alerted to a dangerous condition where one is not present. For example, if you have a house in the mountains subject to winter freeze-ups and cracked pipes, you would certainly like to know if your house is secured and highly protected from the danger of any electrical fire outbreak, hence it is better to pre-record the telephone numbers of fire service station or the nearest neighbour who may eventually help to inform rescue agents for immediate remedy.

Considering the poor economy of our continent presently, it may be suicidal for a family that have lived all their life to build a small house to loose them in a matter of minutes, hence it is economically wise to incorporate in individual houses a telephone line that is interfaced to an alarm dialer, this can generally confirm the global adage of "penny wise pound foolish".

As various telephone companies strive to bring better service to their customers, they are rapidly changing over central office equipment to electronic switching systems. Among the advantages of this new equipment is that it makes touch-tone dialling possible. In areas that have converted to electronic switching and are rapidly expanding, a customer may pay an extra monthly fee to get a tone-operated phone.

Many people don't realise that touch-tone dialling is already available to them for the asking. The dialer discussed in this project requires that you have touch-tone service.

CHAPTER TWO

SYSTEM DESIGN

2.1 DESIGN

The details and breakdown of the design of the fire alarm system can be divided into four basic units, each represented by a building block namely: Input, Output, interface and control devices respectively.

Fig (2.1) shows clearly the block diagram, the details and mode of operation.

OPERATION

The summary of the mode of operation is that for every system, there must be an input, for this project, light dependent resistor (LDR) and thermistor (TH) are used as smoke and heat detector respectively.

The output of the heat and smoke detector are controlled by the followings: 555 timer, transistor, NAND gates, OP-Amp and reset switch. The resultant effect of the control is intefaced with a telephone line and a relay switch.

For a complete system, an output is expected, for this project a tape player and speaker are used as output devices.

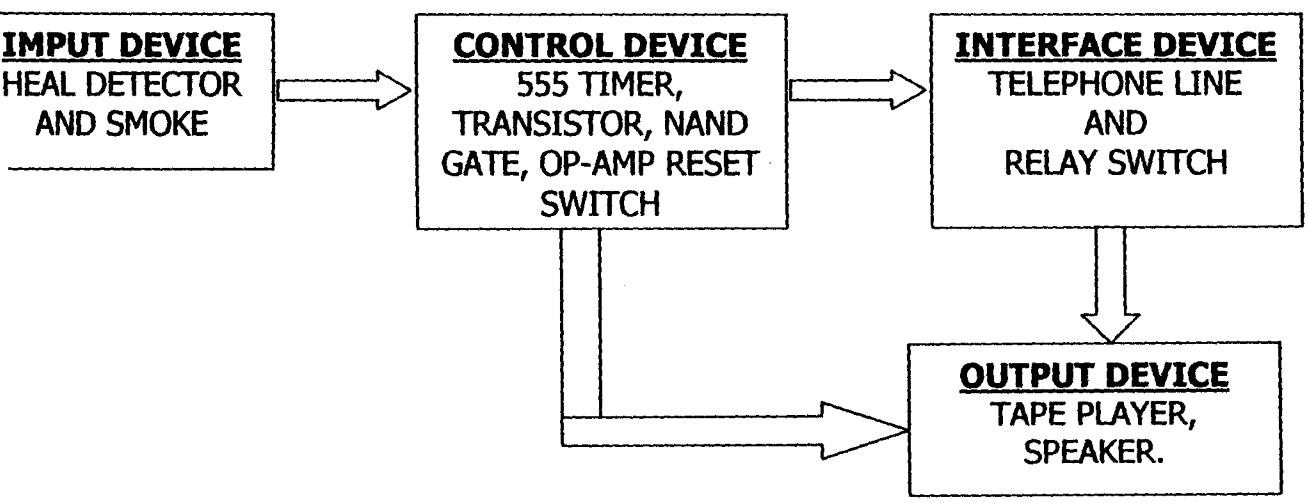


Fig 2.1 DESIGN BLOCK DIAGRAM.

2.3 CALCULATION ANALYSIS

Vcc = 9**V**

V LED = 1.2**V**

R = 3900Ω

i LED = (9-1.2)V/390Ω =20mA

V_{LDR} = $\frac{2}{3}V_{CC} + (0.6x2)$

V_{LDR} = 7.2**V**

R_{LDR} (Dark State) = 240KΩ

R_{LDR} (Morning Light) 8KΩ

Assuming R_{LDR} (Presence of LED without smoke) = 8KΩ

Assuming R_{LDR} (Presence of LED with smoke)

= 50% of resistance range

(i.e.) R_{LDR} (LED without smoke) = R_{LDR} 1

R_{LDR} (LED with smoke) = R_{LDR} 2

R_{LDR} 2 = $\frac{(240 - 8)}{2} + 8 = 124$KΩ

I max (LDR) occurs when R_{LDR} = 8KΩ

I min (LDR) occurs when R_{LDR} 3 = 124KΩ

R_2 (max) occurs at 1 min (LDR)

Using voltage divider:

$R_2 = \frac{(9 \times 124K\Omega)}{6} - 124$

R_2 = 62KΩ

Rv (max) = 62KΩ

For this project, 60KΩ resistor is used for R_2

CALCULATION ANALYSIS

RT = 900.667 - 13337 (T= absolute temperature in Kelvin)

At a temperature of 500C

T=237 + 50 = 323KΩ

RT = 470

Vcc = 9v

VT = 9-7.2 = 1,8V

LT = $\frac{VT}{RT} = \frac{1.8}{470}$ = 3.83 mA

$RV = \frac{7.2v}{3.83mA} = 1.88K\Omega$

THE SCHMITT TRIGGERS DIAGRAM

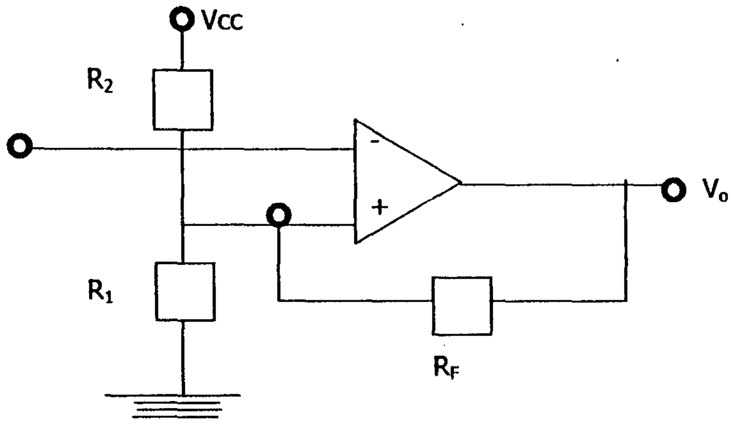


Fig (2.2) Circuit diagram of a Schmitt trigger

Trigger Voltage = 6.0v

V_{Trig} = 2/3 Vcc + 0.6x2

7.2 = $9R_4$/ 471.08+R_4

6.0 (471.08 + Ru) = $9R_4$

6.0 x 471.08 = $6.2R_4$ = $9R_4$

R_4 = 7.2 X 471.08/3.0

R_4 = 1.00 KΩ

i_T = 3.82 mA

LDR (Dark state) = 240KΩ

(Morning light) = 8KΩ

100% = 232 KΩ + X_0

but X0 = 8KΩ

50% = 116 KΩ to X_0

50% = 124 KΩ

Assume (presence of Smoke) = 124KΩ

Assume (presence of Led without smoke) = 8KΩ

Voltage drop across LDR = 7.2v when triggered ON.

Max current = 7.2/ 8 x 10^3 = 0.9mA

To determine Rv:

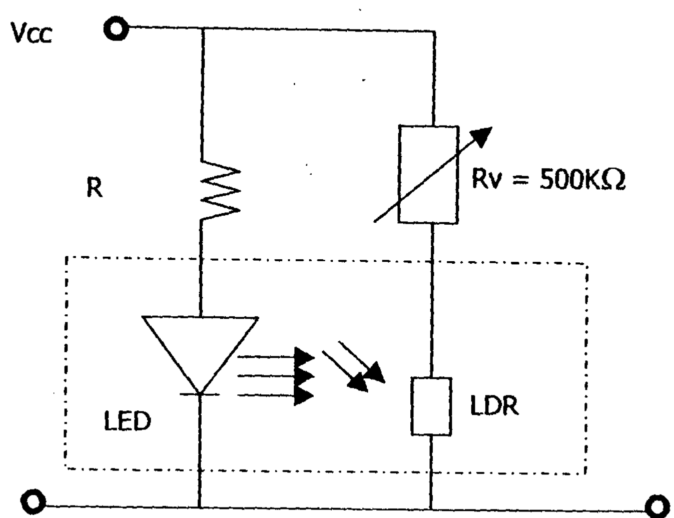


Fig (2.3) EFFECT OF LIGHT EMITTING DIODE ON LDR

When LDR = 8KΩ

6.0 = 9 x Rv/(124 + Rv)

6.0 x 1 24 x103 + 6.0 Rv = 9Rv

Rv = (6.0 x124 x 103)/1.8

Rv = 400KΩ

For this project, 500KΩ resistor was used.

2.4 CIRCUIT OPERATION

The complete block schematic of the fire, smoke and alarm dialer system showing all stages in this project work have early been given and the complete circuit diagram as well.

The power supply unit was designed to operate in both D.C and A.C, modes. This is to enable continuous operation even in the absence of power supply from mains. A D.C voltage of 9V is supplied to the system, while transformer T_l, with an A.C voltage from the main supply steps down this voltage from 220V to 12V the bridge rectifier AC to DC while the voltage regulator is used to achieve the 9v required by the entire circuit which is a steady voltage. Before rectification, the capacitor C_1 is meant to filter off any unwanted voltage, while after the rectification, capacitor C_2 will finally, filter off all the few unwanted output signal before circuit is been fed with the 9volt supply.

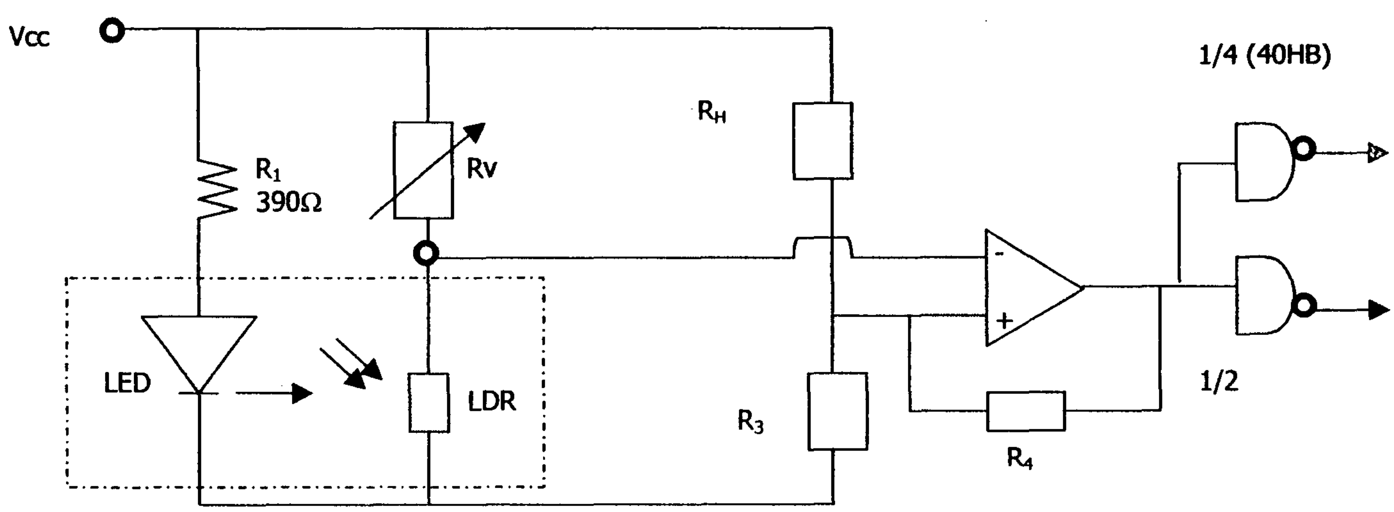
SMOKE DETECTING CIRCUIT OPERATION

At the smoke detecting region where the LED plays an important role, VR_1 serves as a current limiter, i.e. it regulates the amount of current that goes to the LED.

The combination of R, and LDR is a voltage dividing circuit, and this implies that in the absence of smoke, light intensity from the LED is high which result in a decrease in the resistance of the LDR, this leading to voltage drop across the LDR.

And on the other hand, when there is smoke, light intensity from the LED is reduced leading to an increase in the resistance of the LDR, this increase leads to a voltage drop across the LDR.

From the IC, which is an OP-AMP, the Vcc supplied is 9V, hence there will be 6.0v voltage drop on each 10KΩ resistors at the base of the OP-AMP, this will then lead to a voltage of 6.0v supply at the (f) terminal of the OP-AMP. Whenever we have a voltage of less than 6.0v drop across the LDR, the output of the OP-AMP is high, and when we have a voltage above 6.0v across the LDR, the output of the OP-AMP with low. From the above analysis, the rise or drop in voltage is always caused either the presence of smoke, or absence of smoke. When there is smoke the voltage rises above 6.0v, but in the absence of light, voltages below 6.0volt is present leaving the output of the OP-AMP with low output signal.



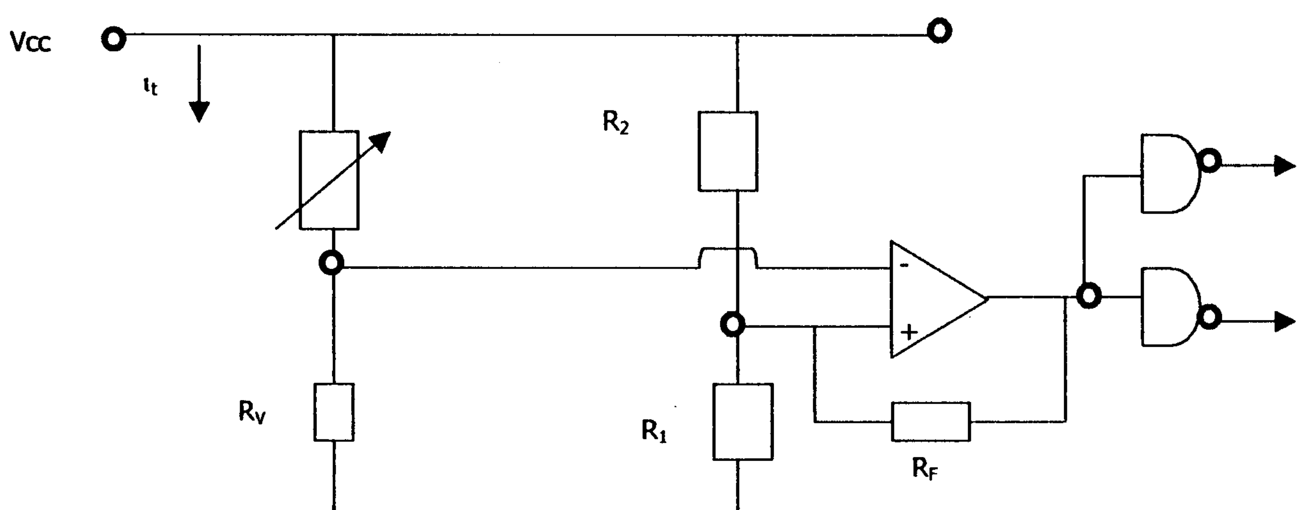
Fig; (2.4) Circuit diagram of smoke detector

2.5 THE HEAT DETECTING CIRCUIT OPERATION

From the circuit, the combination of VR_2 and the thermistor R_{TH} forms a voltage dividing circuit. The thermistor R_{TH} is the positive temperature coefficient type which means that its resistance increases as temperature rises, and decreases as temperature increases.

This means that whenever there is any increase in the atmospheric temperature, for example due to fire, the voltage drop across the thermistor will increase.

IC_2 is also an OP-AMP, with a voltage of 9V from Vcc, 6.0V will drop on each of the 10KΩ resistors which serves as both positive and negative inputs to the op-amps. When the temperature is above 6.0v, the output of the op-amp is low while when the voltage drop across the R_{TH} is below 6.0v, the output of the op-amp becomes high.



$R_1 = R_2 = R_F = 10K\Omega$

FIG (2.5) Circuit diagram of heat detector

2.6 THE CONTROL UNIT FOR SPEAKER

This is the contribution of 1/4 (4011B) IC3 NAND gate and the 555 timer connected in the astable multi-vibrator miode.

This is shown below.

Whenever there is a low input to the NAND gate from either IC_1, or IC_2 out puts, the output of the NAND gate will be high. But whenever there is a low input to the NAND gate from the output of IC_1 and IC_2, we will have a high at the input of the

NAND gate, but if both outputs from the IC_1 and IC_2 are high fed to the input of the NAND gate, the output of the NAND gate will be low.

The output of the NAND gate is connected to pin 4 of the 555 timer which is a trigger pin, the output of the 555 timer which is through pin (3) supplies the base current required to switch ON the transistor. But whenever there is a 'LOW' at the output of the IC_3, no signal is sent to the 555 timer, but when there is a high at the output of the IC_3, the 555 timer is triggered "ON".

A capacitor C_1 connected between Vcc and collector of the transistor filters of D.C currents.

2.7 OUTPUT DEVICE (SPEAKER).

A low 4Ω speaker was used to obtain an audible output. The signal from the emitter of the transistor is connected to the speaker which produces the required audible output whenever there is either heat or smoke detection.

The speaker which produces an audible sound is meant to sensitise the people in the close range of fire outbreak, for the sake of this project, it is one of the most significant devices incorporated, as its signal have reduced the rate of fire outbreak by providing high response rescue initiation.

2.8 THE ALARM DIALLING CIRCUIT

For touch-tone dialling, pairs of audio frequencies are used to signal the dialling of a particular number. In the more conventional rotary dialling system, dialling the number 5, say, results in five pulses being generated and sent to the control office for interpretation. In touch-tone dialling, a unique pair of audio frequencies is generated for each digit. The frequencies generated ranges from slightly less than $700H_Z$ to a little more than $1500H_Z$.

A total of seven different frequency tones are used for LOW and HIGH, as follows: 697 H_z,$770H_z$, $852H_z$ and $941H_Z$ (low) and 1209 H_z, 1336 H_z and 1477 H_z (high). The tones required for each digit are shown below:

Fig (2b) TABLE SHOWING FREQUENCY TONE RESISTOR

Low tone group (H_z)	1209 H_z	High zone 1336 H_z	Group /477H_z
697	1	2	3
770	4	5	6
852	7	8	9
941	1	0	#

The tones are easy to record and play back, the reason being that they are in the audio frequencies range.

For the purpose of this project, the desired tones generated by the telephone (i.e. the number to be dialed) were first recorded, then the audio message was recorded. The dialling circuit uses two 555 IC timer to detect an alarm signal condition, it turns ON the recorder that performs the dialling and relays the message and then turn the recorder OFF.

The two IC timer are connected in the monostable multiribrator mode by using a special configuration called a power-up monostable. (It is shown in fig. 3). The power-up monostable is so called because it prevents a pulse from appearing at the output of (pin 3) of the timer until a certain amount of time (t=1.1RC) has passed after power is applied.

When power is finally applied, the capacitor starts changing through the resistor. The junction f these two components is connected to the junction of pins 6 and 7 of the 555 timer, which are the threshold and discharge pins.

When the voltage applied to pin 6 rises to a value that is greater than two-thirds (2/3) of the value of the voltage applied to pin 8, a flip-flop inside the 555 timer JC is RESET, and output of the timer goes LOW.

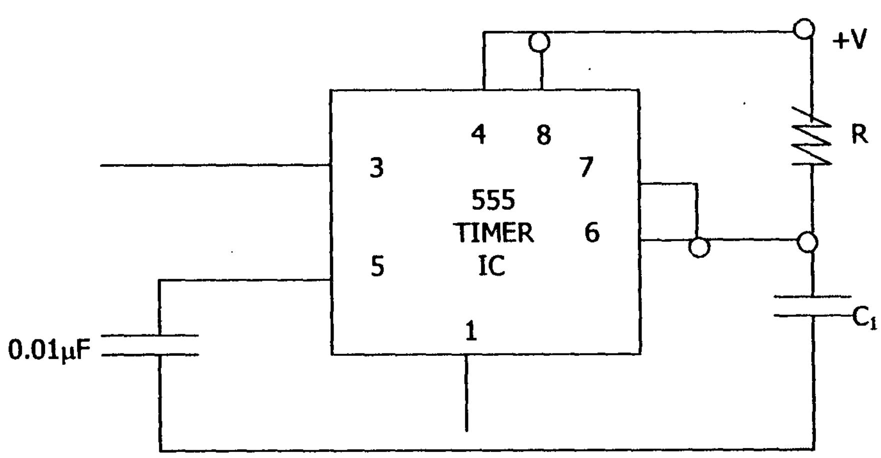


Fig (2.6) POWER-UP MONOSTABLE MULTIVIBRATOR DIAGRAM

In the dialer controller, the first timer circuit IC is used to detect the alarm condition. It is configured as a power-up monostable that waits only 0.1 seconds before during output pin 3 from the HIGH to the LOW State.

In the absence of an alarm condition, transistor (C9013) is switched ON by the 4011B IC, thereby shorting out the capacitor and ensuring that a positive voltage is applied to the base of the multivibrator (21), keeping it in the OFF state.

If an alarm condition is sensed, the transistor (C9013) is switched OFF the capacitor then charges up to 6 volts and triggers the 555 timer, during the output LOW and turning on transistor Q1. When Q1 conducts, it suppliers power to IC_2, another power-up monostable. Thus the monostable's output was initially HIGH, and power was applied to the relay that controls the cassette recorder, turning it ON. The output of IC_2 stays HIGH for about 8.5 minutes (t=1.IR), which is enough time to dial the member so desired when there is danger and give a reasonable long message. After 8.5 minutes, the output of IC_2 will go LOW (this is because the voltage across C3 has 6 volts), thereby shutting OFF the relay, this will also shut OFF the tape recorder in turn and hangs up the phone.

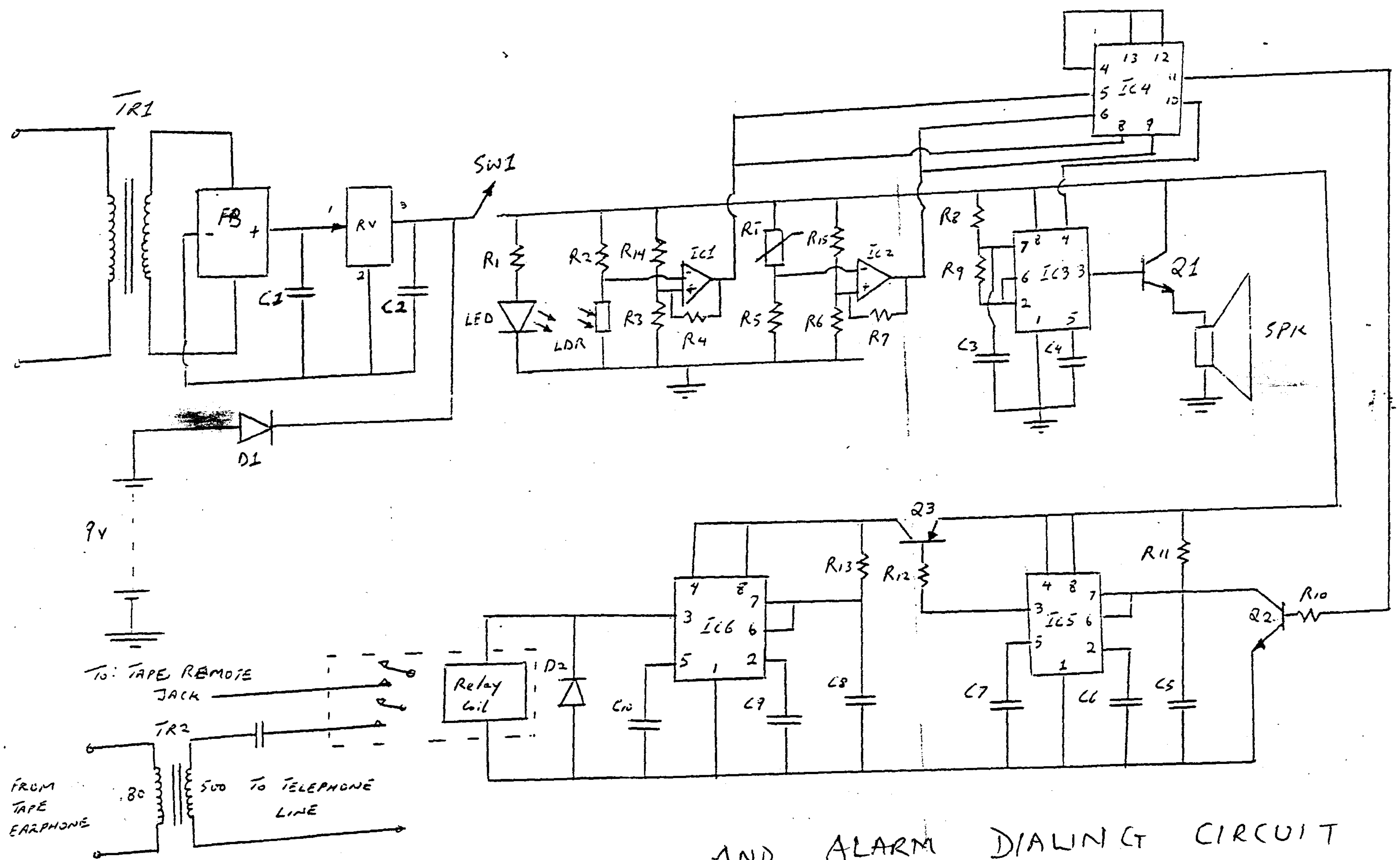


Fig 2.7 FIRE ALARM AND ALARM DIALING CIRCUIT

CHAPTER THREE

CONSTRUCTION, TESTING AND RESULTS

3.1 COUPLING STAGES

With reference to chapter two, the entire system is made up of four building blocks as follows;

(a) **CONTROL DEVICE:** This includes IC's such as the 555 timer, 4011B (QAND GATE), μA741, (OP-AMP) and the Reset switch.

(b) **INTERFACE DEVICE:** This is made up to the, relay switch. Patress, two way socket and line cord (for the telephone line communication).

(c) **INPUT DEVICE:** This includes the transducer like the themistor (meant for heat detection) and the light dependent resistor (meant for smoke detection).

(d) **OUTPUT DEVICE:** This is made up of the speaker and the tape player.

The entire system was powered by the 9V A.C. power supply unit with the 9V D.C power supply by a battery introduced to serve as a back-up in case of A.C. source failure. The practical aspect of this project was first fixed on bread board and tested to have a satisfactory and desired output.

This means the prototype test was carried out under an induced alarm conditions and few adjustments were carried out on the ranges of values of the variables resistors (potentiometer) until a desired output was obtained.

After the confirmation of a satisfactory and desired output, all the components were subsequently transferred to a vero board stage-by-stage and tested accordingly. Necessary cuttings were made on the vero board.

3.1 TESTING

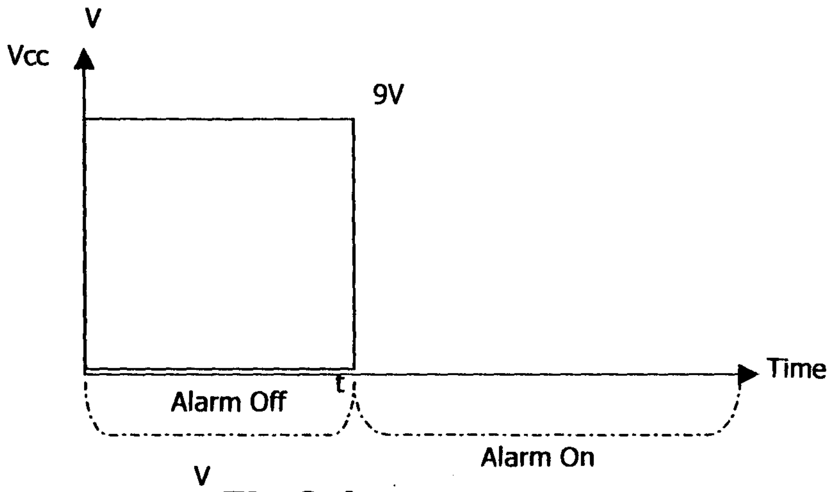
From the analysis expressed in chapter two, all the principle of operation of each stage and the anticipated output have been treated.

This chapter reveals the output waveforms of each stage and voltage levels at various points were monitors and measured respectively. the waveform were monitored with the use of Cathode ray Oscilloscope (C.R.O) while the voltage levels were measured using a digital voltmeter.

The resistive values and other components specifications were just as given in the data book or rated on each components.

All these were done in order to compare the results with the expected theoretical values.

The results obtained at the output of each stage were drawn for the wave-forms and voltages respectively, as shown in fig 3.1 to 3.5.



V

Fig 3.1 **OUTPUT OF ICI (UA741)**

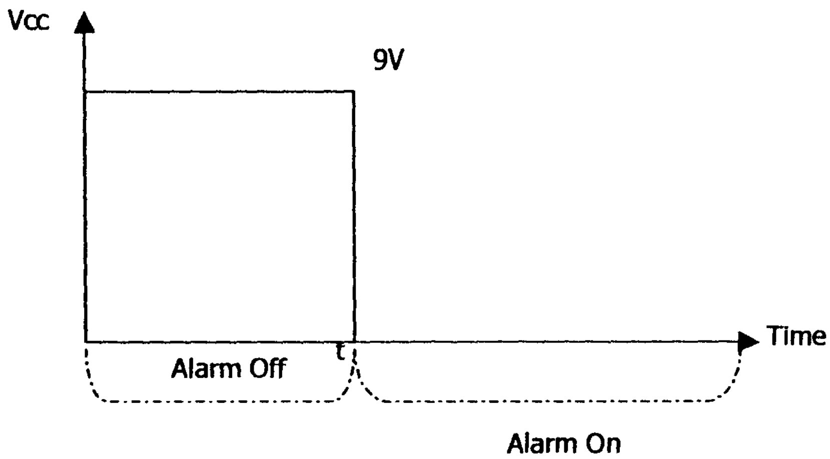


Fig 3.2. OUTPUT OF IC2 (UA741)

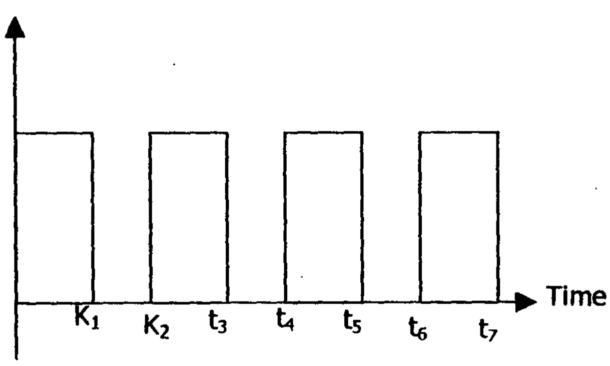


Fig 3.3 OUTPUT OF IC3 (555 TIMER TO SPEAKER)

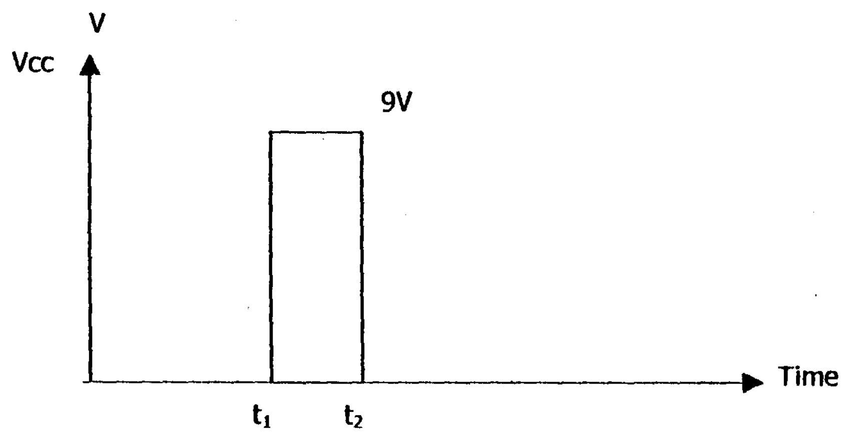


Fig 3.4 OUTPUT OF IC4

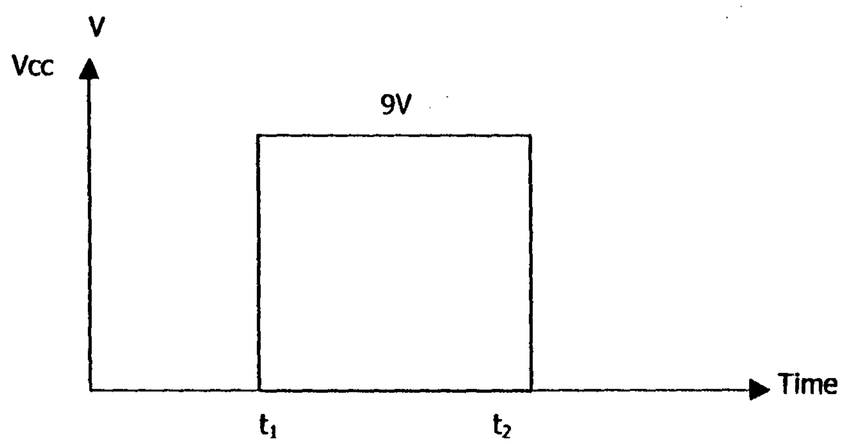


Fig 3.5 OUTPUT OF IC5

3.2 PACKAGING (Picture)

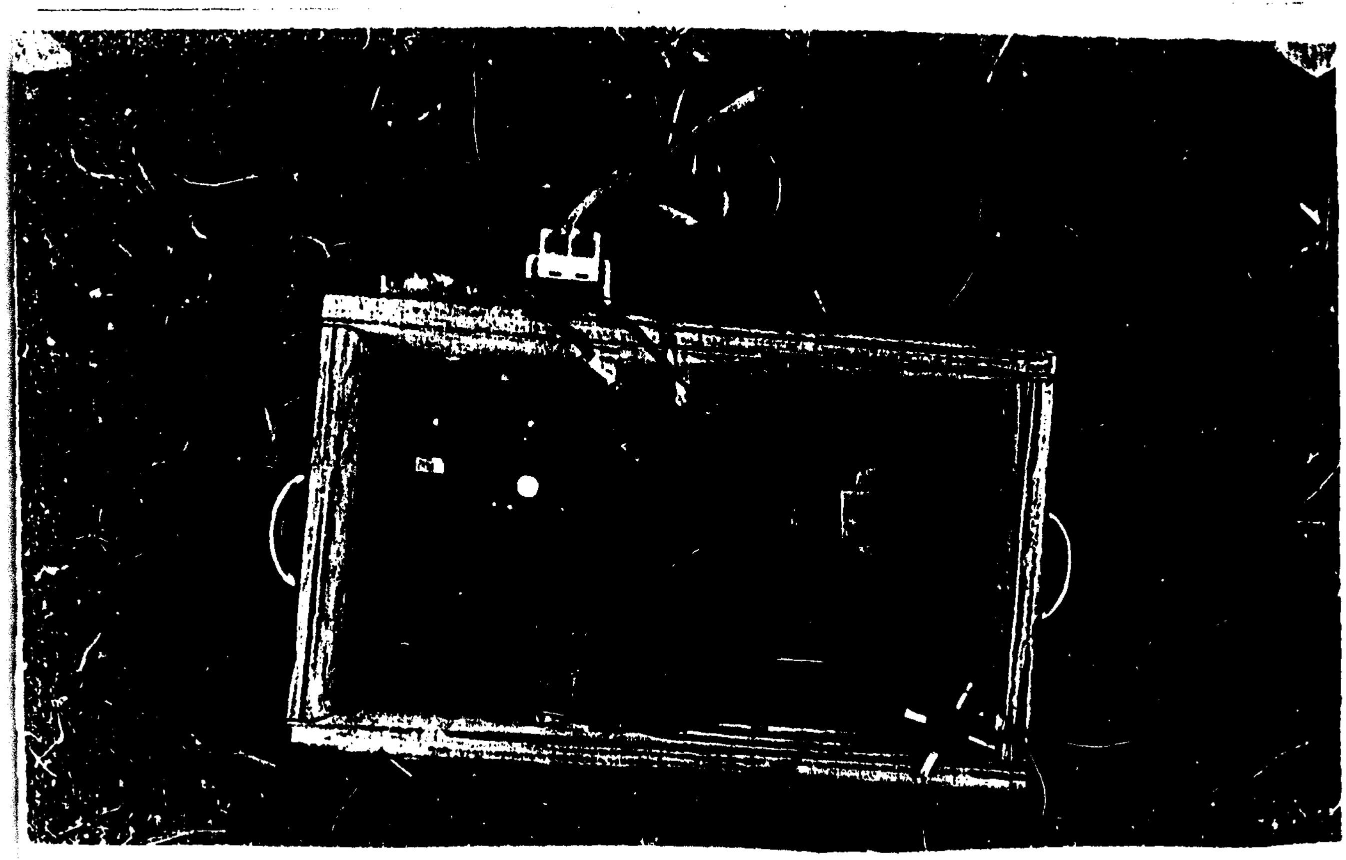


Plate 1. Photograph of project and casing.

3.3 RELIABILITY AND FAILURE RATE

Reliability of a system can be defined as the probability that a system will perform it's prescribed duty without failure for a given period of time within a given and specified working condition.

The failure rate is the probability that the system will fall within a given period of time at a given environmental condition. By carrying out the failure rate test, fault tree analysis method is usually the globally acknowledged method to be able to have a perfect result.

Fault tree analysis (F.T.A) is the top-down method of identifying all possible causes of a particular failure mode and providing a base from which to calculate the probability of occurrence for each systems failure mode.

The analysis shows in a graphical form. The logical relationship between a particular failure (top event) and basic failure causes (prime event) using AND and DR gates.

And OR gate is used when the occurrence of any input event alone or collectively will cause the output event to occur.

The AND gate is used when all the input events must occur for the output event to occur.

The fault tree analysis block diagram is shown in Fig 3.6 as used in explaining the function of each gate. While the reliability block diagram is shown in fig 7.

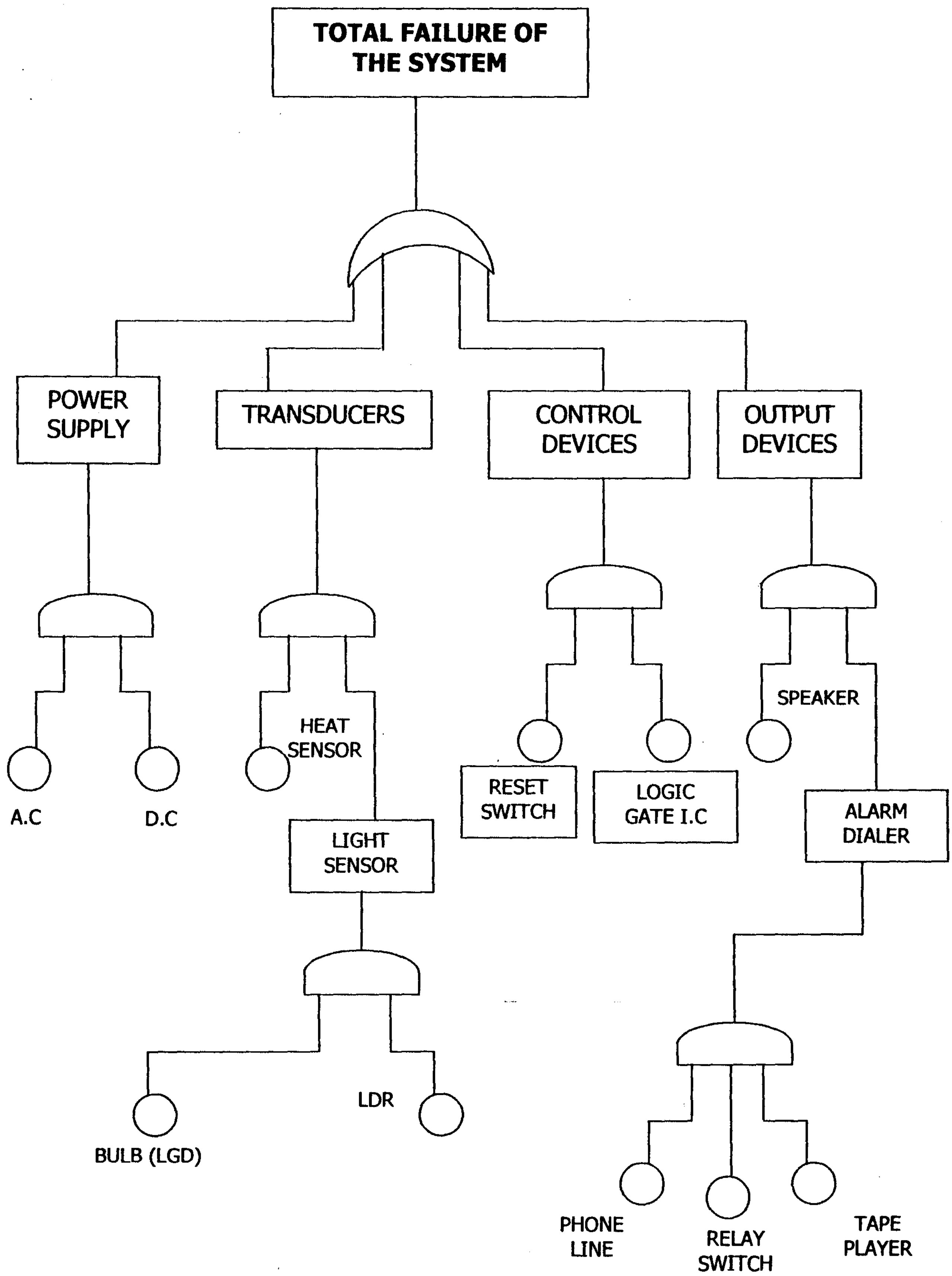


FIG 3.6 FAULT TREE BLOCK DIAGRAM

3.6 FAILURE RATE OF THE COMPONENTS

1) Heat sensor (F_{HS}) = 0.1
2) Light Dependent Resistor (LDR) (F_{LDR}) = 0.1
3) Phone Line (F_{PL}) = 0.03
4) Light Emitting Diode (LED) (F_B) = 0.05
5) Relay Switch (F_{RLS}) = 0.02
6) Tape Player (F_{TP}) = 0.15
7) Alternating Current Supply (A.C) (F_{AC}) = 0.1
8) Direct Current Supply (D.C) (F_{DC}) = 0.05
9) Reset Switch (F_{RS}) = 0.02
10) Logic Gate IC (F_{LG}) = 0.004
11) Speaker (F_{SP}) = 0.02

3.7 THE FAULT TREE ANALYSIS

a) Probability of failure of power supply (FPS)

F_{PS} = (FA.C) (FD.C)

F_{PS} = (0.1) (0.05) = $5X10^{-3}$

b) Probability of failure of light sensor (FLS)

F_{LS} = 1- (1-F_B) (1-F_{LDR})

F_{LS} = 1 (1.0.05) (1-01) = 0.145

F_{LS} = 0.145

c) Probability of failure of control devices (FCD)

F_{CD} = 1- (1-F_{RS}) (1-F_{LG})

F_{CD} = 1- (1-0.02) (1-0.004)

F_{CD} = 2.392×10^{-2}

d) Probability of failure of Alarm Dialer (FAD)

F_{AD} = 1- (1-F_{PL}) (1-F_{RLS}) (1-F_{TP})

F_{AD} = 1-(1-0.03) (1-0.02) (1-0.15)

F_{AD} = 1.92×10^{-1}

e) Probability of failure of Transducers (FTRANS)

F_{TRAN} = (F_{HS}) (F_{LS})

= (0.1) (0.145)

F_{TRAN} = 1.45×10^{-2}

f) Probability of failure of Output Devices (F_{OP})

F_{OP} = (F_{SP}) (F_{AD})

= (0.02) (0.19199)

$F_{OP} = 3.8398 \times 10^{-3}$

g) Probability of failure of the entire system

$F_{TFS} = 1- (1-F_{PS}) (1-F_{TRAN}) (1-F_{CD}) (1-F_{OP})$

$= 1- (1.5 \times 10^{-3}) (1-1.45 \times 10^{-2}) (1-2342 \times 10^{-2})$

$F_{TFS} = 0.0466$

3.8 RELIABILITY ANALYSIS

Reliability = 1- F(E)

F(E) = 0.0466

R(E) =1- 0.0466

0.9534

R(E) = 0.9534 x 100

95.34%

F(E) =0.0466 x 100

4.66%

R(E) = (1 – TT (1-R(E)

Where (t = 1, 2, 3, 4, 5 - - - - - -)

R(E) = (1(1.09) (1-0.95) (1-(1-0.9) (1-0.95) (0.9)

(098) (0.996) (1-(0.97) (0.98) (0.85) (1-098)

R(E) = **0.9534**

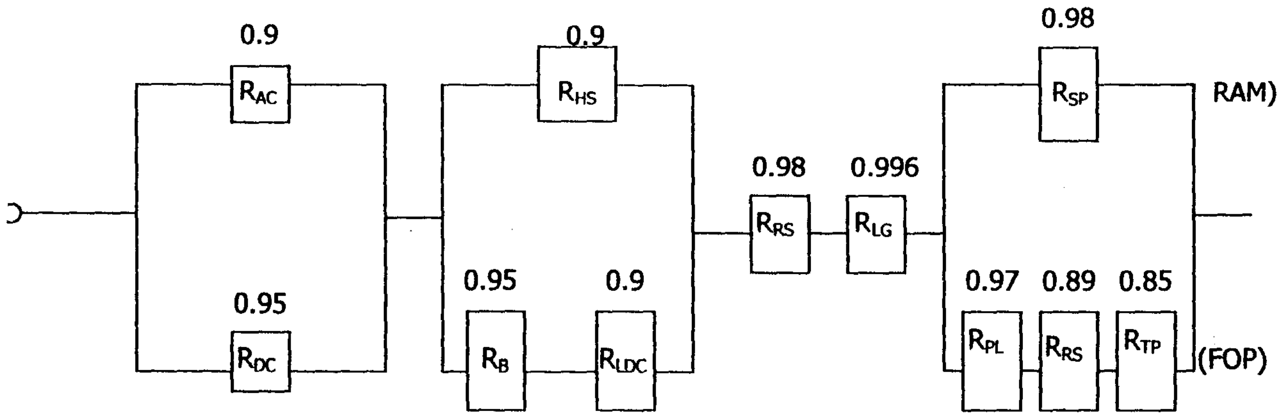


FIG (3.7) RELIABILITY BLOCK DIAGRAM

CHAPTER FOUR

4.1 CONCLUSION

Successful design and construction of a functioning fire and alarm dialer had been carried out as described.

The demonstration of the detection of fire depends solely upon the temperature of the heat sensor or detector (Thermistor), the smoke sensor or detector (Light Dependent Resistor LDR) and the subsequent relay of information to rescue agents (Fire Service Stations) with the aid of pre-recorded phone numbers through phone lines.

The main purposes of this project, is to produce a prototype detector circuit that could accept a LOW input signal (i.e. presence of fire or smoke) from tow sensors (thermistor for heat and light dependent resistor LDR for smoke) sequentially and then give a HIGH output to the input of the interfaced alarm dialer and the interface alarm dialer and the output speaker as well.

The speaker provided instant alarm, with the help of the interface to the telephone system, it is possible for the danger message to pass across to fire service stations and have the information of any damage to get across to many other concerned bodies.

4.2 RECOMMENDATION

After the final construction and analysis as states in this piece of work have been implemented, it is observed that further improvement can still be carried out. This piece of work will serve the primary aim of providing enough back-ground for whoever is interested in building a modern five and alarm dialer system.

Despite the 99.9% reliability of this design, it can still be improved upon by increasing the sensitivity of the smoke and heat detection and as well pre-record more phone numbers so that more rescue bodies can be informed of any five outbreak. The circuit should as well be able to detect when the telephone hand-set is picked or not.

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APPENDIX

PARTS LIST

Item No.	Description	Types
R1	390Ω	Fixed value resistors
R2	60KΩ	
R3	10KΩ	
R4	10KΩ	
R5	940Ω	
R6	10KΩ	
R7	10KΩ	
R8	10KΩ	
R9	10KΩ	
R10	100KΩ	
R11	100KΩ	
R12	330Ω	
R13	10MΩ	
R14	10KΩ	
R15	10KΩ	
C1	3300μF	
C2	1μF	
C3	100μF	
C4	100pF	
C5	1μF	
C6	4.7μF	
C7	0.01μF	
C8	47μF	
C9	4.7μF	
C10	0.01μF	
C11	0.1MF	
LED	Light Emitting Diode	
LDR	Light Dependent Resistor	
RT	Thermistor	
Q1	C1568 NPN Transistor	
Q2	C9013 NPN Transistor	
Q3	C9012 PNP Transistor	
D1	1N4001 Diode	
D2	1N4001 Diode	
D3	1N4001 Diode	
D4	1N4001 Diode	
D5	1N4001 Diode	
D6	1N4001 Diode	
IC1	μA741 Operational Amp	
IC2	μA741 Operational Amp	
IC3	555 Timer	
IC4	4011B	
IC5	555 Timer	
IC6	555 Timer	
SW1	Reset Switch	
TR1	220-12V A.C Transformer	
TR2	80Ω500ΩCoupling Trans.	
FB	Bridge Rectifier	
RV	9V Voltage Regulator	
SPK	4Ω 10W Speaker	
Miscellaneous	Relay Switch	
	Dry cell Batteries	