DESIGN AND CONSTRUCTION OF NON-LATCHING FIRE ALARM SYSTEM WITH MULTI-REGIONAL SENSORS.

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(2005/22032EE)

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

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A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER, 2010.

DECLARATION.

I *GWAMZHI EMMANUEL PONSAH* declare that this work was done by me and has never been presented anywhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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ABSTRACT.

The project designed and constructed is a Non-Latching fire alarm system with multi-regional sensors. It is a fire alarm that detects the presence of fire in three different rooms or floors by sensing the ambient temperature of the room or floor. The alarm is triggered when the temperature sensor (thermistor) in any of the rooms or floors senses any temperature above 41°C. When the fire is eliminated, the alarm goes off on its own without any external aid ridding the environment of any unnecessary noise.

The Non-Latching feature was achieved using a microcontroller which was programmed to achieve that purpose.

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CHAPTER ONE

1.0. INTRODUCTION

Fire detection is one of the chief safety concerns for residential and office of complex buildings, as absence of fire alarm has resulted in much loss of lives and properties through fire. This disaster would have been averted or controlled if they were fire alarms existing in this buildings no notify people of the impending disaster.

The Non-latching fire alarm system with multi-regional sensors is an alarm capable of detecting the presence of fire in three different rooms due to the presence of the three temperature sensors which can be situated in each of the three rooms of a building, such as homes or offices. This alarm displays the state of each room where the temperature sensors are situated on a screen (Liquid Crystal Display) such that, when any of the rooms are in peril of fire, the exact location of the room is known. This allows the precise location where a fire may be present to be identified, saving valuable time for emergency responders and allowing for automated fire expression.

This alarm, once triggered, is also capable of switching off the alarm or reset on its own without any external assistance. Unlike traditional fire systems which are constructed in such way that once the fire alarm is triggered, it continues to sound the alarm until it is manually put off by someone, and these modern traditional fire alarms are usually connected to first aids like water showers, which showers water to the room or office in order to minimize the effect of the fire before the fire service arrives. When the fire service put out the fire, then they switch off or reset the alarm.

In cases where the fire is mild and the alarm is triggered with no one at home or office, or the fire service are a distance away, this implies that though the fire would be put out by the first aid connected to the fire alarm, yet the shower keeps pouring water even when the danger is no more there. This results in the room being drenched with water, though the fire has been put out.

Hence fire alarms that can sense danger, sound an alarm to notify nearby persons of the danger and if the cause of danger or the danger itself is put out, the alarm would stop on its own, without continuous sounding of the alarm or showering of water because the danger has been put out, such alarm would no doubt be preferred to the existing traditional alarms. With such non latching alarms, rooms and the surroundings are ridded of unnecessary noise and wetness.

1.1. OBJECTIVES

- The non latching fire alarm system with multi regional sensors is aimed at modifying the traditional existing fire alarm systems with its non latching feature, by integrating a microcontroller into the system which activates and deactivates the buzzer based on the temperature sensed by each sensor in the different rooms.
- The project is aimed at eliminating or ridding the surrounding of unnecessary noise, especially when the cause of danger or the danger itself is eliminated.
- With the multi regional sensors situated in different rooms, the project is aimed at providing exact and specific direction of which room or rooms are in peril of fire hazard in order to appropriate quick and immediate response in extinguishing the danger.

- The project is aimed at creating a system that is able to take over full-time surveillance responsibility in alerting residents of possible fire outbreak in the buildings.

1.2. METHODOLOGY

The method employed in this project work entails the design of the circuit. The designing of the circuit is aimed at achieving a reduced and compact circuitry that is capable of performing the functions of detecting the presence of fire by sensing the temperature change of the room, sounding an alarm as well as displaying the state of the room or rooms in peril of fire, and also, deactivating the alarm when the fire or cause of fire is eliminated. This reduced circuitry was achieved by the use of a microcontroller instead of multiple 555 timers, relays, and operational amplifiers, which would have made the circuitry of the Non-Latching fire alarm system with multi-regional sensor to be large.

Also, simulation of the designed circuit is to be done in order to know if achieving the project is feasible. The simulation is to serve as a way of examining the circuit to see if it would work or not.

Bread boarding of the circuit will be implemented to verify again if the project could be physically achieved. After which the components would be soldered on a Vero board and tested. Finally, a suitable case would be constructed to house the project.

1.3. SCOPE OF WORK

This project is chiefly concerned with achieving the function of detecting the presence of fire by sensing the abnormal ambient temperature of the rooms, activating the alarm when fire is detected or the ambient temperature is way above normal as well as deactivating the alarm on its own when the presence of danger is eliminated.

The Non-Latching fire alarm system with multi-regional sensors is not connected to any first aid system. Unlike some fire alarms that are connected to first aid system such as water sprinklers that helps to reduce the spread of fire or electromagnetic doors that shuts open doors when fire is detected so that the air handling system can be reconfigured to prevent the distribution of smoke throughout the building. This alarm has three temperature sensors which can cater and serve as a twenty four hour surveillance for only three rooms of any building.

CHAPTER TWO

LITERATURE REVIEW

2.0. HISTORICAL BACKROUND

At the beginning of the 20th century, the threat of fire outbreak existed in both cities and towns. As a result, ways of preventing and fighting fires were invented, and the efficiency of these methods increased through the century. Until recent years, the prime method of preventing injury and death in building was by shielding the occupant from the fires, flame and heat. The smoke and toxic gases from the fire were causing more death than the direct effect of the flame and heat. [2]

Today 80% of deaths in building fires are caused by smoke inhalation. A few breaths of some toxic gases will completely immobilize a person, with death following. In a matter of minutes, the victims are dead before the fire ever reaches them [1].

Two hundred years ago, Americans early fire alarms were pragmatic. Communities announced fires by blowing whistles, ringing church bells or even shooting guns into the air [3]. The earliest American fire alarm came in 1658 when New York first fire department employed eight men. Nightly the fire men walked the streets checking for possible fire outbreak. Also, in the 1850s, the hand shaken wooden rattle alarm was invented by the Australians, which woke people from impending harm. But in 1852, William F Channing and Moses Farmer invented the telegraph technology and designed two fire alarm boxes each with a telegraph key. Once anybody cranked the handle attached to the box, the key is released, sending out a message of box number to a central alarm station. Upon receiving the message, the telegrapher at the station sends the corresponding address of the box location to the fire department response team for immediate action [3]. In the 1970s, the first AC battery powered smoke detectors were made. The residential sales of the same type of smoke alarm brought new companies into the industry. An estimate shows that about 92 percent of all Americans homes had smoke detectors by 1993.

However, the 21st century offers new technology for fire alarm systems working without wires. These fire alarm systems vary considerably in their complexity, from simple manual pull alarm to those which can reduce the spread of fire and provide targeted verbal announcement. Typical fire alarms consist of a central panel, main and backup power supplies, and various initiation and notification devices.

The fire alarm control panel is the heart of any installation constantly monitoring the initiation devices for signs of fire and taking appropriate steps when abnormal conditions are detected. Unlike older models, modern addressable control panels are able to identify and control each device individually. This allows the precise location where a fire may be present to be identified, saving valuable time for emergency responders and allowing for automated fire expression.

Initiation devices provide information to the control panel about the conditions in the building. Manual pull stations, smoke detectors, heat detectors and flame detectors are common types of initiation devices. The most frequently used automatic fire detection devices are smoke detectors. Ionisation or photoelectric technologies are commonly used, though photoelectric technology is more flexible and less prone to false alarms. For critical applications, an air sampling smoke detectors operates over a wider area and offers very high sensitivity.

Modern fire alarms can also control building safety interfaces, which help to reduce the impact of the fire and slow its spread. Fire doors held open when by electromagnets are easily closed, and the air handling system can be reconfigured to prevent the distribution of smoke throughout the building. Activation of a sprinkler system is often successful in controlling the spread of fire. These capabilities make today's fire alarm system valuable partners in the ongoing quest to protect both human lives and materials [6].

2.1. THEORITICAL BACKGROUND

Fire alarms, when used correctly can save lives and valuable tangible assets. Different types of building have different requirements for fire alarm systems. In homes, they are usually simple smoke detectors. Commercial properties and larger buildings will often have hard wired fire alarm attached to an alarm panel in addition to manual fire alarm boxes [3].

2.1.1. TYPES OF FIRE ALARM

Different types of fire alarms exist which are classified into the following:-

- Manual fire alarms: - which must be pulled by a human in larger buildings. They are found mounted on the walls and are wired to a building-wide alarm system. If someone in the building sees a fire or large quantity of smoke, all they need do is to pull the handle to sound the alarm.
- Smoke detectors: - These are the simplest type of fire alarm system. They are also the most commonly used. Ionisation detectors do not detect the fire itself, but just the particles in the smoke from the fire. Due to the fact that the smoke occurs in the early stage of the fire, this method of detection is highly effective.
- Photoelectric alarm system: - These are slightly more complex than ionisation system. They rely on the visible particles created by flames. When enough particles are in the chamber, they reflect and block waves transmitted to the receiver. The receiver will

set off a switch. This switch will route electricity to the beeping alarm; the beeping will notify the building occupants of fire.

- Thermal fire alarms: - These types of alarm detect heat within a room. They work through a sensor. At room temperature, the sensor will have a certain amount of conductivity. When the sensor is heated, the conductivity of the sensor changes. This change of conductivity will trigger the alarm.

The Non-Latching fire alarm with multi regional sensors is built as a thermal type of fire alarm, in which the alarm is triggered as a result of the change in conductivity of the temperature sensors (thermistors) when the ambient temperature is abnormal.

2.1.2. REVIEW OF PREVIOUS DESIGN

From research, I discovered that a similar project titled "Design and Construction of multiple fire alarm system" was carried out by Usman Mohammed Baba of the department of Electrical and Computer Engineering, Federal University of Technology, Minna, in October 2006. This was designed to detect the presence of fire for two rooms or floors using red and green LEDs as his video output and the use of different sound for indicating the location of fire in the building. The displayed colour of the LEDs and the sound associated to it is used to know which room or floor is affected by fire. This is not as effective as using a liquid crystal display (LCD) in showing the exact location of the fire, especially when the neighbours are the ones who come to assist, because they might not know the interpretation of the LED colour nor the sound heard and would impede the immediate response that should have been administered if only they knew which of the rooms or floors the fire is coming from.

Also, the multiple fire alarm system was achieved using 555 timers, relays, comparators and oscillators. This made the circuitry of the multiple fire alarm system to be complex and large compare to the Non-Latching fire alarm system with multi-regional sensors which is of a simple and reduced circuitry due to the use of a single microcontroller that achieves the functions of a 555 timers, relays, oscillators etc.

Finally, the multiple fire alarm system can only serve as surveillance for only two rooms or floors of a building compared to the Non-Latching fire alarm with multi-regional system which is capable of serving as a twenty four hour surveillance for three rooms or floors of a building. And like other traditional alarms, the multiple fire alarm system lacks the non latching feature, in that when it is triggered, it keeps sounding and would require someone to reset it before the alarm is stopped.

2.2. BLOCK DIAGRAM

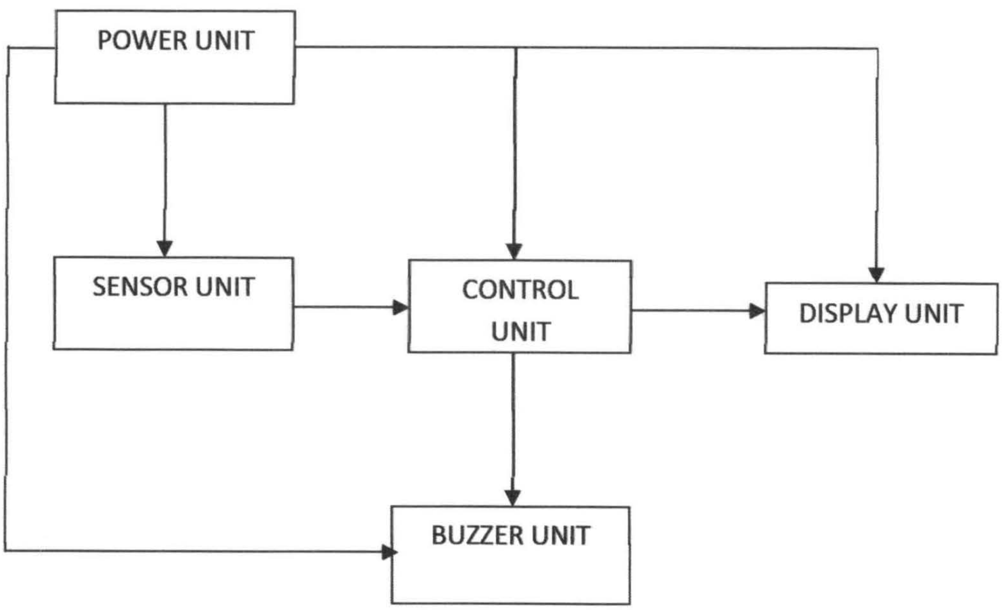


Fig 2.0. Block diagram of the Non-Latching fire alarm system

2.2.1. POWER UNIT

The power unit is responsible for feeding the entire circuit of the Non-Latching fire alarm system with multi-regional sensor with a steady regulated DC supply of 5V from a 230V AC main.

2.2.2. SENSOR UNIT

Sensors are devices capable of detecting and responding to physical stimuli such as movement, light or heat etc. This unit is responsible for monitoring the ambient temperature of all the rooms or floors and reports abnormal temperature to the microcontroller which in turn triggers the alarm.

2.2.3. CONTROL UNIT

The control unit is responsible for feeding the display unit of the monitored temperature from the sensor unit as well as triggering the alarm when abnormal temperature is detected.

2.2.4. DISPLAY UNIT

The display unit is responsible for displaying the fire status of each room or floor. And in cases of fire outbreak, the display unit shows the exact room or floor affected by fire for immediate response.

2.2.5. BUZZER UNIT

The buzzer unit is responsible for alerting nearby persons of the presence of fire by sounding the alarm.

CHAPTER THREE

DESIGN

3.0. POWER UNIT

The power unit consist of a 220V/12V step down transformer, a single bridge rectifier chip which is responsible for converting the AC power to DC power, a filtering capacitor that is responsible for smoothing the ripples of the AC component so that a steady DC is obtained.

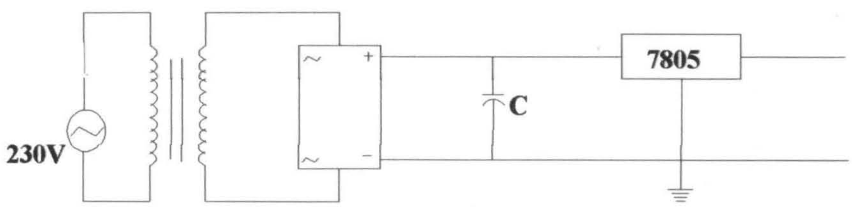


Fig 3.0. The circuit design of the power unit

MATHMATICAL ANALYSIS

From,

$$Q = Cdv \quad \text{...}(1)$$

Also,

$$Cdv = it \quad \text{...}(2)$$

$$C = \frac{it}{dv} \quad \text{...}(3)$$

$$V_{peak} = \sqrt{2}\, V_{r.m.s}$$

But,

$$V_{r.m.s} = 12V$$

$$\therefore V_{peak} = \sqrt{2}X12 = 16.97V$$

But because of the silicon material is used in rectification, the actual peak voltage becomes

Since only two diodes conduct during each cycle for bridge or full wave rectification,

Voltage drop due to the conducting diodes becomes $2X(0.7V) = 1.4V$

Actual peak voltage V $= 16.97 - 1.4 = 15.57V$

Also, from the specification of the step down transformer used, the output current I is given to be

$$I = 0.5A$$

From, $t = \frac{1}{f}$ where f is the frequency of generation from AC mains given to be 50Hz

$$t = \frac{1}{2X50} = 0.01\text{sec}$$ (due to two cycles covered in full wave rectification)

dv = 1.5% of the peak voltage, this gives

$$dv = \frac{1.5}{100}X15.57 = 0.23\text{V}$$

Going back to equation three,

$$C = \frac{it}{dv} = \frac{(0.01X0.5)}{0.23} = 21.739\mu\text{F} \approx 2200\mu F$$

Therefore, a capacitor of capacitance 2200μF is used as the filtering capacitor for the power unit. After wards, a 7805 voltage regulator is used so as to achieve a standard 5V, since the entire project needs a 5V DC to power it.

3.1. SENSOR UNIT

The sensor unit consist of three 1KΩ rated thermistors each connected in series to three 1KΩ resistor as shown below.

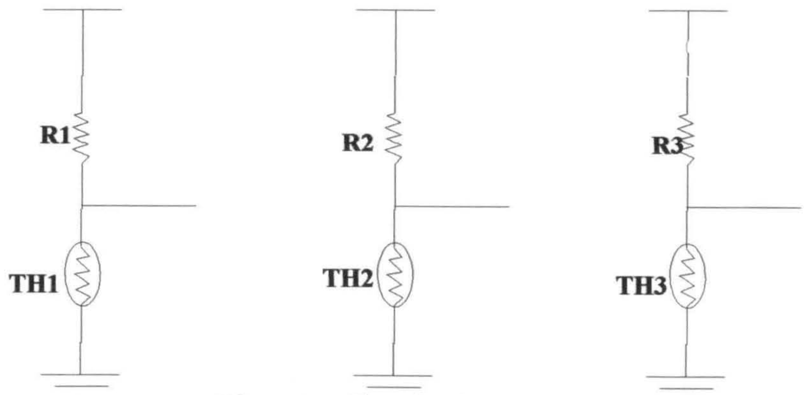


Fig 3.1. Circuit of the sensor unit

From voltage divider rule [9],

$$V_{Th} = \frac{R}{(R+R_{TH})} V_{cc} \quad \text{.......................................(4)}$$

Where R is the resistance of the resistor given as 1KΩ, R_{TH} is the resistance of the thermistor given also as 1KΩ, V_{cc} is $5V$ and V_{Th} is the voltage across the thermistor.

$$V_{Th} = \frac{1000}{(1000+1000)} \text{X } 5 = 2.5V$$

Usually, voltages below 1.7V are read as LOW and voltages above 1.7V are read as HIGH by the microcontroller. Therefore, the thermistor goes from HIGH to LOW (triggers the alarm) at a voltage of 1.7V.

Since the resistance of the thermistor is 1KΩ at 2.5V, then at 1.7V, the thermistor will have a resistance of,

2.5V ———— 1000Ω

1.7V ———— $\frac{1.7 \, X \, 1000}{2.5} = 680\Omega$

From the Stein-Hart equation [10],

$$R_T = R_{T0} \exp[B \, (\frac{T_0 - T}{T \, X T_0})]$$ ....(5)

Where R_T = Resistance at 0° C temperature T (Kelvin)

R_{T0} = Resistance at reference temperature T_0 (Kelvin)

B = constant known as 'B' parameter

$T_0 =$ Reference temperature

T = Temperature at 0°C or 273K

At 0° C or 273K, $R_T = 3.4K\Omega$ (Resistance of thermistor in ice)

At 30° C or 303K, $R_{T0} = 1K\Omega$ (Room temperature)

From equation (5),

$$B = \frac{T\,X\,T_0}{T_0 - T}\, In\, [\frac{R_T}{R_{T0}}] \quad ....(6)$$

$$B = \frac{303\,X273}{303-273}\, In\, \left[\frac{3400}{1000}\right]$$

$$B = 2757.3X1.2238 = 3374.4 \approx 3374$$

Rearranging equation (5), we would have

$$T_0 - T = \frac{T\,XT_0}{B}\, In\, \left[\frac{R_T}{R_{T0}}\right]$$

$$T_0 = T + \frac{T\,XT_0}{B}\, In\, [\frac{R_T}{R_{To}}]$$

$$T_0 = T\,[1 + \frac{T_0}{B}\, In\left[\frac{R_T}{R_{T0}}\right]]$$

$$T = [\frac{T_0}{[1+\frac{T_0}{B}}\, In\, [\frac{R_T}{E_T}]]$$

$$T = \frac{T_0}{T_0[\frac{1}{T_0}+\frac{1}{B}In\left[\frac{R_T}{R_{T0}}\right]]}$$

$$T = \frac{1}{[\frac{1}{T_0}+\frac{1}{B}In\left[\frac{R_T}{R_{T0}}\right]]}$$

$$T = (\frac{1}{T_0} + \frac{1}{B}\, In\left[\frac{R_T}{R_{T0}}\right])^{-1} \quad ....(7)$$

From equation (7), the preset temperature can be calculated over which the alarm is triggered

Resistance of thermistor at 1.7V (When the alarm is triggered), $(R_T) = 680\Omega$

Resistance of thermistor at room temperature (30° C or 303K), $(R_{T0}) = 1000\Omega$

Reference temperature (room temperature), T_0 = 303K

B parameter (constant), B = 3374

This implies that

$$T_{preset} = \left(\frac{1}{303} + \frac{1}{3374}\, In\left[\frac{680}{1000}\right]\right)^{-1}$$

$$= (3.3\ X\ 10^{-3} + [\ 2.963\ X\ 10^{-4}\ X(-0.3857)])^{-1}$$

$$= (3.3\ X10^{-3} - 1.1431X10^{-4})^{-1}$$

$$= (3.1857\ X\ 10^{-3})^{-1}$$

$$T_{preset} = 313.9028K\ \approx 314K \text{ Or } 41^{\circ}\text{ C.}$$

Therefore, the preset temperature over which the alarm will be triggered is 41° C

3.2. CONTROL UNIT

The control unit consist of an ATMEL 89S51 microcontroller. Like most microcontroller, the ATMEL 89S51 microcontroller has 40 pins. Pin 40 and pin 31 is connected to V_{cc} because pin 40 is forV_{cc} and pin 31 helps the microcontroller to be enabled. The crystal oscillator used is 12MHz connected to pin 18 and pin 19 while pin 20 is always grounded as shown in the diagram below.

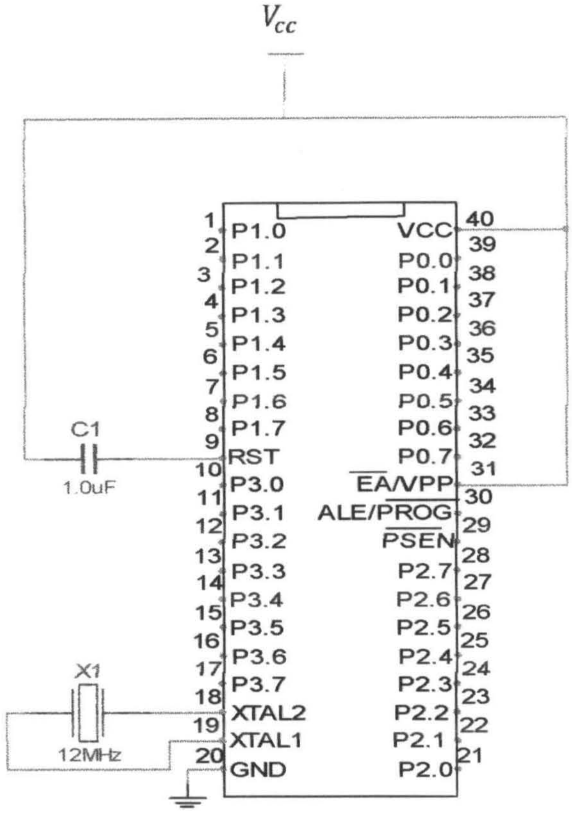


Fig 3.2. Control Unit.

The logic of the control unit is demonstrated in a table as shown below.

Table 3.0. Control Unit Logic.

Floor 1	Floor 2	Floor 3	Output result	Hazard status
0	0	0	All floors	Buzz
0	0	1	Floor 1 and 2	Buzz
0	1	0	Floor 1 and 3	Buzz
0	1	1	Floor 1	Buzz
1	0	0	Floor 2 and 3	Buzz

1	0	1	Floor 2	Buzz
1	1	0	Floor 3	Buzz
1	1	1	NIL	

3.3. DISPLAY UNIT

An HD44780 Liquid Crystal Display (LCD) is used as the display unit. This is used to display the status of each floor of the building in terms of fire hazard so as to be able to know where to launch a counter attack. The HD44780 Liquid crystal display is selected for the display based on the following features or characteristics:-

- Low power operation support (i.e. 2.7 to 5.5V):- The low power operation of the HD44780 liquid crystal Display made it fit it to be used as the display for the project since the entire project is fed with a steady 5V which falls within the power operating voltage of the liquid crystal display
- The HD44780 liquid crystal display allows options for the user in selecting either to program the Liquid crystal display using four bit instruction or eight bit instruction on it
- The HD44780 liquid crystal display supports a maximum of eighty characters i.e. it can accommodate more than eight phrases and at least, three non complex sentences.
- The HD44780 liquid crystal display allows for different font sizes i.e. 5x8 and 5x10 fonts depending on the desire of the user
- The HD44780 liquid crystal display allows for different font sizes i.e. 5x8 and 5x10 fonts depending on the desire of the user

- The HD44780 liquid crystal display has backlight incorporated to it which makes the displayed content to be viewed even in the dark.

3.4. BUZZER UNIT

The buzzer unit consist of an A1015 transistor driver and a buzzer as shown below. The transistor is responsible for triggering the buzzer when the base current of the transistor is low.

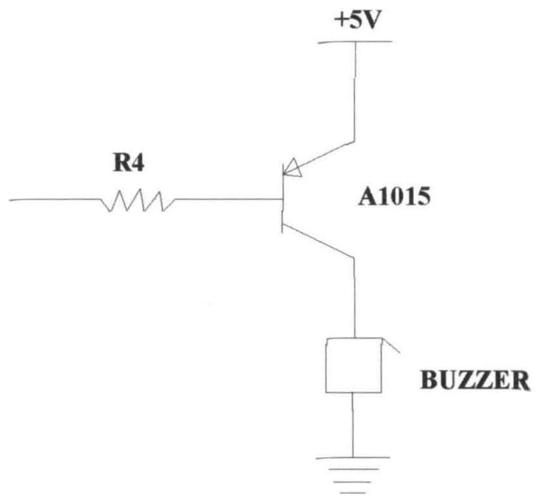


Fig 3.4. The circuit of the buzzer unit

$V_{cc} = I_c R_c + V_{ce}$ ....(8)

But at saturation, V_{ce} is zero i.e. $V_{ce} = 0$

$V_{cc} = I_c R_c$ Where R_c is the resistance of the buzzer given to be 100Ω

$$I_c = \frac{5}{100} = 0.05\text{A}$$

For $h_{fe} = 13$,

$$13 = \frac{0.05}{I_b}$$

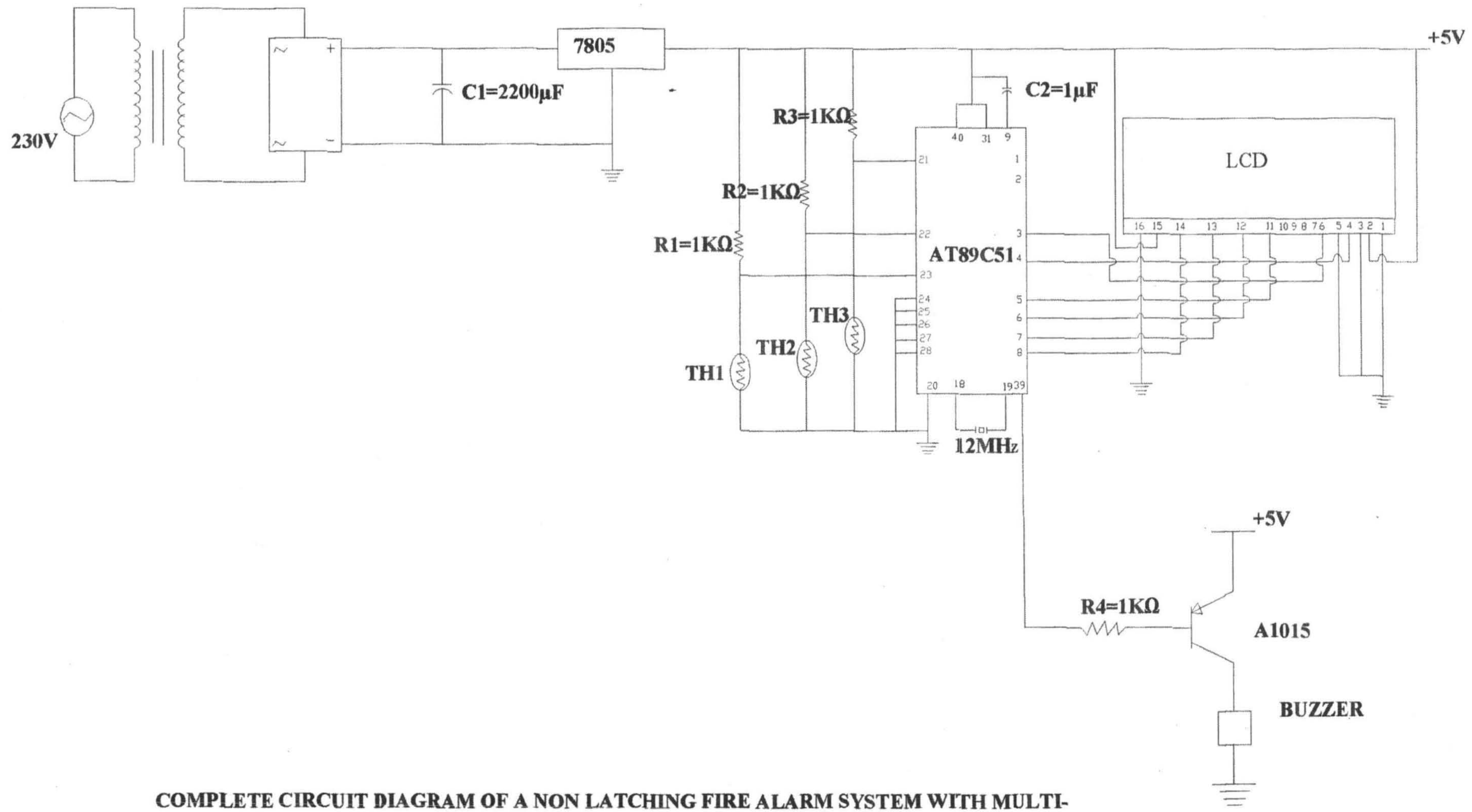
$$I_b = \frac{0.05}{13} = 0.003846\text{A}$$

$$V_b = I_b R_b$$

$$R_b = \frac{V_b}{I_b}$$

The output voltage from the microcontroller is 3.6V, this implies that $V_b = 3.6V$

$$\therefore R_b = \frac{3.6}{0.003846} = 936.037 \approx 1000\Omega$$



COMPLETE CIRCUIT DIAGRAM OF A NON LATCHING FIRE ALARM SYSTEM WITH MULTI-REGIONAL SENSOR

3.5. OPERATIONS

The operation employed in this project work is such that the inputs of the system are the heat sensors (thermistors). The three sensors are each connected to the microcontroller from different rooms. The microcontroller is then connected to a display unit (Liquid Crystal Display) and a buzzer. The Liquid Crystal Display and buzzer are the output of the system. The sensors sense the temperature of the rooms and feed the microcontroller of the state of the rooms. The microcontroller sends the data received from the sensors to the liquid crystal display which displays the hazard status of each room above normal, the sensor is the effected room senses this abnormal temperature and feeds the microcontroller. The microcontroller sends the data of that room to the liquid crystal display which displays the hazard status of the room by displaying the particular room that is affected, while the hazard status of the other rooms are displayed normal. The microcontroller now activates the buzzer. If the presence of the danger is extinguished and the temperature falls back to normal, the sensor of that room feeds the microcontroller of the new state of the room. The microcontroller sends the data to the liquid crystal display to display the new state of the room and the microcontroller deactivates the buzzer.

When the temperature of two or all the rooms is above normal, the sensors in the affected rooms feed the microcontroller of the abnormal temperature. The microcontroller sends data to the liquid crystal display. The hazard status of the affected rooms are displayed by displaying the affected rooms on the liquid crystal display, also, the buzzer is activated by the microcontroller. If the danger in the affected rooms is put out and the temperature in the affected rooms is put out and the temperature in the affected rooms fall back to normal, the sensors in those rooms feeds the microcontroller of the new states of the rooms. This data is then sent to the liquid crystal display from the microcontroller and the new state of the rooms is displayed while the microcontroller deactivates the buzzer.

CHAPTER FOUR

CONSTRUCTION AND TEST

BILL OF ENGINEERING MATERIALS AND EVALUATION

Name of components	Quantity	Unit price (#)	Total amount (#)
Bridge rectifier chip	1	50	50
220V/12V step down transformer	1	150	150
2200μF capacitor	1	50	50
1 μF capacitor	1	20	20
Crystal oscillator	1	60	60
HD44780U 16X2 liquid crystal display	1	2000	2000
Resistors	4	10	40
Thermistors	3	400	1200
Buzzer	1	250	250
Microcontroller	1	1000	1000
7805 Voltage regulator	1	50	50
Switch	1	30	30
Casing	1	2600	2600
		Total	7500

4.0. CONSTRUCTION AND CASING

Each stage of the circuit was first carried out on a breadboard to check the practical workability of each stage. As soon as all was seen to be working, the whole work was then transferred on a vero board and tests were carried out on it. When it was discovered that the whole project was working, everything was then cased

4.1. TEST AND RESULTS

Test	Observation	Remarks
Power was supplied to the power unit and the voltage was tested using a multi meter.	The voltage measured was found to be 4.96V.	Voltage within working range for the circuit.
Each of the thermistor was subjected to heat from a fire lighter for some considerable time.	The alarm was triggered in all the cases and the liquid crystal display, displayed the affected floors	The temperature of the surrounding is above the preset temperature of 41^0c.
The fire lighter was removed from the thermistors after being heated.	After a while, the alarm stopped and the liquid crystal display, displayed the new status of the floors to be NIL.	Temperature of the surrounding is now below the preset temperature.

4.2. PRECAUTIONS.

Proper and neat soldering was carried out to avoid unnecessary short circuiting on the board. Components soldered on the vero board were spaced from each other to avoid complications. Also, air inlets were created in the construction of the casing to allow ventilation, so that components would not be overheated.

CHAPTER FIVE

CONCLUSIONS

5.0. CONCLUSIONS

The project was successfully completed and besides the ability of the alarm to detect the presence of fire, the non latching feature was also successful i.e. the ability of the alarm to go off on its own when the temperature falls below 41^0C which is the preset temperature over which the alarm comes on.

5.1. PROBLEMS FACED

The only problem faced in accomplishing this project was the inability for the circuit to be simulated at the circuit design stage. This is because of the use of a microcontroller in the design of the circuit. Circuits involving microcontroller are difficult to simulate because a microcontroller works based on the program that has been burnt into it. Therefore at simulation stage involving a microcontroller, the circuit proves abortive since the microcontroller has not been programmed yet.

5.2. RECOMMENDATION

After the completion of this project, the following recommendations were proffered.

- A smoke and heat sensor could be used for this project for more effective detection of fire. This is because, the sensitivity of a heat sensor in detecting the presence of fire from a naked flame is not as effective compared to smoke sensors, only that smoke sensor can trigger false alarm due to the presence any smoke, whether cigarette smoke or candle or lamp etc. when it is not necessarily fire. A such, the microcontroller can be programmed in such a way that even when there is smoke, until a preset temperature is reached, the alarm would come on.

- The scope of this project was to offer full surveillance for three rooms or floors due to the three sensors present on it. However, the number of sensors could be increased beyond three based on desire in order for the alarm to cater for buildings that have more than three rooms or floors.
- First aids such as water sprinklers could be incorporated into the project by connecting a pump to the microcontroller and programming the microcontroller in such a way that when the alarm comes on, the pump is also put on so that the sprinkler can minimize the effect and spread of fire before the fire service comes.

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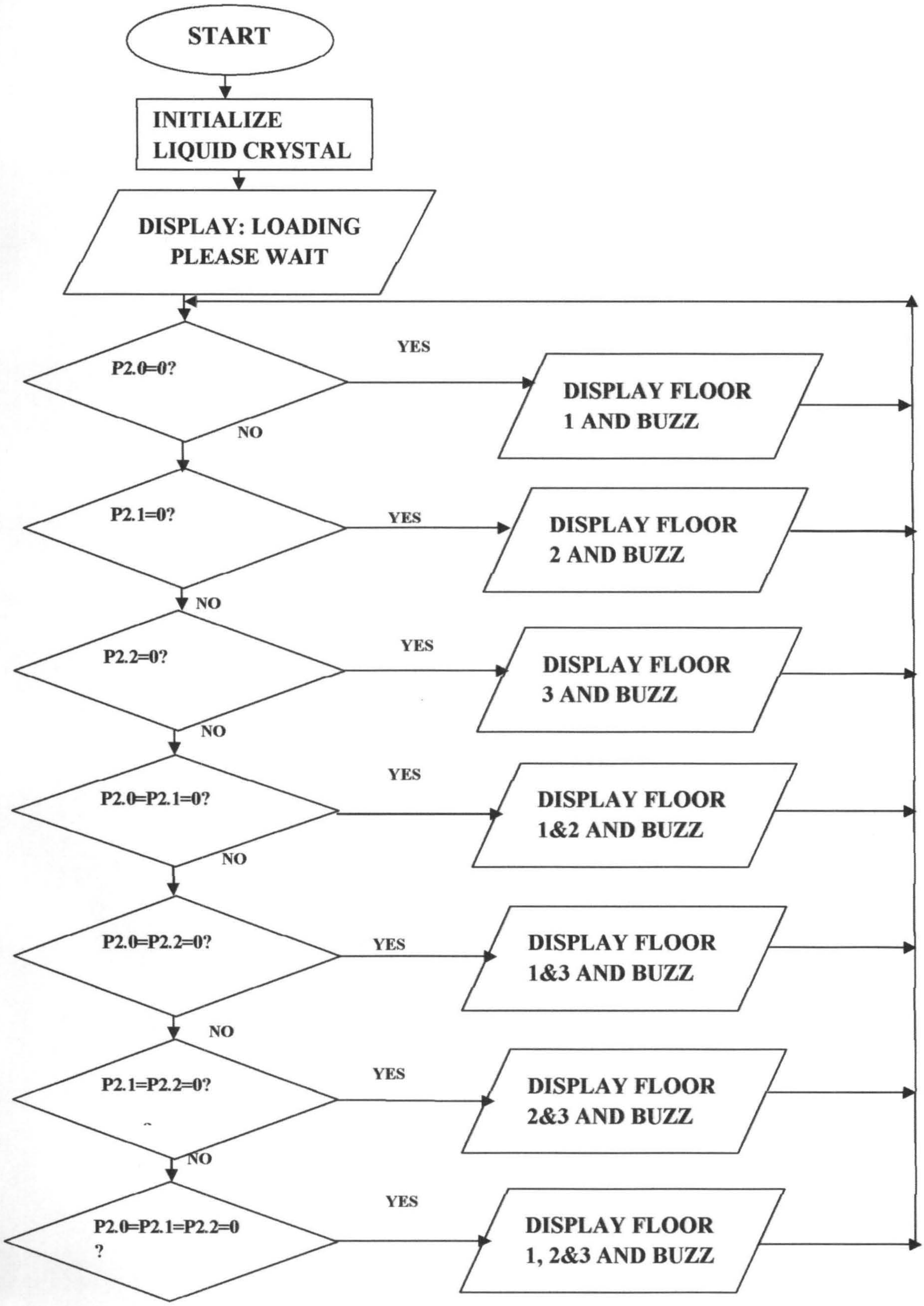
FLOW CHART

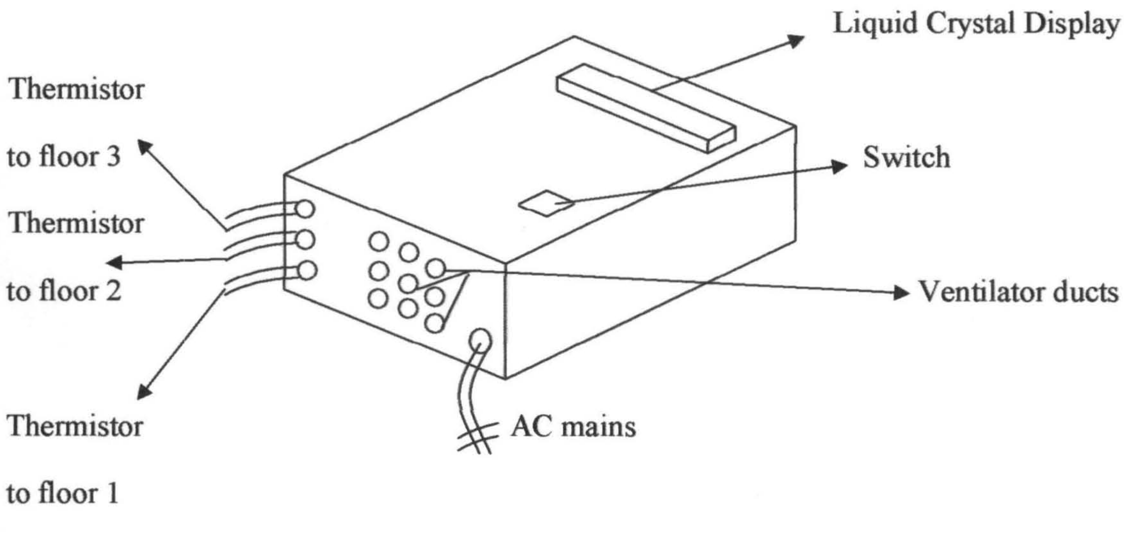

START
INITIALIZE LIQUID CRYSTAL
DISPLAY: LOADING PLEASE WAIT
P2.0=0?
YES
NO
DISPLAY FLOOR 1 AND BUZZ
P2.1=0?
YES
NO
DISPLAY FLOOR 2 AND BUZZ
P2.2=0?
YES
NO
DISPLAY FLOOR 3 AND BUZZ
P2.0=P2.1=0?
YES
NO
DISPLAY FLOOR 1&2 AND BUZZ
P2.0=P2.2=0?
YES
NO
DISPLAY FLOOR 1&3 AND BUZZ
P2.1=P2.2=0?
YES
NO
DISPLAY FLOOR 2&3 AND BUZZ
P2.0=P2.1=P2.2=0 ?
YES
DISPLAY FLOOR 1, 2&3 AND BUZZ

PROJECT MANUAL

NON-LATCHING FIRE ALARM SYSTEM WITH *MULTIREGIONAL SENSORS*

FUT MIN ELECTRONICS

3D VIEW



- ABOUT THE PRODUCT

The Non-Latching fire alarm system with multi-regional sensor is a fire alarm that detects the presence of fire especially from naked flames in three different rooms or floors simultaneously by sensing the ambient temperature of the room or floors. The alarm is triggered when the temperature sensors (thermistors) in any of the rooms or floors detects any temperature above 41^0C.

When the fire is put out, the alarm will on it's own go off without external aid.

- VOLTAGE RATING

230 AC

- PRESET TEMPERATURE

The preset temperature, above which the alarm will be triggered, is 41^0C

- MODE OF OPERATION

The Non latching fire alarm with multi-regional sensor operates on this wise, the temperature sensors (thermistors) are the imputs to the system, these sensors are connected to a microcontroller which performs the logic operations of the system. The microcontroller is connected to a buzzer as well as a liquid crystal displaying (Display Unit) The buzzer as well as Display unit are the output to the system. Once any sensors or all sensors detects the temperature of the room or floor in which they are placed to be above 41^0C, the signal is sent to the micro controller, the microcontroller now sends the data to the display unit to be displayed which room or floor is in peril of fire and also triggers the alarm. After the fire is put out, the sensors now will detect the new temperature and sends the signal to the microcontroller which now sends the data to the displaying unit to display the new status of the room or floor and also deactivates the buzzer.

- HOW TO USE THIS PRODUCT

1) Connect the power supply cable to a 230 AC main
2) Put individual thermistors in each room, the lower thermistor to floor 1 or room 1, the middle thermistor to floor 2 or room 2 and the upper thermistor to floor 3 or room 3. Make sure that the thermistors are put in a high place like the ceiling of the room or floor and at the centre of the room.
3) Put on the switch and you are ready for use.

- LIMITATION

1) This device is limited to three rooms or floors and can only cater for that much.
2) This device has no point of connection to first aids such as water sprinklers that can minimize the spread of fire before the fire fighters come around.

- PRECAUTIONS

1) Make sure that the thermistors are put in the centre of the room and on a high altitude to enhance uniform sensitivity of the room from all angles.
2) DO NOT bring any two thermistors together to make contact. This action will result in false alarm.

3) DO NOT put objects on the Alarm itself as this will result in Damage of the casing and subject the delicate Liquid Crystal Display also to damage