A Project

On

"HEAT SENSOR AND ITS APPLICATION"

SUBMITTED FOR THE BACHELOR DEGREE OF SCIENCE IN PHYSICS

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REPORT

A project on "**Heat Sensors and its applications**" was prepared by students of Department of Physics during the month March 2021. Six members of student participated in the project work. They collected several materials on the concerned topic from different libraries and other studious places. The department faculties co-operated them in all these works and this project is original.

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CONTENT

ABSTRACT

This research focuses on the construction & application of a heat sensor monitoring system. The circuit works by monitoring temperature from an external input &comparing the temperature level with that of a pre-set temperature value. The power output of the circuit is cut-off or switched OFF or an alarm is triggered ON if the temperature of the external input is equal to or, greater than the pre-set temperature value. The methodology involves the application of Linear precision temperature sensors I. e. they generate a voltage that is directly proportional to the temperature. Basically, the system is constructed using temperature sensor & comparators. The system is powered using a 12V power supply. The results of the tests showed that the power output of the circuit is switched OFF hence switching OFF the heating device or an alarm is triggered ON when the device exceeded a pre-set temperature level. The general operation of the system & performance is dependent on the temperature difference between the pre-set temperature value & external temperature intended to be monitored. The overall system was tested & found perfectly functional.

INTRODUCTION

The word "HEAT" is made manifest as a result of increase in temperature. Temperature is most often measured environmental quantities which correspond to primary sensation of hotness & coldness. The temperature sensors are often used in providing inputs to those control systems. However, in the case of too much exposure of some electronic components to high extreme temperature, there will be an advance effect on them which can lead to the damage of the components. Though, some of the components can even be affected & get damaged by low temperature values.

Semiconductor devices as well as LCDs (Liquid crystal Displays) can be affected & get damaged by temperature extreme. As the temperature threshold gets exceeded, an immediate action should be taken so as to prolong the lifetime of the system. In these, temperature sensing helps to improve the reliability as well as the lifetime of the system.

Most temperature monitoring devices are designed to respond to a particular (critical) temperature level. They are usually incorporated with different kind of alarms & light indicator units, which are triggered ON at an un acceptable temperature level. The temperature monitoring devices work with temperature sensor normally transducers which generate accurate voltage output that varies linearly with temperature. They are mainly used for monitoring industrial machines, electrical boilers, ovens & other heat energy related activities & this can be done by ensuring the temperature sensor &its leads are at the same temperature as the object to be measured. This usually involves making a good mechanical & thermal contact.

WHAT IS HEAT SENSOR

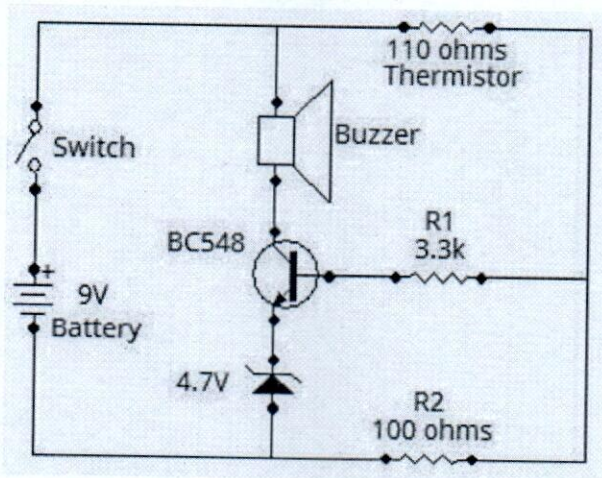
A heat sensor/ detector is a fire alarm device design to respond when the CONVECTED thermal energy of fire increase the temperature of a heat sensitive element. The thermal mass & conductivity of the element regulate the rate flow of heat into the element. All heat detectors have this thermal lag. Heat detectors have two main classification of operation, "rate-of-rise" & "fixed temperature". The heat sensor is used to help in the reduction of property damage.

HEAT SENSOR CIRCUIT & WORKING OPERATION

The main property of heat sensor is to sense the heat, which is present around the sensor. When the set value of temperature is high, then it is indicated with the help of a glowing LED. Heat sensor circuit senses the heat from various electronic devices like amplifiers, computer, etc, & thus generate the warming alarm.

Operating Principle of Heat Sensor Circuit Diagram

The simple heat sensor circuit is as shown below. A BC548 transistor, a thermistor (110 ohms) are a few components used in heat sensor.



110 ohms Thermistors: It is used to detect the heat.

BC548: BC548 is an NPN transistor TO92 type. We can use other alternatives like 2N2222, BC168, BC238 etc.

Buzzer: A buzzer is between the +9V battery & the collector terminal of the transistor. When the temperature exceeds a certain level, we can hear the alarm sound.

ZENOR Diode: 4.7V ZENOR diode is used to limit/ control the emitter current.

R1, R2: 100 ohms 1/4w is used as R2 & a 3.3k 1/4w resistor is used as R1.

9V battery: It is used as a single power source.

Switch: It is used as a Single Pole Single Throw (SPST).

In the above circuit diagram, a 100 ohms resistor & a thermistor are connected in series. If the thermistor is of negative temperature coefficient type, then after heating the thermistor, the resistance decreases & excess current flows through the thermistor. As a result, more amount of voltage is found at the thermistor & resistance junction. The voltage at the output is applied to an NPN transistor through resistance. With the help of the ZENOR diode, the emitter voltage can be maintained at 4.7V. This voltage is used as a comparison voltage. If the base voltage is greater than the emitter voltage, then the transistor conducts. If the transistor gets more than 4.7 base voltage, then it conducts & the circuit is completed through a buzzer & it generates sound.

(Heat Detector) –

A heat detector is a fire alarm device that detects the changes in the fire or heat. Any changes in the heat that exceeds the range of heat sensor rating is sensed by using the heat sensor. To avoid fire accidents, a heat sensor generates a signal that alerts & helps avoid damage.

HEAT DETECTOR CIRCUIT

Based on the operation, the heat detectors are mainly classified into two types.

- Fixed temperature heat detectors
- The rate of rising heat detectors

Fixed temperature heat detectors

There are two heat sensitive thermo couples in a heat detector. One thermocouple responds to ambient temperature. The other thermocouple is used to monitor the heat, which is transferred by radiation or convection. The heat detector operates irrespective of the starting temperature. The temperature rises from 12 deg. 15 deg. F per minute. These detectors can be operated at low temperature fire conditions if the type of heat detector threshold value is fixed.

Fig- (fixed temperature heat sensor)

A Rate of Rising Heat Detector

It doesn't respond to low energy release rates that deliberately develop fires. These combination detectors add a fixed temperature element which is used for detecting slowly developing fires. This element responds whenever a fixed temperature element reaches the threshold. Generally, an electrically connected fixed temperature point is 136.4 deg. F or 58 deg. C.

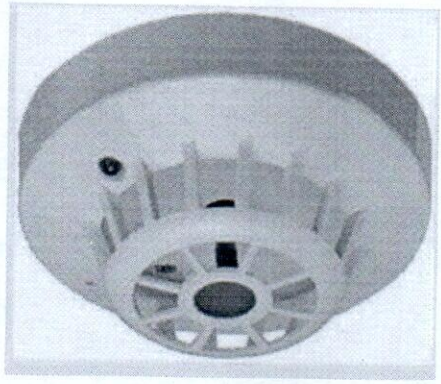


Fig- (A rate of rising heat detector)

TEMPERATURE SENSOR

It senses the amount of heat energy generated by a system or an object that allows us to detect or sense any physical change due to the temperature produced by digital or Analog output. Based on the applications, a temperature sensor is classified into different types with different characteristics. The two basic physical types of temperature sensor are;

Contact temperature sensor- The contact temperature sensor can be used to detect liquids, solids or gases over a wide range. The temperature sensor is required to be in contact with the object physically & it uses conduction for monitoring the changes in temperature.

Non- contact temperature sensor- the temperature sensor uses radiation on & convection for monitoring the changes in the temperature. The non- contact temperature sensor can be used to detect the gases & liquids that emit radiant energy, which is transmitted in the form of infra- red radiation.

TYPES OF TEMPERATURE SENSOR

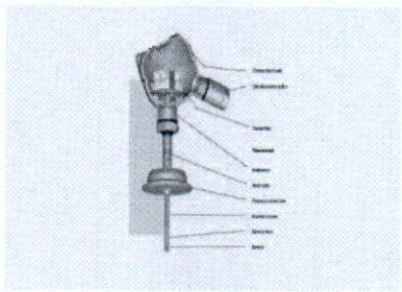
(a) Thermocouples
(b) RTD
(c) Thermistors
(d) Semiconductor based ICs
(e) Thermometer
(f) IR temperature sensor

Thermocouples-:

Temperature sensing is performed by equipment which is used to called thermocouple. A thermocouple is a temperature-measuring consisting of two dissimilar conductors that contact each other at one or more points. It produces a voltage when the temperature of one of the points differs from the reference temperature at other parts of the circuit.

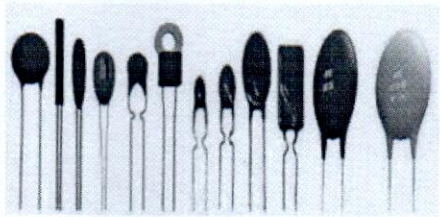
RTD (Resistance temperature detector)-:

These are the temperature sensor with a resistor that changes the resistive value simultaneously with temperature changes. The RTDs are used in a wide temperature range from -500C to 5000C for thin film & for the wire wound variety the range is from the +2000C to 8500C. The thin layer of platinum substrate is present on the thin film RTD element. A new pattern is created which provide the electrical circuit & it is trimmed to give a specific resistance.



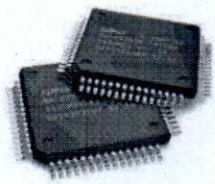
Thermistors-:

The thermistor sensor is a type of sensor. This type of sensor is used mostly in the human thermometers. If there is a change in the temperature, then the electrical current or resistance also changes. The thermistor is prepared by using the semiconductor materials with a resistivity which is especially sensitive to temperature. The resistance of a thermistor decreases with increasing temperature so that when the temperature changes, the resistance change is predictable.



Semiconductor based ICs-:

Semiconductor sensors are the type of temperature sensor which are available in the market in the form of ICs & these are called temperature ICs sensors. These sensors are divided into different types such as current output sensor whose output current is changed by changing temperature, voltage output sensor whose output voltage is changed by changing temperature, silicon temperature sensors with resistance output whose output resistance is changed by changing temperature, digital output temperature sensor and diode temperature sensors etc.

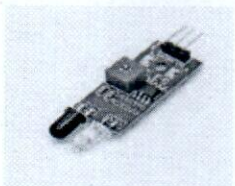


Thermometer-:

It is a device which is used to measure the temperature of any glass solids or liquids. In this type mercury or alcohol is used in a tube whose volume is changed by changing the temperature. Its volume is directly proportional to temperature.

IR temperature sensors-:

These are electronic & non- conducting sensor which have a certain characteristic such that it can detector emits IR radiations. Normally two types of IR sensor used in the market first one is an infrared sensor & second one is quantum infrared sensor. It detects the temperature by merit of radiations. Accuracy level depends upon its cost.



APPLICATION

- Used in Electric motors for measuring motor winding temperature
- Used in Internal housing temperature
- Used in Bearing temperature
- Used in Brushes temperate and external body temperature
- Used in Measuring the engine oil temperature & engine bearing temperature
- Used in water incoming water incoming tubes for measuring the water internal temperature
- Used in biomedical industry

ADVANTAGES OF TEMPERATURE SENSOR

- It has no effect on the medium
- More accurate
- It has an easily conditioned output
- It responds instantly

CONCLUSION

Overall the project was successful. The milestones & deliverables were done on time & within the schedule of the original chart.

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PROJECT ON: **Heat Sensor and its applications**

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SESSION 2020-21

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