A Project report on

FIRE WARNING DEVICE - THERMOCOUPLE SYSTEM

Submitted in partial fulfillment of the award of the

BACHELOR OF SCIENCE

IN

AERONAUTICS
(AVIONICS)

By

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BONA FIDE CERTIFICATE

This is to certify that project report titled " ***FIRE WARNING DEVICE - THERMOCOUPLE SYSTEM"***, is a bonafide record of work carried out by **Ms. ANKITA ANKUSH DAUNDKAR** during the final semester from **November 2020** to **April 2020** under my guidance, in partial fulfillment of the requirements for the award of **Bachelor of Science** in **Aeronautics** (**Avionics).**

Prof. Dr. M Suresh Kumar

Principal

DECLARATION

I, **ANKITA ANKUSH DAUNDKAR** hereby declared that this project report titled **Fire Warning Device – THERMOCOUPLE SYSTEM** submitted in partial fulfillment of the requirement for the award of **"BACHALOR OF SCIENCE -in AERONAUTICS (AVIONICS)** is my original work and it has not formed the basis for the award of any other degree.

ANKITA ANKUSH DAUNDKAR.

Place :

Date :

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It is my pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced my thinking, behavior, and acts during the course of study.

I express my sincere gratitude to my Project Guide **Ms. Ashwini** for providing me an opportunity to work under him.

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ANKITA ANKUSH DAUNDKAR

(2017-A-03)

Date : _____/_____/_____.

ABSTRACT

At the end of fifth semester when there is announcement about the final year projects I decided to make something that is related to our real life, something that is interesting and different. Firstly I thought about different projects like landing gear, Radio antennas, Aircraft light etc. But finally, I decided to do something related to Fire Detection and Warning System.

Since my childhood I have seen fire alarm system at various locations, such as schools, restaurant, organization offices, colleges and other public places, but never knew that how these system work and engineering approach is involved to meet this criterion. I started with a heat sensor that gives a certain output voltage corresponding with the increase in temperature. As fire occurs temperature increases therefore I have used this sensor in this project. This sensor sends the signal to the buzzer and the alarm starts sounding confirming fire.

Chapter 1

Introduction and Objective

1.1. Introduction

A short circuit, an overheated part of an aircraft, a lit cigarette, a burning splinter or just about any of these can trigger a fire and other flammable material works as a catalyst. So it hardly needs to spread the fire.

The fire alarm system that I have seen around me is not so advanced and the systems that are currently available in the market have high initial cost as well as it requires more maintenance. So there is four types of fire warning Devices. First one is thermal switch, second is thermocouple system, third is continuous loop system and the last one is

spot detector.

The thermocouple system consists of a heat sensor that is used for detection of fire. The thermocouple depends upon rate of temperature rise and does not give warning when an engine slowly overheats or a short circuit develops. The system consists of a relay box, warning alarm, and thermocouples.

The wiring system of these units may be divided into the following circuits:

- Detector circuit
- Alarm circuit
- Test circuit

1.2. Aim

The main idea of this project is to design a fire warning device Thermocouple system that can be produced at a low cost with effective and competitive usage. This system is designed to be more user friendly, easy to operate at any level and at any location and whose parameters can be adjusted according to requirements.

1.3. Problem Identification

The existing fire alarm systems available now-a-days in the market are costly and complex in terms of its design and structure. Due to higher complexity

of the fire alarm system, it needs regular maintenance in order to properly working of it. So it raises the using cost of the system. Therefore, the proposed Thermocouple system is designed with a low cost that can be used by all users for a safety purpose.

1.4. Project Objectives

Our objective is to design a Fire Warning System that would fulfill the following objectives:

- Indicate the part of an aircraft in which fire erupted.
- Sound the alarm if fire occurs.
- The system should be flexible enough to be easily modified.

1.5. Inspiration behind this

In any modern aircraft, modern structure or buildings of the world, safety has the highest priority and every now and then we witness the incidence of fire due to one reason or other, therefore fire detection and warning system is one of the biggest necessity of not only aviation industry but also any other industries.

CHAPTER 2

Technical Details

2.1. Reasons for choosing this solution

Conventional fire alarm systems having hard wire layout and normally opened warning devices like heat detector and in general specifications, have a good view in low price, but have a bad view in:

1. Low efficiency to warn
2. Difficulty of maintenance
3. Hard expansion and transformation of working

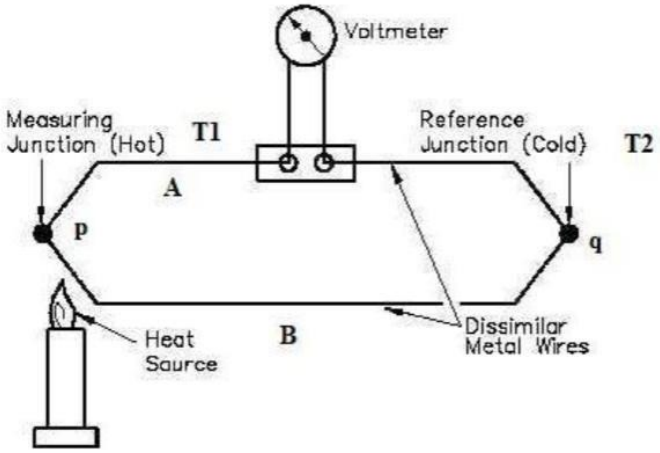
My proposed fire warning system is designed and built to solve these problems.

2.2. General Working

The general circuit for the working of thermocouple is shown in the figure 1 below. It comprises of two dissimilar metals, A and B. These are joined together to form two junctions, p and q, which are maintained at the temperatures T1 and T2 respectively. Remember that the thermocouple cannot be formed if there are not two junctions. Since the two junctions are maintained at different temperatures the Peltier emf is generated within the circuit and it is the function of the temperatures of two junctions.

If the temperature of both the junctions is same, equal and opposite emf will be generated at both junctions and the net current flowing through the junction is zero. If the junctions are maintained at different temperatures, the emf's will not become zero and there will be a net current flowing through the circuit. The total emf flowing through this circuit depends on the metals used within the circuit as well as the temperature of the two junctions. The total emf or the current flowing through the circuit can be measured easily by the suitable device.

The device for measuring the current or emf is connected within the circuit of the thermocouple. It measures the amount of emf flowing through the circuit due to the two junctions of the two dissimilar metals maintained at different temperatures.



Thermocouple Circuit

- **<u>Working Principle</u>**

The working principle of thermocouple is based on three effects, discovered by Seebeck, Peltier and Thomson.

They are as follows:

1) Seebeck effect: The Seebeck effect states that when two different or unlike metals are joined together at two junctions, an electromotive force (emf) is generated at the two junctions. The amount of emf generated is different for different combinations of the metals.

2) Peltier effect: As per the Peltier effect, when two dissimilar metals are joined together to form two junctions, emf is generated within the circuit due to the different temperatures of the two junctions of the circuit.

❑SEEBECK EFECT

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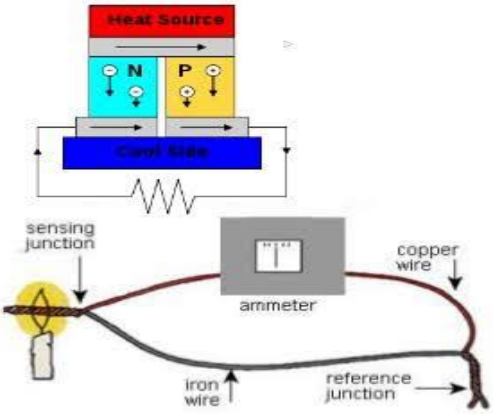

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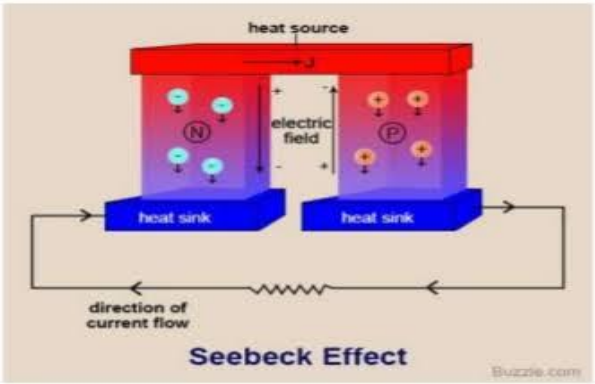


Cause of peltier effect

- When a current flows across the junction of two metals, it gives rise to an absorption or liberation of heat, depending on the direction of the current. i.e. Applying a current (e^- carriers) transports heat from the warmer junction to the cooler junction.

3) Thompson effect: As per the Thomson effect, when two unlike metals are joined together forming two junctions, the potential exists within the circuit due to temperature gradient along the entire length of the conductors within the circuit.

In most of the cases the emf suggested by the Thomson effect is very small and it can be neglected by making proper selection of the metals. The Peltier effect plays a prominent role in the working principle of the thermocouple.

2.3. Brief Description of Components

The proposed Fire detection and warning system will include :

– Heat sensor

– Buzzer

– Battery

2.4. Detailed Description of Components

Now we are going to discuss the details of the components that we have been used in my project.

2.4.1 Heat Sensor

Now a days various kinds of heat detecting devices are available in the market. Some of them are :

• Thermistor

• Thermocouple

• Diode based Temperature sensor

All of the above mentioned device have their own advantages and disadvantages but we are going to discuss the device that is most suitable for design. The advantages and disadvantages of each of the following are as follows:

2.4.1.1 Thermistor :

A Thermistor is a device whose resistance increases with temperature. It has

very high sensitivity for a wide range of temperatures but it has a non-linear scale. So a lot of mathematics required to get linear results.

2.4.1.2 Diode as Temperature Sensor :

As we know that the current flowing through the diode is a function of temperature. So a diode is an extremely low cost device that can be used as a temperature sensor but it has the disadvantage of a non-linear scale and it poor rating on the scale of reliability.

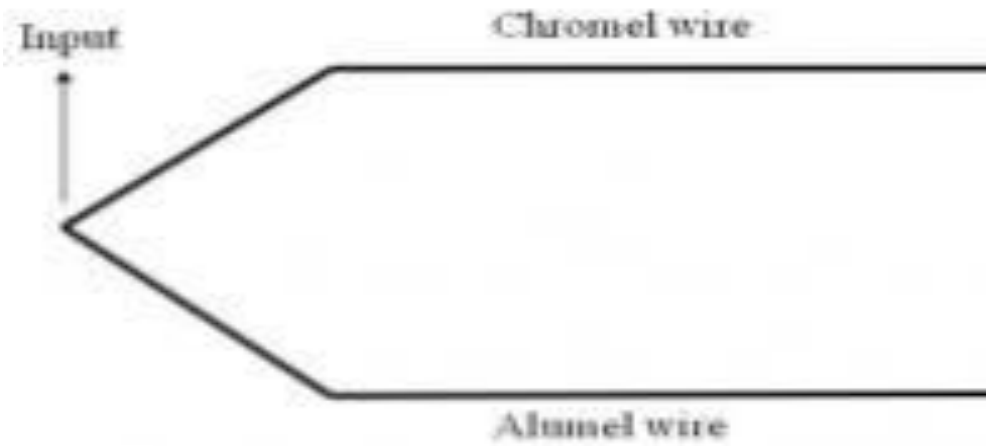
2.4.1.3 Thermocouple :

• The thermocouple is constructed of two dissimilar metals, such as chromel and constantan.

• The point at which these metals are joined and exposed to the heat of a fire is called a hot junction. There is also a reference junction enclosed in a dead air space between two insulation blocks.

Heat sensor

• A metal cage surrounds the thermocouple to give mechanical protection without hindering the free movement of air to the hot junction. If the temperature rises rapidly, the thermocouple produces a voltage because of the temperature difference between the reference junction and the hot junction.



2.4.2 Buzzer

A lot of buzzers, electric bells and alarms are available in the market for alarm purposes having different prices and uses. The buzzer that I have used is a 1.5-30V buzzer and it has sufficient sound to inform. A buzzer with louder sound would have been better but it will require high operating voltage, a constraint to our design

because I have only 30 V maximum supply voltage. One pin of the Buzzer is connected to battery and the another one is connected to heat sensor.

2.4.3 Battery

There are so many batteries available in market for all purposes having different prices. The battery that I have used is 9- Volt battery. It is a common size of battery and it has polarized snap connector at the top. It common used in fire detectors and smoke detectors. This battery has sufficient voltage to provide power to the system. One wire of the battery is connected to the hot junction and one wire is connected to the cold junction.

Battery

Chapter 3

Methodology

3.1 Procedure

This project consist of the following components :

1. Heat Sensor LM-35
2. 30V Buzzer
3. 9V Battery

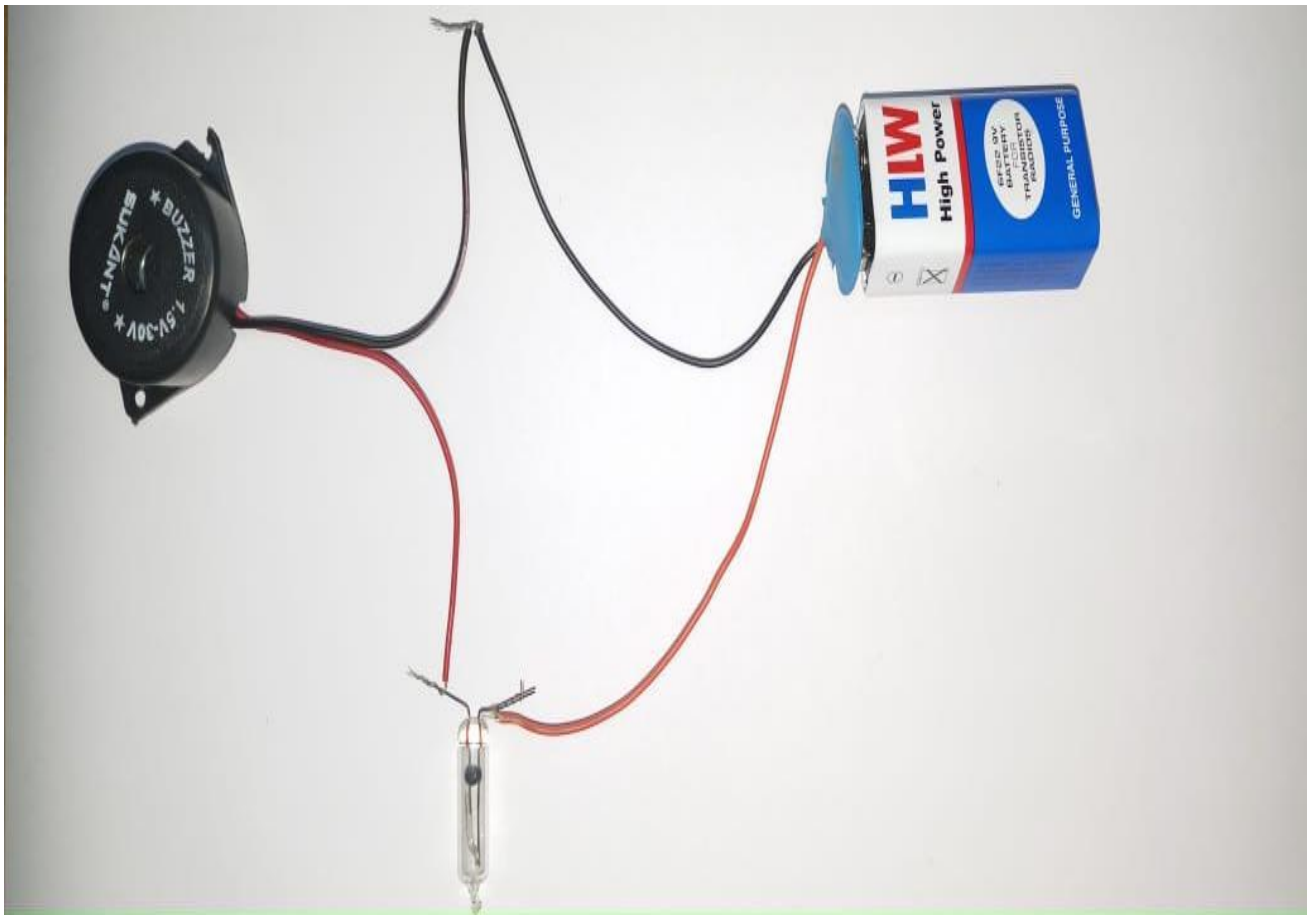
To accomplish the desired task step wise execution of project is necessary. Following are the steps to execute the project.

1. Select and purchase the components necessary or require for the project.
2. Components are to be to complete the circuit.
3. Then begin with, connect two dissimilar metal wire, this end known as Hot junction.
4. On the other end, one wire of Thermocouple is connect to buzzer and other to battery.
5. Hot junction is connected to the sensor that gives and output voltage to the corresponding temperature.
6. If the circuit catches fire, the temperature increases, so the output voltage of the heat sensor and gives the indication of the fire through the buzzer.
7. One wire which is left of the buzzer and battery will connect together and will become cold junction of the thermocouple system.
8. With the formation of the cold junction, the circuit of thermocouple is complete.
9. For the testing of my model thermocouple system I would light a lighter near

the heat sensor and wait further buzzer to go on.

10. If the buzzer sounds the alarm then model is successful.
11. If it not then necessary changes are to be made with respect to connections.

3.2 Hardware Implementation



3.3 Application

Thermocouples used in aerospace applications need to be able to withstand extreme environments. Even with extreme pressure changes, heavy vibration, and the threat of icing, aerospace thermocouples must be able to provide, precise, reliable temperature measurements at all times.

Thermocouples are widely used in science and industry. Applications include temperature measurement for Aircrafts, Gas turbine exhaust, diesel engines, steel and other industrial processes. Thermocouples are also used in homes, offices and businesses as the temperature sensors in thermostats and also as flame sensors in safety devices for gas-powered appliances.

Thermocouples are used in different temperature-sensing applications in turbine engines. However, despite their abundant use in aircraft systems, we are often not aware of how these seemingly simple devices actually work.

Thermocouple Types

Type	Positve Lead Material	Negative Lead Material	Useful Application Temperature
J	Iron	Constantan	200-1,400 F (95-760 C)
K	Chromel	Alumel	200-2,300 F (95-1,260 C)
T	Copper	Constantan	-330-660 F (-200-350 C)
B	Platinum 30%, Rhodium	Platinum, 6% Rhodium	2,500-3,100 F (1,370-1,700 C)
R	Platinum 13%	Rhodium Platinum	1,600-2,640 F (870-1,450 C)
S	Platinum 10%	Rhodium Platinum	1,800-2,640 F (980-1,450 C

The two types of thermocouples commonly used in aviation applications are Type J and Type K.

- **Type J**

Type J thermocouples are composed of a positive leg of iron and a negative leg of Constantan (45 percent nickel and 55 percent copper) wire. The iron lead is the positive (magnetic) lead and is color coded black. The Constantan lead is negative (non-magnetic) and is color coded red.

Type J thermocouples are usable from zero to 870 C for the largest wire sizes, although smaller wire sizes should operate in correspondingly lower temperatures. These are the recommended type thermocouples for use in reducing atmospheres.

- **Type K**.

Type K thermocouples are composed of a positive leg of Chromel® (90 percent nickel and 10 percent chromium) color coded yellow, and a negative leg of Alumel® (95 percent nickel, 2 percent aluminum, 2 percent manganese, and 1 percent silicon), color coded red. These are usable from -36 to 1,260 C.

Chapter 4

Conclusion

This project is done mainly considering safety and security of the aircraft, people and industry equipment's. The heart of this project is heat sensor. It senses heat of the surrounding then give the alarm with the help of buzzer. In this project I have monitored the critical parameters like temperature and fire. This project can be used for domestic purpose as well as industrial usage. The main advantage of this project is simple and easy method of controlling and it requires very low voltage for its operation. So with this project we can safe guard the equipment's and prevent serious injury and heavy loses.

Chapter 5

References

- http://www.kkingson18.wixsite.com/aerospaceservice
- www.wikipedia.org
- https://www.thermocoupleinfo.com/
- www.brighthubengineering.com

THANK YOU!