Smart Heat Detection and Emergency Response Interface

Takawira J. Mumanga[1], Rodolfo M. Martinez[2], Michael F. Grobler[3]
[1]Centro de Investigaciones en Óptica, A.C. Lomas del Bosque 115, Lomas del Campestre, León, 37150, Guanajuato, México;
[2]Centro de Investigaciones en Óptica, A.C. Prol. Constitución 607, Fracc. Reserva Loma Bonita Aguascalientes, 20200, México;
[3]Electrical and Electronic Engineering Science Department, University of Johannesburg, Auckland Park 2006, Republic of South Africa.
takah@cio.mx

Abstract

This document presents the progression through the development and an experimental test of a multipoint heat detection system with a smart emergency response interface.

Introduction

- The safety of people and their assets from fires is of paramount importance for all large building complexes.
- Fire outbreaks require immediate, clear and ordered evacuation procedures.

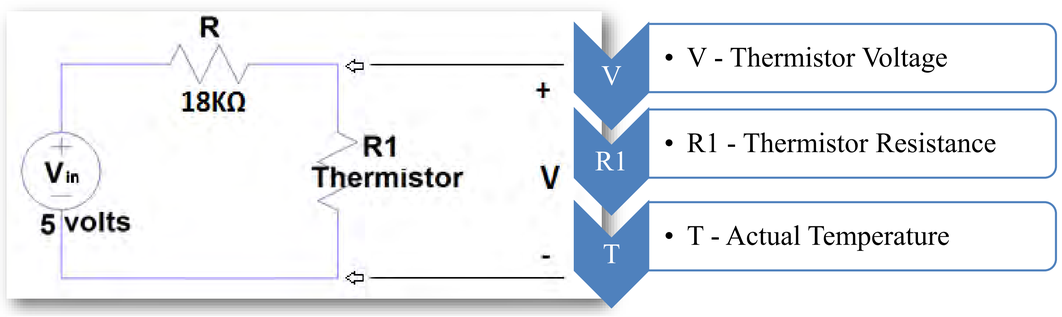
Purpose

The development of a real-time multipoint temperature monitoring system with an audio-visual emergency response interface that enhances fire detection and the evacuation procedure.

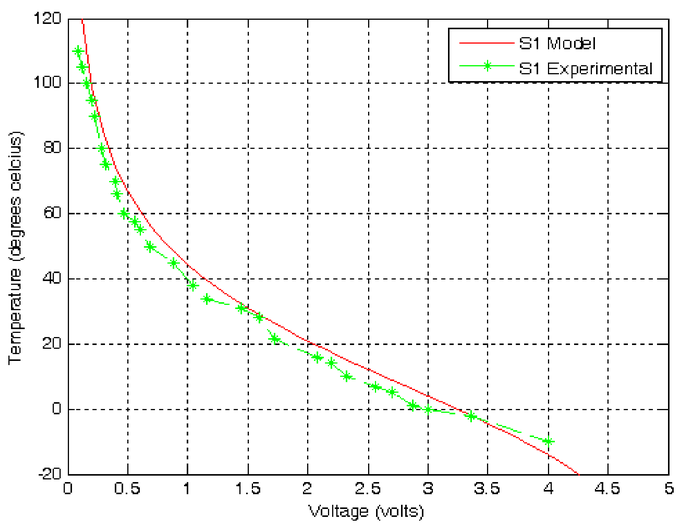
Operation Principle

Heat Detection

- The heat detector is a thermistor embedded on a small, thin and flat steel plate.
- The thermistor is connected in circuit as presented below.
- The voltage across the thermistor, indicates its resistance from which temperature is calculated.



The circuit connection of a single thermistor sensor forming the heat detector



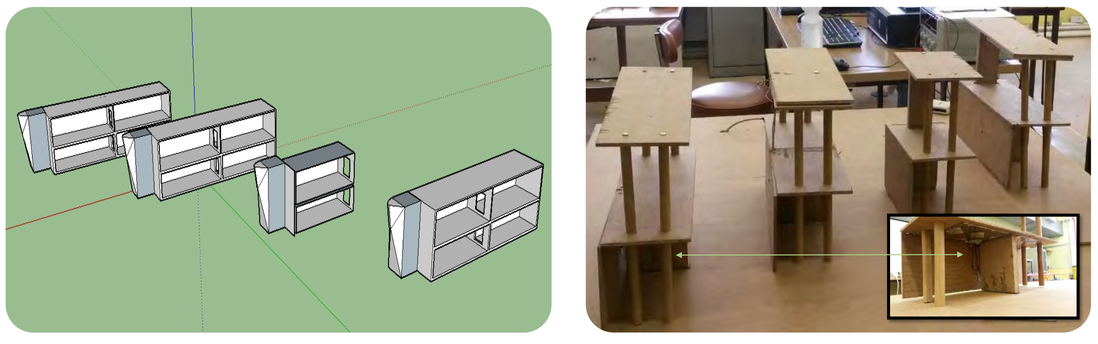
$$T = \left[\frac{1}{T_R} + \frac{1}{B}\, ln \frac{R2 \times V}{R_R(V_{in} - V)}\right]^{-1}$$

- ✓ R_R - Reference resistance, 10KΩ
- ✓ T_R - Reference temperature, 25 °C
- ✓ T - Changing temperature
- ✓ B – Steinhart's constant = 3900

Graphical relation according to the thermistor calibration formula

Implementation

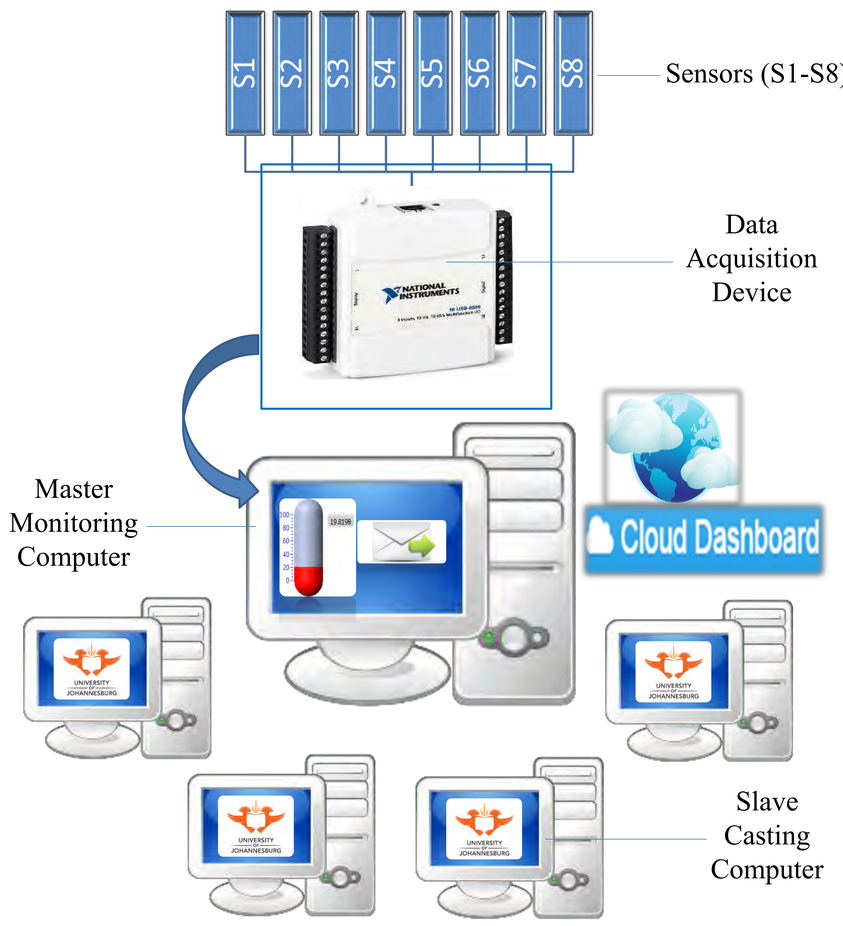
- Eight sensors are installed within a building complex model of eight zones.
- Each sensor is placed at the roof of each zone within the building sections.



Building complex in 3D (left) and a construction (right)

Setup

- A data acquisition device receives real time voltage changes from each of the sensors (S1-S8) simultaneously.
- Data is processed on the Master Monitoring Computer in Labview to display and smartly monitor real time temperature readings of each zone on a graphical interface.



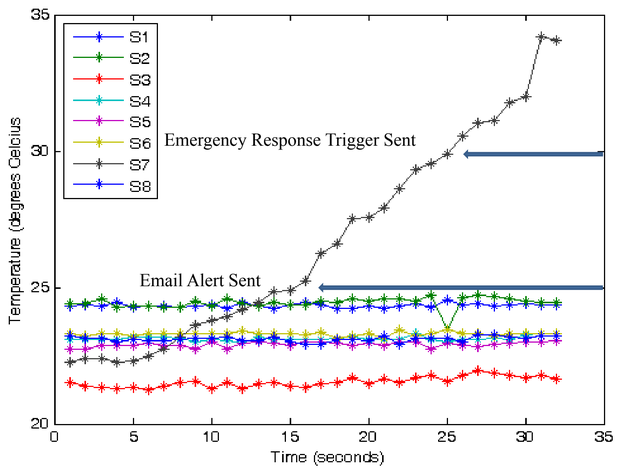
Progression of detection and the alerts

- When a temperature reading exceeds 25ºC, an alert notification message is automatically sent to an authorised operator via e-mail.

Experimental Results

When the temperature reading exceeds 30ºC (for this experiment in particular), a switch trigger signal is sent to an interface cloud dashboard, via the internet so that the slave casting computers within the building read a fire trigger signal.

The trigger causes the display to switch view from daily information casting to emergency casting: an audio-visual evacuation video displaying the safest evacuation route.



Multi-point sensors with S7 under heat excitation

Caution.

A fire has been detected within this building.

Do not panic…

Progression of an emergency response

Conclusion

- Fully automated detection and emergency response.
- Alarming, informative and guided evacuation process.
- The odds of fire detection failure are ebbed.

Acknowledgements

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