

PERMANENT REFERENCE

PR

536.5072
L04



INVESTIGATION OF TEMPERATURE VARIATIONS UNDER HOUSE ROOFS OF
DIFFERENT COLOURS BY COMPUTER INTERFACING

~~194~~

BY

SELVADURAI LOHEESWARAN

~~194~~

57017



FACULTY OF SCIENCE,
EASTERN UNIVERSITY, SRILANKA

JANUARY 2002

PROCESSED
Main Library, EUSL

Abstract

In the view of experiments, interfacing is the communication between an experimental setup and a microcomputer. In this work temperature measurements were carried out using personal computer. To measure a physical quantity by using a computer, a sensor, signal conditioning, and data acquisition are required. In our experiment K-type thermocouple is used as a sensor, thermocouple input device (TC-08) is used as a signal conditioning and Pico Technology is used as a data acquisition.

The colour of the roof of a house is one factor in to reduce or increase the temperature inside the house. In this project two houses one control and other experimental house were constructed and four colour paints were applied to the roof of the experimental house. The experimental house was interfaced with a personal computer to measure the temperature inside the house. In these experiments the interfacing system contained a K-type thermocouple, uninterrupted power supply and a thermocouple input device TC-08 as analog to digital converter.

In this project the temperature inside the houses were measured as voltage of the thermocouple and this voltage of the thermocouple was recorded as temperature by the computer through AD converter TC-08. The experimental results were presented in the form of graph using a Pico data logging software.

According to our experiments

The white colour painted roof reduced atmospheric temperature by the amount of 6°C and blue colour painted roof reduced atmospheric temperature by the amount of 4°C further green colour painted roof reduced atmospheric temperature by the amount of 5°C and aluminum colour painted roof increased atmospheric temperature by the amount of 12°C .

CONTENTS

Acknowledgment

Abstract 01

Chapter 1 02

Chapter 2

Background Theory

2.1. Thermocouple 04

2.1.1. Seebeck Effect 04

2.1.1.1. Variation of Thermo-e.m.f. with Temperature in
a Thermocouple 05

2.1.2. Peltier Effect 05

2.1.2.1. Explanation of Seebeck and Peliter Effects 06

2.1.2.2. Peltier Coefficient 07

2.1.3. Thomson Effect and its predication 08

2.1.3.1. Thomson Effect 09

2.1.3.2. Thomson Coefficient 10

2.1.3.3. Explanation of Thomson Effect 10

2.1.4. E.M.F. in a Thermocouple 11

2.2. The Thermocouple Effect 12

2.2.1. Thermoelectric Effect 13

2.2.2. Additional Junctions 14

2.2.3. Compensation without Reference Junction 15

2.3. Interfacing Thermocouple to a Computer 15

2.3.1. The path from Human to Computer 15

2.3.2. The Sensor 16

2.3.3. Input & Output Transducers 16

2.3.4. Signal Conditioning	16
2.3.4.1. Signal Conditioners	17
2.3.4.2. Additional Requirements for Signal Conditioning	18
2.3.4.3. Amplification of Thermoelectric Voltage	19
2.3.5. Data Acquisition	26
2.3.5.1. How to interpret analogue to digital converter specification	26
2.3.5.2. Analog Data Acquisition	26
2.3.6. Pico Data Acquisition Software/Data Logging Software	26
2.3.6.1. Multiple Views	27
2.3.6.2. Program Modes	27
2.3.6.3. Exporting Data	28
2.3.6.4. Useful Features	28
2.3.6.5. Dos Software	28
2.3.6.6. Useful Menus in PicoLog Data Logging Software	28
2.4. Considerations, which must be taken when using the Thermocouple	30
2.4.1. Wire Size of Thermocouple Probe	30
2.4.2. Length of Thermocouple Probe	30
2.4.3. Location of Thermocouple	31
2.4.4. How to Run Thermocouple Wire	34
2.5. General Rules	34
2.6. Comparison of Thermocouple and Resistance Temperature Devices	35
2.7. Comparative Temperature Measurement Devices	36

Chapter 3

Experimental Techniques

3.1. Pico Technology	37
3.1.1. Conditioners	37
3.1.2. Thermocouple Input Device	38
3.1.3. Type K-Thermocouple	38
3.1.3.1. CM005 Type K Thermocouple	39
3.2. Detail of The Experimental Setup	40
3.2.1. Construction of a House	40
3.2.2. Connection of Thermocouple Input Device (TC-08)	40
3.2.3. Computer Software	41
3.2.3.1. Starting the Experiment	41
3.2.3.2. Set up the Sampling Dialog	42
3.2.3.3. Set up the Recording Dialog	42
3.2.3.4. Set up the Converting Detail Dialog	43
3.2.3.5. Calculated Parameter List Dialog	43
3.2.4. The Block Diagram of the Experimental Set up	44
3.3. Experimental Procedure	45
3.3.1. Apparatus	45
3.3.2. File Selection	45
3.3.3. Sampling Rate	46
3.3.4. Converter Detail Dialog Box	46
3.3.5. TC-08 Channel Box	47
3.3.6. Editing Box	47
3.3.7. TC-08 Channel Box	48
3.3.8. Editing TC-08 Channel Box	48
3.3.9. Channel Reading Box	49
3.3.10. Temperature measurements	50

Chapter 4

Presentation of Results and Interpretation

4.1. Measurements for White Colour Painted Roof	52
4.2. Measurements for Aluminum Painted Roof	55
4.3. Measurements for Blue Colour Painted Roof	57
4.4. Measurements for Green colour Pined Roof	59

4.5. Discussion	61
4.5.1. Wavelength Dependent Characteristics of the Radiation	61
4.5.2. Thermal Consideration of in Roof Design	61
4.5.3. Control of Heat Loss/ Gain	62
4.5.4. Temperature Effects	62
4.5.5. Control of Temperature	63
4.6. Calibration and Errors	64
4.6.1. Sources of Errors	64
4.6.1.1. Thermocouple Wire	64
4.6.1.2 Thermocouple Extension Wire	64
4.6.1.3. Amplifier Error	66
4.6.1.4. A/D Converter Error	66
4.6.1.5. Analogue Input Range	66
4.6.1.6. Analog to Digital Conversion	67
4.6.1.7. Common Mode Voltage	67
4.6.1.8. Thermal Shunting	68
4.6.1.9. Some Reasons for TC-08 Reads Incorrect Temperature	68
4.7. Calibration Techniques	69
4.7.1. Thermocouple Wire Calibration	69
4.7.2. Reducing Noise	69
4.7.2.1. Filtering	69
4.7.2.2. Minimize the Input Signal	70
4.8. Reasons for Choosing Thermocouple in my Experiment	70