Development of monitoring system from a temperature
data collector / Muhammad Hidham Haris.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF MONITORING SYSTEM FROM A TEMPERATURE DATA COLLECTOR

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic and automation) with Honours

by

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I hereby declare that this report entitled "Development of a Monitoring System from a Temperature Data Collector" is the result of my own research except as cited in the references.

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APPROVAL

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ABSTRACT

Temperature is a physical property of a system that underlies the common notions of hot and cold; something that is hotter generally has the greater temperature. Temperature is defined as the average energy of microscopic motions of a single particle in the system per degree of freedom. In this project combination between hardware component and software development is used to develop a monitoring system from a temperature data collector. Basically in this project temperature sensor is used to detect the temperature on something place. The input (temperature) from the sensor will be transmit the data to the converter and then sent the data to personal computer via serial port. Temperature data will be appeared on the screen at personal computer. Serial port is used as an interface communication between temperature sensor and personal computer. A Visual Basic programming is used to monitor or display the data temperature.

i

ABSTRAK

Suhu adalah satu sifat fizikal sesuatu sistem yang menjadi bahan umum kepada suasana panas dan sejuk; secara umumnya suhu yang tinggi adalah menandakan suhu yang panas. Suhu juga ditakrifkan sebagai tenaga pada unsure-unsur satu zarah tunggal dalam sistem. Projek ini telah menggunakan gabungan antara komponen perkakasan dan perisian untuk menghasilkan satu paparan sistem data suhu yang di kesan melalui pengesan suhu. Umumnya projek ini telah menggunakan pengesan suhu untuk mengesan suhu di sesuatu tempat. Bacaan suhu yang dikesan melalui pengesan suhu akan menghantar bacaan kepada alat pengubah syarat dan seterusnya ia akan menghantar data terus ke komputer melalui alat penghantar sesiri. Data bacaan suhu akan dipaparkan di skrin komputer. Alat penghantar sesiri digunakan sebagai data penghubung antara pengesan suhu dan komputer. Visual Basic digunakan untuk memaparkan bacaan suhu pada monitor komputer mengikut aplikasi yang dikehendaki.

DEDICATION

I dedicate this PSM thesis to my beloved parents, my lovely brothers, friends and colleagues, not forgot UTeM's lecturers.

iii

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADC — Analog Digital Computer

ANSI — American National Standard Institute

ASCII — American Standard Code for Information Interchange

ASME — American Society of Mechanical Engineering

Btu — British thermal unit

Cal — calories

CNC — Computer Numerical Controlled

IEEE — The Institute of Electrical and Electronic Engineers

IOP — Institute of Physic

LSB — List significant bit

MSComm — Microsoft Comm Control

PC — Personal Computer

RTD — Resistance Temperature Detector

VB — Visual Basic

VBA — Visual Basic for Application

CHAPTER 1
INTRODUCTION

1.1 Introduction

Temperature is an important parameter in many control systems, most familiarly in environmental control systems. Several distinct transduction mechanisms have been employed. The most commonly used electronic temperature sensors are thermocouples, thermostats, and resistance temperature detector. However, defining temperature is not so easy. Humans primarily experience as a feeling or sensation of hotness or coldness based on an object quality of feeling hot or cold. It is this quality that causes the experience of sensation of heat or coldness.

The feelings of hot and cold are caused by molecular motion, and temperature is a measure of the average kinetic energy of the molecules of a substance. The term kinetic means having to do with motion. Therefore, temperature is a measure of the average energy of a substance due to the motion of the molecules in the substance. As the average motion increase, so does the temperature and temperature decrease as the average motion is reduced.

Temperature measurements are fundamentally important to many industrial processes. There are several popular methods for measuring temperature by contact. Readings are produced by the expansion of a liquid or metal, the generation of a current in the presence of heat, or the generation of resistance to current flow in the presence of heat. The first two are called active devices; they generate a signal. The third is called a

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passive device; it creates a blockage. All these devices react proportionally to the temperature they contact. (Foszcz, 2001).

Temperature is measured in a variety of ways. All methods of temperature measurement use some type of sensors. A temperature sensor has one or more properties that change. The changing properties of the temperature sensor are interpreted as changes in temperature by a temperature scale, a voltmeter, a thermometer, or a similar device.

1.2   Problem Statements

Nowadays, the readout of the majority of temperature data in environmental or industrial in manufacturing especially the process in manufacturing industry that involves CNC (Computer Numerical Control) machine is not known because there is no actual temperature data collected while machine is operating. In current situation, temperature data normally can be found on air-conditioner. Therefore, with this project the actual temperature data for that area can be found, where the temperature data will be transmitted to the computer as temperature data collector when temperature sensors detected the temperature in that area.

1.3   Objectives

a) To develop a programming code for monitoring system of a temperature data collector

b) To integrate hardware (temperature sensor) with pc (personal computer)-based simulation.

2

1.4   Scope

Scope of project should be identified and planned to achieve the objective of the project successfully on the time. This project will adapt in CNC machine lab at Fasa B, Universiti Teknikal Malaysia Melaka (UTeM). Among the scopes that been fixed for this project are as:-

a) To sense the temperature in CNC machine when it operate.

b) To know condition temperature at the part area which are at work piece and tool area in CNC machine.

This project will focus on programming for monitoring system from temperature data collector using Visual Basic. It will display current temperature based on temperature data collector which used a temperature sensor namely thermocouples. Port programming which enables interrupt process for the operating system can be used to control any external devices attached to the pc via serial port. Port programming and user interface design can be done using programming language such as Visual Basic.

This project will develop both the software and hardware. The system will be developed using temperature sensor and some electrical system to demonstrate the response of the output and input devices. Integration of hardware and software will be done in this project to create a simple pc-based simulation.

3

CHAPTER 2
LITERATURE REVIEW

2.1   Introduction

This chapter describes all the information necessary to complete this project. Overall, it will explain about the type of temperature sensor and interface communication line using in this project, software development using Visual Basic for monitoring the data temperature and the control unit based on this project.

2.2   Definition of Temperature Units

According to Anton and Johan (2000), to determine temperatures between those fixed points, a temperature meter was needed. Another issue was the definition of the scale. In 1714, Fahrenheit proposed a scale that takes the minimal possible temperature he could imagine to appear in Central Europe as 0°F (-18°C) and the body temperature as 96°F. Celsius proposed a few years later in 1742 a similar scale but he took the freezing point of water as 0°C and its boiling point as 100°C. Both scales are still in use, but the Celsius scale is the most widely used scale. More than a century later, in 1851, Kelvin proposed his law of thermodynamics in which he proved that the theoretically minimal possible temperature is -273.15°C. Since that time, scientist has often used the Kelvin scale, which is a Celsius scale that is shifted by -273.15 degrees.
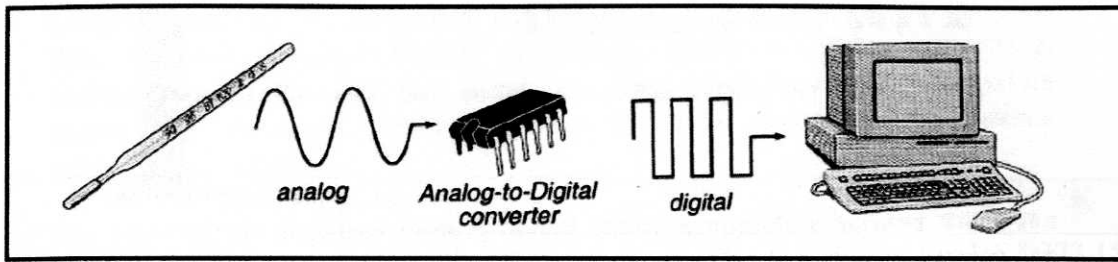
4

Figure 2.1: Communication between a temperature sensor and a computer (Dunn and William, 2005)

To communicate with a computer, the temperature data changes have to be converted into a digital signal. This is done with an analog-to-digital converter. Such as a system shown in Figure 2.1.

Temperature is measured in a variety of ways. All methods of temperature measurement use some type of sensor. Before that, we must know about scale of temperature to measure the temperature or heat data. Meanwhile, scale of temperature determined through on scales often used in this time. Therefore, scale of temperature must prescribe which using on temperature or heat data. Dunn and William (2005), defined temperature as a measure of molecular energy, or heat energy, and the potential to transfer energy. Four temperature scales were devised for the measurement of heat energy and heat transfer. Conversion between the units is shown in Table 2.1. Three temperature scales are usually used to measure the relative hotness or coldness of a material. The scales are Fahrenheit (°F) (attributed to Daniel Gabriel Fahrenheit.), Celsius (°C) (attributed to Anders Celsius) and Kelvin (K), which is based on the Celsius scale and is mainly used for scientific work. The Rankine scale (°R), based on the Fahrenheit scale, and is less commonly used.

5

Table 2.1: Conversion between Temperature Scales (Dunn and William, 2005)

References point	°F	°C	°R	K
Water boiling point	212	100	671.6	373.15
Internal oxen temperature	100	37.8	559.6	310.95
Water freezing point	32	0.0	491.6	273.15
Salt solution freezing point	0.0	-17.8	459.6	255.35
Absolute zero	-459.6	-273.15	0.0	0.0

The conversion factors are as follows:

1. to convert °F to °C

$$°C = (°F - 32)5/9$$

2. to convert °F to °R

$$°R = °F + 459.6$$

3. to convert °C to K

$$K = °C + 273.15$$

4. to convert K to °R

$$°R = 9/5 \times K$$

The temperature and heat relationship is given by the British thermal unit (Btu) in English units, or calories (cal) per joule in SI units. By definition, 1 Btu is the amount of energy required to raise the temperature of 1 Lb of pure water 1°F, at 68°F and atmospheric pressure. The joule is normally used in to the calories commonly. It is

6

widely used unit for measurement of heat energy (Dunn and William, 2005). The conversion between the units is shown in Table 2.2.

Table 2.2: Conversion Related to Heat Energy (Dunn and William, 2005)

1 Btu = 252 cal	1 cal = 0.0039 Btu
1 Btu = 1055J	1J = 0.000948 Btu
1 cal = 4.19J	1J = 0.239 cal

2.3   Temperature Sensing

Temperature is a measure of heat intensity. The simplest way of measuring temperature is the thermometer, which makes use of thermal expansion of materials, such as liquid in glass. According to California Energy Commission (2002), a thermometer is a device that measures the temperature of things. The name is made up of two smaller words: "Thermo" means heat and "meter" means to measure. A thermometer can be used to tell the temperature outside or inside a house, inside a oven, and the temperature of a human to tell people whether they are sick or not.
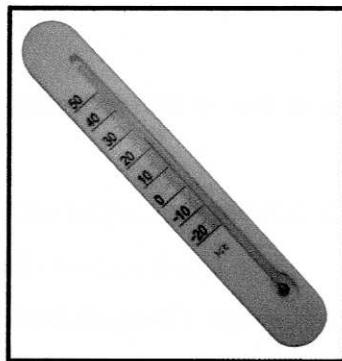

Figure 2.2: Thermometer (Energy Quest, 2002)

7

The methods of measuring temperature can be categorized for a few types; with each temperature transducers have certain advantages and disadvantages. Therefore, it is important to know about a few type of temperature sensing characteristic such as their functions, temperature range, advantages and disadvantages, accuracy, responses and cost, a wide variety of temperature transducers and temperature measurement system have been developed for different applications requirements. According to Kalsi (1995), that defined most of the temperature transducers are of resistance temperature detectors (RTD), thermistors and thermocouples. Of these RTD's and thermistors are passive devices whose resistance changes with temperature hence need an electrical supply to give a voltage output.

Another idea of temperature sensor is defined from Joseph (2001), who said that temperature measurements are fundamentally important to many industrial processes. Many measurements are made with a probe in or on a pipe or vessel. However, if an object cannot be contacted, measuring temperature may be difficult. Contact sensors such as thermometers, thermocouples, and RTD's are accurate and cost effective but not always practical. For many industrial applications, optical and infrared temperature sensors can carry out measurements virtually impossible for contact sensors.

Therefore, is important to know which type of temperature sensors is compatible for this project. The following should be considered while selecting transducers:

a) Operating range:
   Chosen to maintain range requirements and good resolution
b) Sensitivity:
   Chosen to allow sufficient output (temperature data collector)
c) Frequency response and resonant frequency:
   Flat over the entire desired range of temperature data
d) Environmental compatibility:
   Temperature range, corrosive fluids, pressure, shocks, interaction, size and mounting restrictions

8