NETWORK ALARM MONITORING SYSTEM – TEMPERATURE IN SERVER ROOM

NORFIDA ERWANI BINTI MOHD SHAFIE

A report submitted in partial fulfillment of the
requirements for the award of the degree of
Bachelor of Computer Science
(Computer Systems & Network)

Faculty of Computer Systems & Software Engineering
University College of Engineering & Technology Malaysia

NOVEMBER, 2005

ABSTRACT

Together with the rapid growth in information technology (IT), server is important instruments that need in every company even the small company indeed. Network Alarm Monitoring System - Temperature in Server Room is a project to develop a prototype that capable to keep those server investments in a good condition, providing a return and help keep downtime to a minimum. This is because server is computer equipment that is so sensitive and need a fully care every time. So for security, the system development need to trigger an alarm sound as a warning sign if the temperature is go off from the setting range. This is the most valuable asset because the risk for losing the important data can be avoided especially when network administrator was in incautious situation. The techniques that used for developing this project prototype are combine skills in development software and hardware where a circuit that capable to detect the level of temperature is developed. For the temperature sensor, LM35dz thermometer-in chip is used as the main chip for this project. A part of the warning sound, in the same time one (1) of the three (3) LED also take turn to light on based on the current temperature condition and status. In shortly, red LED is light on if the server room temperature was exceeded from the setting range, green LED is used for the normal temperature while yellow LED is function as the warning sign for lower temperature. Then an interface to display the current temperature value and status is developed by using Visual Basic version 6.0 applications.

ABSTRAK

Sejajar dengan pembangunan information teknologi (IT) yang berlaku, server merupakan satu keperluan yang cukup penting bukan sahaja kepada syarikat –syarikat rangkaian gergasi malah juga kepada syarikat-syarikat kecil. 'Network Alarm Monitoring System - Temperature in Server Room' merupakan satu projek pembangunan modul yang berupaya menyimpan server-server di dalam keadaan baik bagi mengelak dari berlakunya kerosakan. Ini adalah kerana server merupakan suatu alatan komputer yang sensitif dan memerlukan pengawasan setiap masa. Maka untuk keselamatan, model yang dibangunkan perlu menghasilkan satu bunyi sebagai tanda amaran sekiranya suhu telah terkeluar dari domain yang ditetapkan. Ini merupakan asset penting kerana risiko untuk kehilangan data pada waktu kecemasan dapat dielakkan terutamanya apabila para pegawai rangkaian yang bertugas berada dalam keadaan cuai. Teknik-teknik yang digunakan untuk pembangunan model bagi projek ini menggabungkan kemahiran dalam pembangunan perisian dan perkakasan di mana satu litar yang berupaya untuk mengesan paras suhu di bangunkan. 'LM35dz thermometer-in chip' digunakan sebagai cip utama untuk mengesan suhu. Selain tercetusnya bunyi amaran, pada masa yang sama salah satu (1) daripada tiga (3) LED juga menyala mengikut keadaan dan status suhu tersebut. Secara ringkasnya, LED merah menyala apabila suhu bilik server telah melebihi garis domain suhu, LED hijau pula untuk suhu normal manakala LED kuning adalah untuk tanda amaran bagi suhu yang rendah. Kemudian satu antaramuka direkabentuk dengan menggunakan applikasi Visual Basic versi 6.0 untuk memaparkan nilai dan status suhu semasa.

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LIST OF ABBREVIATIONS

ADC	-	Analog to Digital Converter
Amps	-	Amplifier
API	-	Application Programming Interface
BIOS	-	Basic Input/Output System
C	-	Celsius
CMOS	-	Complementary Metal-Oxide Semiconductor
DAC	-	Digital to Analog Converter
DLL	-	Dynamic Link Library
DOS	-	Disk Operating System
F	-	Fahrenheit
IC	-	Integrated Circuit
I^2C	-	Inter-Integrated Circuit
I/O	-	Input/Output
K	-	Kelvin
LED	-	Light Emitting Diode
OP	-	Operational
PC	-	Personal computer
PCB	-	Printed Circuit Board
RTD	-	Resistance Temperature Devices
SMBus	-	System Management Bus
SPI	-	Serial Peripheral Interface
SPP	-	Standard Parallel Port
V	-	Volt
VB	-	Visual Basic

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CHAPTER 1

INTRODUCTION

1.1 Project Overview

Nowadays, even small companies have spend hundreds thousands of dollars on computer equipment. Protecting that investment is critical and keeping servers and associated equipment in a controlled environment is an essential part of protecting that investment. The temperature in a server room need to set up to make it always secure and effective. Additional air-conditioning or ventilation ducts may be required to keep the server room environment comfortable, not only for human operators, but also for sensitive equipment especially server.

Even the server is store in a server room with a lot of functioning air-conditioning but it is still sometimes given low priority when there have an electrical shot. But if it has the chance to offer input on the room by using efficient technology, the suggestions prototype of Network Alarm Monitoring System – Temperature in Server Room can be helping in strengthen that case.

A good server room will accommodate all the server equipment with sufficient space for cabling and easy access to all sides of equipment. Cooling and ventilation is more important in a server room than the other rooms because of the extra heat generated by the computer equipment. Dedicating a single room for server organization will give a safe and secure environment for the critical information systems. As well, centralizing all those equipment to one location allows us to efficiently monitor operation and troubleshoot problems.

1.2 Problem Statement

All electronic equipment such is sensitive to fluctuations in temperature. If we look at hardware specifications, we will see an operating temperature that is often in the range of fifty to ninety five degrees Fahrenheit (50 °F – 95 °F) or ten to thirty five degrees Celsius (10 °C – 35 °C).(Brian Killin, 2002). The same goes to server which is most sensitive equipment that need a fully care. It is important that the ambient temperature does not exceed the limits of the server, or we will risk equipment failure and downtime.

Every network manager needs a strategy to ensure that the temperature within the server room remains at a proper level. Here the thesis of application suggestion system created to manage the server always in a good condition. This allows them to react quickly, avoiding or minimizing the impact of situations on users and the organization. This system also can be directed to auto-respond to an alarm condition and gives managers' benefit because they appear extremely responsive in resolving important system issues.

1.3 Project Objective

The primary objectives of the Network Alarm Monitoring System – Temperature in Server Room that needs to be achieved are:

(i) To develop hardware prototype that capable to detect the server room temperature.

(ii) To design a software model that able to read and display the current temperature value in server room.

(iii) To alert an alarm notification when the server room temperature goes above or below from the determined level.

1.4 Project Scope

The scopes of this project are:

(i) Data was based on University College of Engineering & Technology Malaysia (KUKTEM) server room temperature environment which the range is from seventeen to thirty seven degrees Celsius (17 °C – 37 °C).

(ii) Notify Network Administrator by:

(a) Triggering alarm sound from system when server room temperature goes above or below from the range of setting level.

(b) Alerting the LED notification from hardware based on specification below:

- *Red* for High Temperature Warning
- *Yellow* for Low Temperature Warning
- *Green* for Normal Temperature

(iii) This project prototype is done without auto recovery function.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

It is important to select the proper device to measure and read the temperature, understand the information, and process it effectively. Electronic systems are like humans in that their temperature needs to be measure at regular intervals. However, measurement alone is usually not enough. The temperature reading must be properly interpreted and processed so that appropriate actions can be taken to counteract the unwanted temperature change.

2.2 Current System

There are several existing systems that have the related function as this project which are:

(i) Tire Pressure Monitoring System.

(ii) TempAware.

(iii) LINDY Rack Monitoring System.

2.2.1 Tire Pressure Monitoring System

The MPXY8020 series is compatible with tire pressure monitoring systems using a remote RF sensing approach, and is ideal for integration with existing remote keyless entry (RKE) systems. In addition, Freescale offers a comprehensive chip set for a TPMS-RKE system that eliminates the need for an additional TPM specific receiver. This chip set is comprised of the following:

(i) MPXY8020 - pressure and temperature sensor and interface circuit.

(ii) 68HC908RF2 - MCU and RF transmitter housed in a single package.

(iii) MC33591 - RF receiver.

(iv) MC9S12DP256 – microcontroller.

The features of this chipset enable a system to identify individual tires (including the spare) as well as to detect both "over-pressure" and "under-pressure" conditions. The system also has the ability to compensate for changes in cargo load and monitor tire temperature. The module level energy management supports extended battery life and signals a low-battery condition. Furthermore, the system is compatible across vehicle platforms and tire technologies.(Duane Sprague, 2004)

2.2.2 TempAware

TempAware is a small peripheral device that plugs into the serial port of a computer. When the temperature in the room goes above or below the settings that have predetermined, an automatic e-mail notification is sent to network administrator. The temperature fluctuation also can be notified by e-mail that enabled cell phone, in no matter situation, and prevent potential damage to the investment. When the temperature sensor indicates that pre-determined upper or lower limit has been exceeded, the system will send a text alert to cell phone or Email. The convenient way to keep track of the temperature levels anywhere in the home, office or vacation property, this simple wireless sensor install in seconds.(Hvac Atlanta, 2003)

2.2.3 LINDY Rack Monitoring System

The LINDY Rack Monitoring System monitors all relevant environmental data and can automatically respond when certain conditions move out of a preset range. In addition, the RMS can set an alarm to alert the user of any changes. Some users prefer to receive this warning in the form of an audible alarm, or send error messages (alarm TRAP's) via network connection. The RMS can be programmed via front panel push buttons, Telnet/VT100/RS-232 console or Management Console via network connection (SNMP, browser). The RMS can work as SNMP agent that can provide all relevant monitored data and alarm traps to an SNMP Management Station. The SNMP Management Program is not included with the RMS.(Chris Lonsdale, 2005)

2.3 Temperature Measuring Devices

Temperature measuring devices are classified into two major groups, temperature sensors and absolute thermometers. Sensors are classified according to their construction. Three of the most common types of temperature sensors are thermocouples, resistance temperature devices (RTDs), and filled systems. Typically, temperature indications are based on material properties such as the coefficient of expansion, temperature dependence of electrical resistance, thermoelectric power, and velocity of sound.

Calibrations for temperature sensors are specific to their material of construction. Temperature sensors that rely on material properties never have a linear relationship between the measurable property and temperature. The accuracy of absolute thermometers does not depend on the properties of the materials used in their construction.

2.3.1 Classes of Temperature Sensors

There are four types of temperature sensor as illustrated in Figure 2.1. An ideal analog sensor provides an output voltage that is a perfectly linear function of temperature (A). In the digital I/O class of sensor (B), temperature data in the form of multiple 1s and 0s are passed to the microcontroller, often via a serial bus. Along the same bus, data are sent to the temperature sensor from the microcontroller, usually to set the temperature limit at which the alert pin's digital output will trip. Alert interrupts the microcontroller when the temperature limit has been exceeded. This type of device can also provide fan control.

"Analog-plus" sensors (C) are available with various types of digital outputs. The V_{OUT} versus temperature curve is for an IC whose digital output switches when a specific temperature has been exceeded. In this case, the "plus" added to the analog temperature sensor is nothing more than a comparator and a voltage reference.

The system monitor (D) is the most complex IC among them. In addition to the functions provided by the digital I/O type, this type of device commonly monitors the system supply voltages, providing an alarm when voltages rise above or sink below limits set via the I/O bus. Fan monitoring or control is sometimes included in this type of IC. In some cases, this class of device is used to determine whether a fan is working or not. More complex versions control the fan as a function of one or more measured temperatures.(Jay Scolio, 2000)

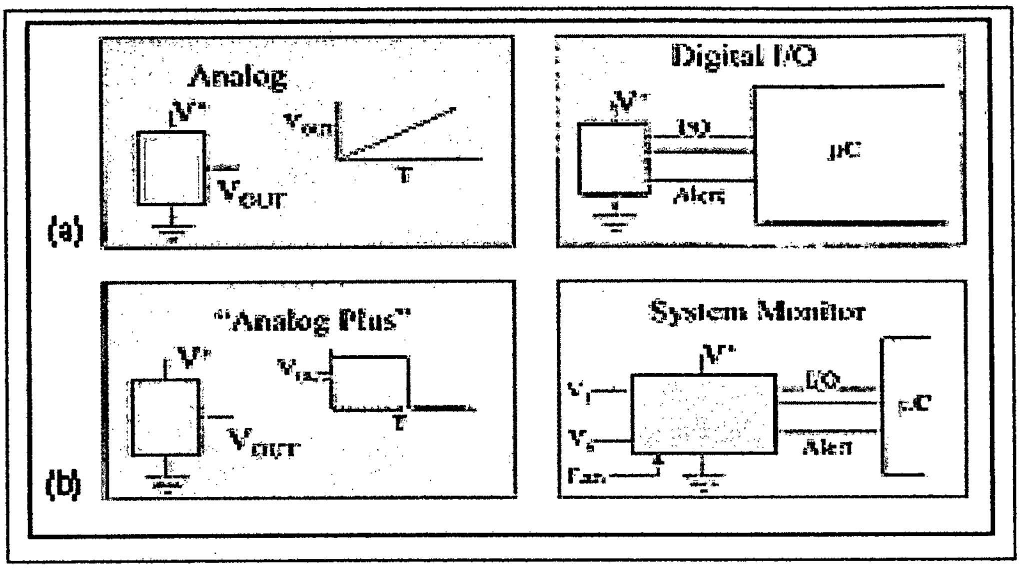

Figure 2.1: Sensor and IC Manufacturers Currently Offer Four (4) Classes of Temperature Sensors.(Jay Scolio, 2000)

2.3.2 Types of Temperature Sensors

To select a temperature sensor, it is no longer limited to either an analog-output or a digital-output device. There is now a broad selection of sensor types, one of which should match the system's needs.

Until recently, all the temperature sensors on the market provided analog outputs like thermistors, RTDs, and thermocouples followed by another analog-output device, the silicon temperature sensor. In most applications, unfortunately, these analog-output devices require a comparator, an ADC, or an amplifier at their output to make them useful. Thermistors have long been favored for their very small form factor, low cost, and high sensitivity. On the negative side, they operate over a limited temperature range and are often difficult to replace due to lack of industry standards. They also require compensation circuitry to overcome nonlinearity. RTDs are generally used where accuracy and stability are vital, but rarely where cost is a deciding factor. Thermocouples are ideal for monitoring extreme temperatures, but get poor marks in accuracy and stability and must be thoroughly tested under controlled conditions.

Thus, when higher levels of integration became feasible, temperature sensors with digital interfaces became available. These ICs are sold in a variety of forms, from simple devices that signal when a specific temperature has been exceeded to those that report both remote and local temperatures while providing warnings at programmed temperature settings. These devices are in competitively priced, available in tiny packages, highly accurate, and able to operate over a wide temperature range, are beginning to replace their precursors in many commercial applications. The choice now is not simply between analog-output and digital-output sensors. There is a broad range of sensor types from which to choose.(Jay Scolio, 2000).

2.3.3 Integrated Circuit (IC) Temperature Sensors

In contrast to analog sensors, digital temperature detectors are complete in themselves, requiring no additional circuitry for signal conditioning or linearization. They can be directly connected to the microcontroller, saving design time, PCB area, and expense. They can flexibly reduce their current consumption, particularly useful in battery-operated applications where minimal power consumption is important. The user can also program temperature limits (T_{HIGH} and T_{LOW}) where an alarm is required. If a programmed limit is exceeded, an interrupt is generated and the microcontroller can take action. Many IC design systems integrate ADCs and DACs onto a single chip to save on board space and reduce cost. Some have built-in algorithms that drive cooling fans at the optimum speed while consuming the least amount of power and keeping noise to a minimum. These sensors are also particularly useful for closed-loop applications in general.(Claire O'Keeffe and Donal McNamara, 2004)

The use of IC temperature sensors is limited to applications where the temperature is within a –55°C to 150°C range. The measurement range of IC temperature sensors may be small compared to that of thermocouples and RTDs, but they have several advantages: they are small, accurate, and inexpensive, and are easy to interface with other devices such as amplifiers, regulators, DSPs, and microcontrollers.

IC temperature sensors continue to evolve, providing a varied array of functions, features, and interfaces. With the higher level of integration now feasible, digital IC temperature sensors can report both local and remote temperatures, monitor other system parameters, control fans, or warn when a specific temperature is exceeded.

However digital temperature sensors are similar to analog temperature sensors, but instead of outputting the data in current or voltage, it is converted into a digital format of 1's and 0's. Digital-output temperature sensors are therefore particularly useful when interfacing to a microcontroller. Such interfaces include single-wire PWM, two-wire I^2C and SMBus, and three/four-wire SPI protocols.(Claire O'Keeffe and Brian Black, 1999)

2.3.4 Temperature Sensor Summary

Table 2.1 describes the main differences between four types of the familiar temperature sensor, which are RTD, thermistor, thermocouple and integrated circuit (IC) sensor. The researches are study based on the several characteristics of each one. The comparison of their strengths and weaknesses are described in the Table 2.2.

Table 2.1: Main Differences among RTDs, Thermistors, Thermocouples, and Integrated Circuit (IC) Sensors.(Claire O'Keeffe and Donal McNamara, 2004)

Summary of the Main Differences Among RTDs, Thermistors, Thermocouples, and IC Sensors				
Characteristic	**RTD**	**Thermistor**	**Thermocouple**	**IC Sensor**
Active material	Platinum	Metal oxide ceramic	Two dissimilar metals	Silicon
Changing parameter	Resistance	Resistance	Voltage	Voltage
Cost of system (relative)	Moderate to low	Moderate to low	High	Low
Additional circuitry	Lead compensation	Linearization	Reference junction	None
Temperature range	-200°C to 850°C	-100°C to 500°C	-270°C to 1800°C	-55°C to 150°C
Interchange-ability	-0.06%- 0.1%, 0.3°C-0.2°C	10%, 2°C typ.	0.5%, 2°C	1%, 3°C
Stability	Excellent	Moderate	Poor	Moderate
Sensitivity	0.39%/°C	-4%/°C	40 V/°C	10 mV/°C
Relative sensitivity	Moderate	Highest	Low	Moderate
Linearity	Excellent	Logarithmic/ poor	Moderate	Moderate
Slope	Positive	Negative	Positive	Positive
Noise susceptibility	Low	Low	High	Low