A Precision Temperature Controller Using Embedded System

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Abstract- The objective is to design and implement an automated Temperature control system using embedded system design in order to control the temperature of a system. As such, it is vital that those in engineering fields understand the technologies associate with this area. My paper will include the design and construction of a microcontroller-based automated temperature control system along with a temperature display using LCD. A working system will ultimately be demonstrated to validate the design. The system made is only a prototype. A larger system can be made using this prototype as a model.

Index Terms- Temperature Controller ICs, Microcontroller, Embedded system

I. INTRODUCTION

The concept of this paper is to create an Automatic Temperature Control System to control the temperature of a system. The circuit maintains the temperature of the system in a particular range. The fan RPM increases with increase in temperature and vice versa. For the circuit, it consists of Temperature Sensing Unit, PIC AT89c52 µC, LCD Module, Switching Device, Driver, PWM generator, a Fan and a Heater. It will operate based on the values or ranges of temperature in the system which is detected by the Temperature Sensor. The Temperature Sensor detects the temperature of the system. The Temperature Sensor consists of an LM35 IC. The temperature sensor is connected to the ADC input of the PIC µC. It converts the analog input to a digital value. The PIC is connected to a switching device relay. It is used to switch on the heater. The PIC generates PWM according to the temperature sensor value. The PWM generated output control signals are sent to the Motor Driver IC L293D. Motor Driver ICL293D is fed with the PWM generated output from PIC. By using the L293D, two dc motors can be connected. The speed of the fan is controlled by the ON time of the PWM generated by the controller. With increasing ON time, the speed of the fan or the heater increases reducing the temperature of the system. The LCD module is also connected to the PIC microcontroller. The LCD module displays the current temperature. The LCD display used is a 16x2 Alphanumeric Display with code LM016L. It is a parallel LCD which is connected to the microcontroller I/O ports.

II. PROBLEM STATEMENT

The basic idea of the project is to replace manual settings of fan in accordance with temperature so that it detects temperature variations automatically and control its speed. The application dictates that temperature settings are usually kept constant for long periods of time, but it's nonetheless important that step changes be tracked in a "reasonable" manner. Thus the main requirements boil down to

1. Allowing a chamber temperature set-point to be entered,
2. Displaying temperature sensor, and,
3. Tracking step changes in set-point temperature with acceptable rise time and error.

TEMP RANGE

1. **LESS THAN ROOM TEMPERATURE**
2. **ROOM TEMP**
3. **MORE THAN ROOM TEMPERATURE**

Although not explicitly a part of the specifications in Table 1, it was clear that the customer desired digital displays of set-point and actual temperatures, and that set-point temperature entry should be digital as well.

III. METHODOLOGY

The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the micro controller through ADC. The analog signal is converted into digital format by the analog-to-digital converter (ADC). The sensed and set values of the temperature are displayed on the 16x2-line LCD. The micro controller drives control relays by means of ULN driver circuit to control the fan speed with the help of high wattage tagged wire wound resistor.

Single pole double throw (SPDT) relays are connected to the micro controller through a ULN driver circuit. The relays require 5 volts at a current of around 50 mA, which can not provided by the micro controller. So the ULN driver circuit is added. The relays are used to operate the electrical fan or for operating any other electrical device. Normally the relays remain off. As soon as pin of the micro controller goes high, the relays operate. This project uses regulated 5V, 500mA power supply. 7805 three

terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac out put of secondary of 230/12V step down transformer.

The circuit maintains the temperature of the system in a particular range. A fan and a heater are used for controlling the temperature of the system. The fan RPM increases with increase in temperature and vice versa. The working of the heater is also the same. The current temperature within the server room is measured by using a temperature sensor. When the current temperature is below the lower limit of the desired range, the system must be heated by using a heating element, air heater.

When the current temperature is below the lower limit of the desired range, the system must be cooled by using a fan. When the current temperature is within or successfully turned back to the required range, no control action is needed. The current temperature of the room must be continuously displayed on the LCD. The controller should use LEDs as backup display to indicate the current state of temperature .This makes user is easily to know current temperature of the system. The Temperature Sensor detects the temperature of the system.

The Temperature Sensor consists of an LM35 IC. The temperature sensor is connected to the ADC input of the PIC µC. It converts the analog input to a digital value. The PIC is connected to a switching device relay. It is used to switch on the heater. The PIC generates PWM according to the temperature sensor value. The PWM generated output control signals are sent to the Motor Driver IC L293D. Motor Driver IC L293D is fed with the PWM generated output from PIC. By using the L293D, two dc motors can be connected. The speed of the fan is controlled by the ON time of the PWM generated by the controller. With increasing ON time, the speed of the fan or
the heater increases reducing the temperature of the system. The LCD module is also connected to the PIC microcontroller. The LCD module displays the current temperature. Maintenance and controlling of Boilers temperature.

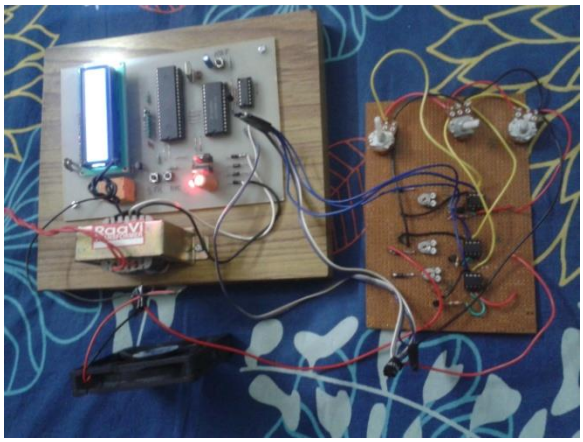

Fig1. Working Model of project

IV. CONCLUSIONS AND SCOPE OF FURTHER WORK

Here by we come to the end of our mini project "A PRECISION TEMPERATURE CONTROLLER USING EMBEDDED SYSTEM. This project has presented a means of controlling the temperature of a system. This system helps to maintain the temperature within a limit. This system is very marketable because of its simplicity, low cost, low power consumption and small size. It can be used in various industrial applications such as to control the temperature in boilers, refrigerator, AC, Computers and Laboratories.

V. MODIFICATION

The goals of this paper were purposely kept within what was believed to be attainable within the allotted timeline. As such, many improvements can be made upon this initial design. That being said, it is felt that this design represents an functioning miniature scale model which could be replicated to a much larger scale. The following recommendations are provided as ideas for future expansion of this project.

1. Changeable temperature limits can be applied by adding a matrix keypad.
2. High precision sensors such as Platinum Wire can be used. This makes it possible to measure more range of temperature.

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AUTOBIOGRAPHY

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