Development of Microcontroller Based Tool for Effective Learning of Concepts in Control System

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Abstract

The aim is to design and develop a temperature control system. It is an useful tool for the researcher, students and all those who are affiliated with control system. This will help them to develop and understand the concepts of the control system. An embedded system is used to control the temperature.
This paper includes the design and development of Microcontroller Based Temperature Sensor circuit. Microcontroller which senses temperature and measures it. To Sense the temperature LM35 is used and the output is displayed on LCD. The sensed temperature is compared with the value stored by the set point and the respective reading obtained and temperature verses time graph has been plotted accordingly, Different Materials such as cuboids of 1 cm each of Copper, Zinc, Aluminum Brass were heated for various duty cycles of PWM used from the microcontroller.[1] The various graphs showing relationship between temperature and different parameters have been plotted to validate the accuracy of the system.

Keywords—*Embedded system, Temperature Sensor LM35, Pulse Width Modulation (PWM) , Liquid Crystal Display [LCD], etc.*

I. INTRODUCTION

The temperature controller is mostly used in various industries such as chemical, food processing, pharmaceutical etc. In these kinds of industries some product need the required temperature to be maintained.

In recent years, the rapid advancements in embedded system technologies can be seen, to bring a great impact on the industries and hence sophisticated society is evolving.

This paper incorporates design and development of the temperature sensor. The objective is to develop a system, which senses the temperature.

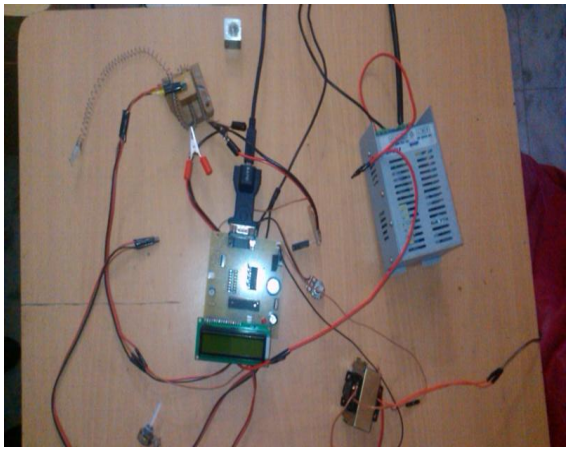
We have used the embedded knowledge in order to maintain and control temperature. Temperature control is a process to maintain the temperature at certain level. This process is commonly used in all areas of the world. [2][3]

The designed temperature measurement circuit is basically a closed loop system. Temperature is sensed, displayed and it is compared with set value. If it is greater/less than set value, then control the heat produced by heating element & changing its supply current. In this ON-OFF type controller has been implemented. Here the set value for temperature can be externally set by the user. The actual temperature is sensed by the temperature sensor. It is displayed on LCD with the set value.

II. WORKING PRINCIPLE

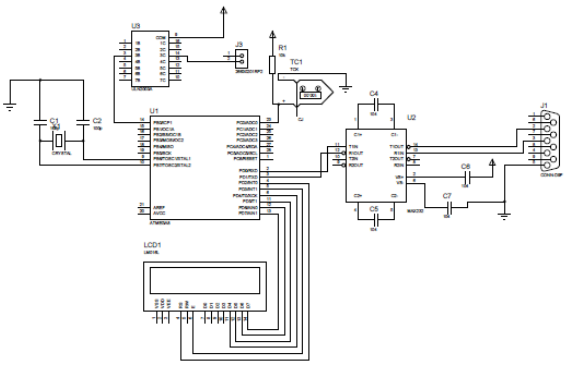
The sensor senses temperature in an environment when the heater is heated. For this we are using ATMEGA8 microcontroller as the main controller and LM35 for Temperature Sensor. One 16X2 LCD is attached with the microcontroller to display the Set Temperature Value and Present Temperature Value. LCD will also to display the status of Heater. [4]

Whenever the system is switched ON, LCD will display “Welcome enter the mode”, to enter the value for set point and present the graphs of the sensed temperature and its difference with the set point. To the right side of the display duty cycle as 5%, 10% 15%,20%, 25 %. We have interfaced three switches with the microcontroller. The circuit maintains the temperature of the system. The temperature in coil of the heater increases with increase in voltage.

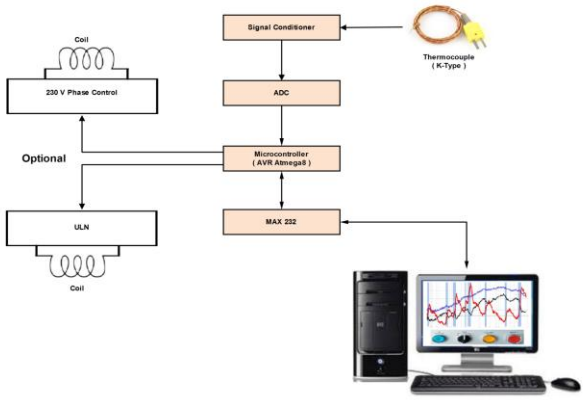


SNAP OF THE ACTUAL WORKING CIRCUIT

Circuit Diagram



Block Diagram



III. WORKING

The circuit is designed such that it uses temperature sensor. The current temperature is sensed through sensor given to ADC of Atmega8. It gives the output in milli volts. This output is converted into corresponding digital data using inbuilt ADC of the ATmega8 microcontroller. LCD is interfaced with the microcontroller & the display value. The LCD displays the present temperature as well as set temperature.

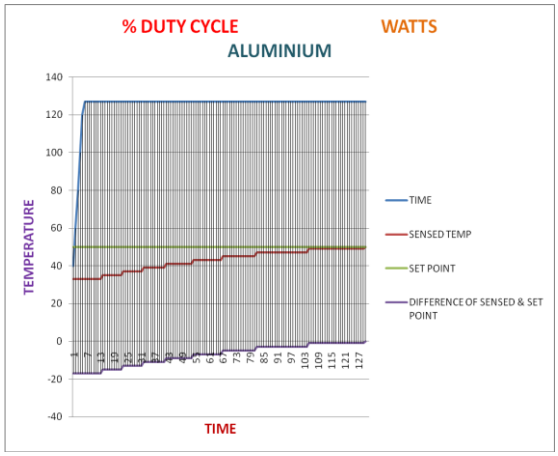
For the circuit, it consists of Temperature Sensing Unit LM35, Atmega8, LCD, Driver, PWM generator, Heater. It will operate based on the values or ranges of temperature in the system which is detected by the Temperature Sensor. The Temperature Sensor consists of an LM35 IC which is connected to the ADC input of the µC. It converts the analog input to a digital value. Then it is used to switch on the heater. The duty cycles of is kept at 5%, 10% PWM according to the temperature sensor value. The PWM generated output control signals are sent to the Driver IC is fed with the PWM generated output to the coil for increasing current in coil consequently increase in the temperature. [5]With increasing ON time, the heater increases or reduces the temperature of the system. The LCD module is also connected to the microcontroller which displays the current temperature. The LCD display used is a 16x2 Alphanumeric Display connected to the microcontroller I/O ports. To do the main function of heating the coil, i.e. HEATER, we use three coils of different wattage viz 5 watt, 10 watt, 15 watt etc. and then compare functions in our software.[6]

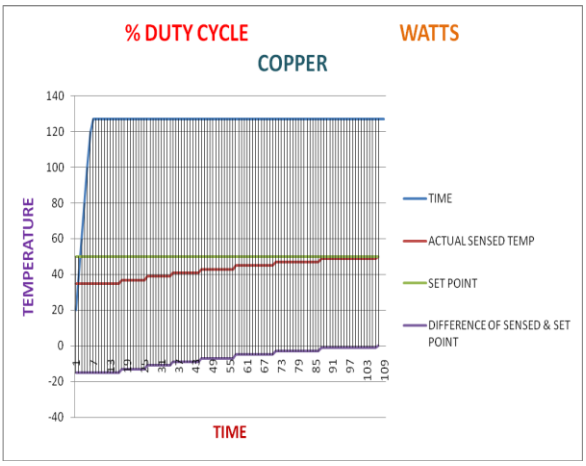
Due to the use of PWM, accuracy is maintained exactly The software used to display is Graphs of the SENSED and DIFFERENCE of the SENSED temp with the set point.[7]

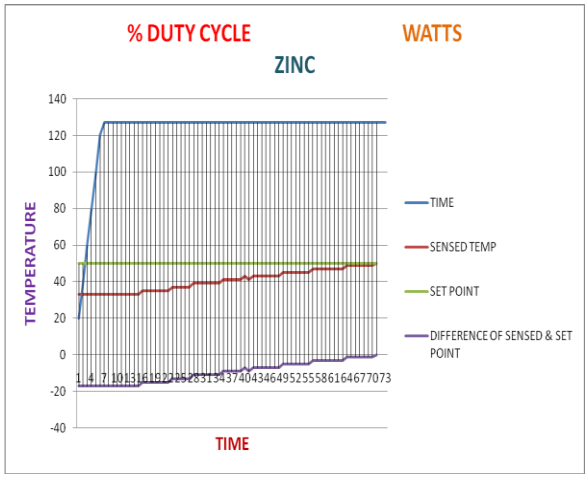
IV. RESULTS

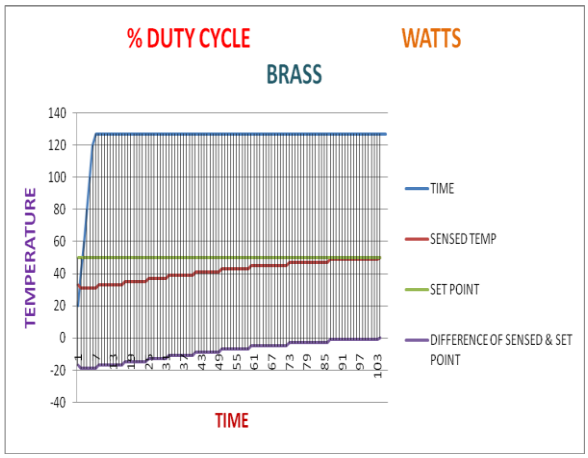
Microcontroller based temperature Sensor is a simple and useful circuit which can be used to measure the temperature above a set value using LM35 temperature sensor. The actual temperature and set value of temperature were getting displayed on the LCD screen and the set temperature was found changing. Output was verified by setting the temperature at different levels and it was found that the heater is turn ON when the device crosses the set value.[7]

In this paper, we have designed and implemented a microcontroller-based system for sensing temperature, using Atmega8 microcontroller and LM35 temperature sensor. Based on the testing results, the system works according to desired output. This system can be used to sense the temperature.









The result of the system is connected to the PC using a cable to anyone of the port, at a particular serial port which will be selected. The set temperature button is used to set the particular temperature. As soon as the required temperature is set, the current temperature will be sensed and the difference of the current temperature and the sensed temperature will display on the screen.

The temperature has been sensed using PWM technique. The logic used in the system is verified and shown in the waveform. The duty cycle is varied according to user by just clicking the respective % of duty cycles from 5 to 25. The graphs showing the relationship between temperature verses time at respective duty cycle are plotted in MATLAB and accuracy of the system is validated. [10]

V. CONCLUSIONS

A novel design of sensing the temperature using LM35 and PWM technique is proposed in this paper. The simulation of the system is working properly. Various graphs have been plotted for different set of materials used to heat and time taken to heat. PWM technique is found to be appropriate for this purpose. This design can be further extended for various applications.

FUTURE SCOPE AND ENHANCEMENTS

Good temperature control is important during the research, reaction, separation, processing, and storage of products and feeds, thus a key to product quality. The temperature measurements place major role in industries, warehousing, and hospitals.[11]

Microcontroller based temperature sensor is a simple, useful circuit with which the temperature can be sensed with the aid of a LM 35 temperature sensor. As explained the circuit can be made useful in practical area where the circuit can be connected to a device whose temperature has to be measured at a particular limit say a water tank with a heater whose temperature can be set

to a particular value. Similar another application is that the circuit attached with a buzzer which can be connected to a device like an iron box so that it would help to save electricity by avoiding overheating of the device. In future the circuit can be enhanced by so that damages to the machine can be avoided by disconnecting the equipment with GSM technology.[8]

It can be extended by introducing authentication over the system. The user name and password authentication is done using Internet. Only the authenticated user can access the personal computer to set the particular temperature which is required to maintain the products or chemicals. Similarly with the use of upgraded version of at mega 8, GSM message can be sent in case of any emergencies. [9]

Since, it has become an integral part of any control system operating in a temperature sensitive environment and the various learning outcomes associated during its implementation.

ACKNOWLEDGEMENT

Authors wishes thank to Prof. Dr. A. D. Shaligram, Professor & Head of Electronic Science Department, Savitribai Phule Pune University, Pune (India) for their valuable guidance & co-operation.

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