Temperature Control Based LED indication system

Shekhar Mishra[1], Roja Peter[2], Zahed Ahmed Khan[3], M.Renuka[4], Syed Sultan Mahmood[5], S.V. Altaf [6]
[1,2,3,4] *B.Tech student, Dept. of ECE, Lords Institute of Engineering and Technology,*
[5]*Professor, Dept. of ECE, Lords Institute of Engineering and Technology,*
[6]*Associate professor, Dept. of ECE, Lords Institute of Engineering and Technology,*
Hyderabad, Telangana India

***Abstract*- As the name implies, a temperature controller is an instrument used to control temperatures, mainly without extensive operator involvement. A controller in a temperature control system will accept a temperature sensor such as a thermocouple or RTD as input and compare the actual temperature to the desired control temperature, or setpoint. It will then provide an output to a control element. It senses the actual temperature of the system, to convert the temperature recorded by the sensor into a digital quantity, LCD for display and to turn the LED's on or off.**

***Index Terms*- LCD, LED, LM35, AT89S52**

I. INTRODUCTION

With science, it's always a step ahead you can think of. Just think of an operation you want to perform and you can embed it to be done automatically. Yes, its Embedded Systems we talking about. Engineers' minds all over the world have done lots in this area which though is a boon from electronics engineering but requires sound knowledge of both electronics hardware as well as software. Engineers from Multyremotes are here with a range of tested projects on Embedded Systems. Industrial Temperature Controller is an on-off type controller which senses the temperature of the system, compares it with a user-fed threshold temperature value and switches the heater on or off accordingly. Such kind of product is of great importance in industrial applications as a little aberration from the required temperature may bring voids in the functioning of the system or deteriorate the quality of the product being manufactured. Chemical, petrochemical, food processing, and pharmaceutical industries are the major industries where the automatic temperature controller can be installed.

Existed system: Sometimes the simplest things are ones that people are unaware of. This is one of the hobby circuits that we can build by own at homes. The function of this circuit is to indicate the temperature levels using LED. Here we give a small idea about device which controls the temperature using a LED. The device is *temperature controlled led's*. This device senses the temperature by monitoring the sensor and reminds the condition of the temperature every time when temperature either decreases or increases. The circuit will work when LED glows and also give an indication about the temperature is high or low. In temperature controlled systems, when the assumed temperature is high then red LED glows which makes transistor1 turns ON and transistor2 OFF, if it is low then the green LED glows which makes transistor2 ON and transistor1 turns OFF. It can also be monitored by varying the potentiometer. The circuit can be assembled on any general purpose PCB or Veroboard. The circuit can be powered from the battery ranging 9volts. The circuit requires well regulated power supply to avoid unwanted triggering while the battery is charged from the dynamo. The input given is 9v dc supply voltage from the battery.

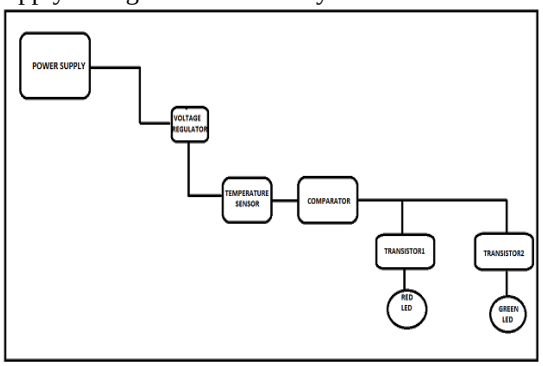

Fig.1 Tradational circuit

The block diagram consists of power supply, voltage regulator, temperature sensor, comparator, transistors and red, green LED's. The input is given to the voltage regulator through power supply of 9v regulated dc voltage. This is taken as input to the voltage regulator, where voltage regulator7805 is used. The voltage regulator

provides 5v dc supply to the circuit. The output of the voltage regulator is given as input to the temperature sensor followed by comparator. The output of the comparator is fed to the transistor1 followed by red LED and also green LED. In this block diagram op-amp IC CA3130 is used as comparator, IC LM35 is used as a temperature sensor, ic7805 is used as a voltage regulator, transistors, red LED,green LED. The circuit is nothing but two LEDs (D1 and D2), whose status are controlled by the temperature of the surroundings. The famous IC LM35 is used as the temperature sensor here. Output of LM35 increases by 10mV per degree rise in temperature. The temperature sensor output is given to the non-inverting terminal so that the comparator remains low till it receives any input at inverting terminal. Till the comparator output is low the green LED glows and is the indication for temperature below 60degrees. At this situation the red LED is in OFF. Whenever the temperature is increased above than 60 degrees. The input to the non-inverting terminal becomes high than the inverting terminal. This makes red LED glow and the green LED OFF. This is the indication for temperature is above 60degrees.

II. DESIGN APPROACH

Temperature controllers are used in most of the manufacturing industries. The industries like textile mill, pharmaceutical industry, oil refinery etc. all requires temperature controller. The temperature controllers are used to maintain constant temperature of process or plant or any material. In such temperature controller system there is one reference temperature called set point or set temperature that is the desired temperature that must be maintained. This reference temperature is set by external means. Also it can be always adjustable according to requirements. Once this temperature is set the system tries to maintain it by sensing the current temperature and controlling it using heater, cooler or compressor etc.

It senses current temperature, compares it with reference temperature and generates error signal. Then based on this error signal it controls heating element (or cooling element). If set temperature is more then error signal is negative and vice versa. So here we have given one such temperature control system that senses current temperature using temperature sensor. It compares it with the set temperature that is set by external reference. And it gives indication of error signal as positive or negative.

1) If error is positive that means current temperature is more than set temperature that has to be reduced
2) If error is negative that means current temperature is less than set temperature and it is required to increase it.

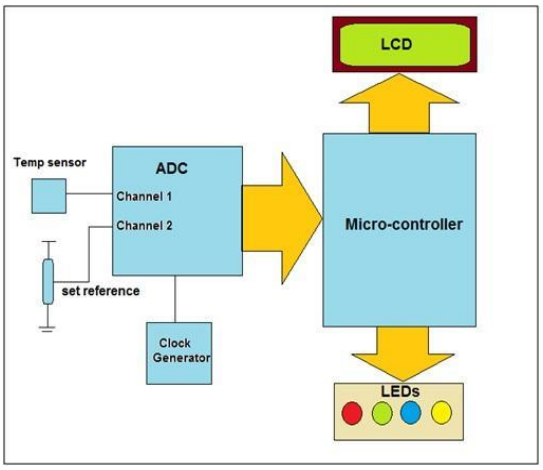

Fig.2 Block diagram

As shown in above fig.2, major building blocks of system are temperature sensor, Analog to Digital Converter (ADC), micro-controller, LCD, clock generator and LED indicators.

Temperature sensor: It's a transducer. It gives corresponding voltage (or current) output as change in temperature. It can be calibrated to degree Celsius. Otherwise it has to be calibrated first.
LM35 is a device which converts the physical signal into electrical signal. That's why this is known as the transducer. It is calibrated with the environmental temperature and it is linearly varies with the temperature and its output is in volt. There is no need of external calibration to provide the accuracy of the LM35 at room temperature which is about ±¼°C. Minimum temperature that can be measured by the LM35 device is -55°C. And maximum temperature that can be measured by LM35 is 150°C. Calibration of LM35 is done by trimming at the water level. To make the interfacing of control circuitry and readout circuitry very easy, low impedance at output side, output which is linear and precise inherent calibration of LM35 plays an important role. Temperature sensor takes a very low current of order 60 μA from the input supply. Heat loss in the LM35 is very less degree of around 0.1°C. LM35 can work in the

range of -50°C to +150° which is the rated value. Another device which is also a temperature sensor of the family of LM35 known as LM35C which ranges from -40°C to +110°C. LM35 costs around 10 rupees in India and is easily available in the market which anyone can buy at any convenience store or electronics store.

Reference potentiometer: It sets reference temperature between min to max value. The system operation depends upon this set temperature value.

ADC: Its analog to digital converter with built in multiplexer. It takes two analog inputs one from temperature sensor and another from reference potentiometer. It gives 8-bit digital output corresponding selected analog input. To get the digital output of any one channel, micro controller will select the required channel and takes digital output.

Clock generator: ADC requires clock signal for its operation. This clock signal is generated by IC555 based clock generator.

Micro controller: it controls operation of ADC and LCD. It takes digital output of both channels and displays them on LCD. It takes suitable decision by comparing two temperatures. Also it gives different indications on LEDs.

The AT89S52 is high-performance, low-power CMOS 8-bit microcontroller with 8Kbytes of in-system programmable Flash memory. It is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industrystandard 80C51 instruction set pin out. By combining a versatile 8-bit CPU with insystem programmable Flash on a monolithic chip, AT89S52 is a powerful microcontroller which provides a cost-effective and highly-flexible solution to many embedded control applications. It provides the following standard features: 256 bytes of RAM, 8K bytes of Flash, Watchdog timer, 32 I/O lines, three 16-bit timer/counters, two data pointers, on-chip oscillator, a full duplex serial port, clock circuitry and a six- vector two-level interrupt architecture, and in addition to that, the AT89S52 is designed with static logic for operation down to zero frequency and it also supports two software selectable power saving modes. The first mode is the Idle Mode which stops the CPU while allowing the timer/ counters, RAM, serial port, and interrupt system to continue functioning. The second mode is the Power-down mode which saves the RAM contents but freezes the oscillator, thus disabling all other chip functions until the next interrupt occurs. The on-chip Flash allows the program memory to be reprogrammed in-system.

LED indicators: shows different indications like

Reading Ch1 temperature	Red LED
Reading Ch2 temperature	Green LED
Sensor temperature > Set value	Blue LED
Sensor temperature < Set value	Yellow LED

Light-Emitting Diodes (LEDs):
LED's are all around us: In our phones, our cars and even our homes. Any time something electronic lights up, there's a good chance that an LED is behind it. They come in a huge variety of sizes, shapes, and colors, but no matter what they look like they have one thing in common: they're the bacon of electronics. They're widely purported to make any project better and they're often added to unlikely things (to everyone's delight).

III. SYSTEM PROCESS

Microcontroller first latches address of channel 1 in to ADC. Then it asserts start signal to start conversion. It waits for end of conversion (EOC) signal from ADC. When it gets it, it takes digital input from P1 and after processing it displays it on LCD as set temperature.

Next microcontroller latches address of channel 2. Again it asserts start signal and waits for EOC. When it gets EOC, takes digital input – process it – displays it on LCD as current temperature. Then microcontroller take difference of these two temperature values that is the error. If error is positive then it indicates this on blue LED. If error is negative then it gives indication on yellow LED. This process is continuously repeated after every two second.

IV. CONCLUSION & FUTURE SCOPE

The temperature controller module has a 89S52 microcontroller brain, temperature sensor LM35 which senses the actual temperature of the system, to convert the temperature recorded by the sensor into a digital quantity, LCD for display and to turn the LED's on or off. Since the controller is

automatic it has a brain which is preprogrammed manually to work as per the requirements. Here, Embedded C language has been used to program the controller with instructions.

The project can be further extended. The error signal output can be used to control any heating or cooling element that will change the temperature. The change in temperature is continuously monitored using temperature sensor. So this becomes complete close loop control system. The system will try to automatically maintain the set temperature value by getting feedback and generating +Ve or –Ve error signal.

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Author's Profile

Syed Sultan Mahmood received the B.E. degree in the year1999 in ECE. He has around 12 years of both industrial as well as teaching experience. His current research interest includes wireless communications, mobile communication and optical fiber communication. He is currently working as a Professor in Department of ECE at Lords Institute of Engineering and Technology, Hyderabad, Telangana, India.

S.V. Altaf Currently working as Associate Professor in Lords Institute of Engineering and Technology, Hyderabad, Telangana, India. He has 27years' Industrial experience, 15 years' experience in Teaching.

Shekhar Mishra pursuing final year B.tech(ECE) in Lords institute of engineering and technology.

Roja peter pursuing final year B.tech(ECE) in Lords institute of engineering and technology

Zahed Ahmed Khan pursuing final year B.tech(ECE) in Lords institute of engineering and technology

M.Renuka pursuing final year B.tech(ECE) in Lords institute of engineering and technology