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Thermometer Designed using AT89C51 for Displaying Digital Records

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***Abstract*—** a digital thermometer is a simple low cost temperature measuring device which senses our body temperature and displays the output in 7 segment display. The normal temperature of human body is 78°F or 36.7°C (37°C). It is more accurate and efficient; since its cost is low it can be used in medical fields, to measure the body temperature of patients. In this fast developing world, we want quick and accurate result thus a digital thermometer is best over the analogy (mercury) thermometers. On completion of this project the temperature can be just with the simple touch on temperature sensor LM35.

***Keywords*—** *Temperature sensor, ADC, Microcontroller, transistor, 7-Segment display, power supply.*

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I. INTRODUCTION

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4Kbytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer [1]. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

AT89S51 is an ATMEL AVR micro controller family. It has high performance and is a low power CMOS 8bit microcontroller. It has 4 kilobyte of system programmable flash memory within it. The on chip flash memory allows the program memory to be re-written the programme in system. The efficient 8bit CPU (central processing unit) within system makes the ATMEL 89s51 a powerful microcontroller. It has high flexibility.

The ATMEL 89S51 has the following standard classification: It has 128 bytes of RAM, 32 input/output (I/O)ports, 4 kilobytes of flash memory, 216 bit timer counters. AT89S51 has a watchdog timer, a full duplex serial cord on chip oscillator. It has two software selectable power saving mode. The operating voltage is 4.5 V to 5.5 V. The speed grade is 0-16MHz. The power consumption in idle mode 1.0mA and in power down mode is 0.5 µA. The ATMEL 89S51 has a5 interrupt vectors:-two external interrupt (INT0´ and INT1´), the serial port interrupt and two timer interrupts (Timer0, Timer1). The watch dog timer consist of

Watch dog timer reset (WDTRST) and is a 14bit counter. The oscillator characteristics includes a quartz crystal or ceramic resonator which can be used to the XTAL 1(pin 18) and XTAL2 (pin 19) which provides external clock signal.

Some microcontroller may use 4 bit words and operate at clock pulse frequencies as low as 4 kHz this is done in order to consume lesser power. Other microcontroller may serve performance critical roles, in condition when they need to perform more like a digital signal processor with greater clock speed and higher power consumption

The 89C51 can be configured to bypass the internal 4 k ROM and run solely with external program memory. For this its external access (EA) pin has to be grounded, which makes it equivalent to 8031. The program store enable (PSEN) signal acts as read pulse for program memory. The data memory is external only and a separate RD* signal is available for reading its contents.

Use of external memory requires that three of its 8-bit ports (out of four) are configured to provide data/address multiplexed bus. Hi address bus and control signals related to external memory use. The RXD and TXD ports of UART also appear on pins 10 and 11 of 8051 and 8031, respectively. One 8-bit port, which is bit addressable and, extremely useful for control applications.

The UART utilizes one of the internal timers for generation of baud rate. The crystal used for generation of CPU clock has therefore to be chosen carefully. The 11.0596 MHz crystals; available abundantly, can provide a baud rate of 9600. The internal RAM utilizes the 256-byte address space and special function registers (SFRs) array, which is separate from external data RAM space of 64k. The 00-7F space is occupied by the RAM and the 80 - FF space by the SFRs

II. OUR WORK

The most important factor of this project is to make a low cost reliable and more efficient (higher accuracy) digital thermometer using components based on Electronics

(semiconductors) and Electrical. As name suggested, a digital thermometer is designed in such a way that it provides higher and accurate result while measuring body temperature which varies from person to person. The ATMEGA89S51 is used to receive a digital signal fed by an analog to digital converter (ADC0804) and the controller displays the processed output in cathode 7 segment displays. The design is totally different compared to analog thermometer and body temperature can be simply determined by just touching the temperature sensor with our fingers. There is no required of putting a mercury thermometer inside your mouth or placing it underarms.

The whole of the circuit works with the supply of 5v 750mA. There are total of 3 ICs (integrated circuit). The key role is played by the microcontroller ATMEGA89S51 which serve as the brain of our circuit. The temperature sensor LM35 is an analog IC (integrated circuit) which consists of 3 pins. The output signal from LM35 is fed to analog to digital converter, which converts the analog input signal to digital output signal and feeds to the microcontroller AT89S51. The ADC 0804 is so used because the microcontroller AT89S51 has no on chip ADC.

III. BLOCK DIAGRAM AND DESCRIPTION

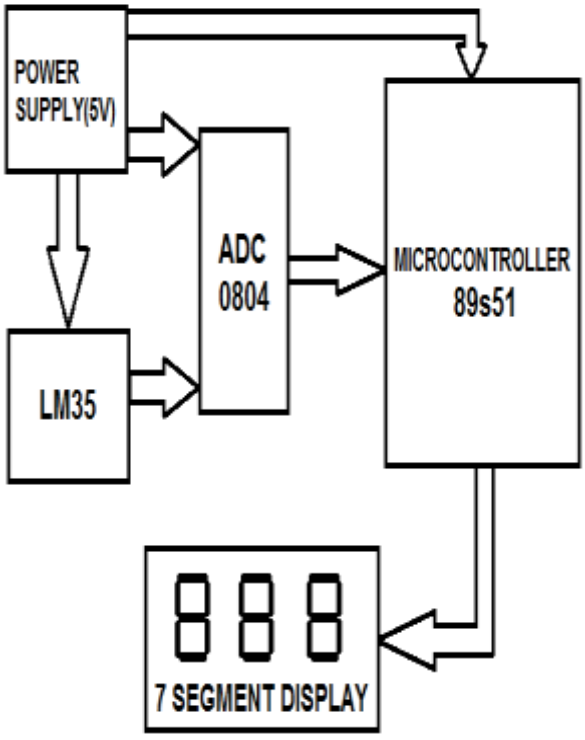

Fig.1 shows the block diagram.

A. *LM35*:

It is a precision integrated circuit temperature sensor and its output is constantly proportional to centigrade (Celsius) temperature [2-3]. The LM35 does not require any external calibration and provides accuracy of ±1/4°C. At room temperature it can work from -55°C to +150°C. It has TO-46 transistor. Its various functions are:-

1. Sensing the body temperature.
2. Generates voltage in terms of MV to ± 10MV.
3. Gives analogue output to ADC 0804.

B. *Adc0804(Analog To Digital Converter):*

ADC0804 is CMOS 8bit analogue to digital converter which uses a differential potentio-metric ladder. It appears like memory and no interfacing logic is needed.[4] It provides differential analogue voltage input and has a on chip clock generator. Its working voltage is 0-5v. Its various functions are:-

1. It receives analogue signal from LM35 and converts it into digital signal.
2. Digital signal obtained is fed to microcontroller AT89S51.

C. *Microcontroller(At89s51):*

This is a central processing unit of our project. We are using ATMEGA 89S51 microcontroller. Its various functions are:-

1. Receives the digital input from analogue to digital converter [5].
2. Process and transfers the signals to 7 segment LED driver circuit.
3. Enables the NPN transistor.
4. Helps to display the body temperature.

D. *Transistor*(2N2222P):

It is a NPN type transistor. Its main function is that it enables the cathode 7 segment display on receiving the signal from microcontroller [6].

E. *Cathode 7 Segment Display:*

It is used to display the person's body to temperature. Two common cathode displays are used obtain the body temperature [7].

Principle behind the Circuit:

The main component in the circuit is AT89S51 microcontroller. Here the temperature sensor LM35 produces a required output voltage in terms of milli volts. Whenever there is a slight increase or decrease in its temperature. A degree increase in temperature causes 1mV to be generated at the output pin of IC-LM35 [9-10]. This analogue voltage is fed to analogue to digital converter which converts this analogue input into digital output. Thus the digital output is fed to microcontroller ATMEGA89S51 and the controller processes data and produces the required output and displays it in cathode 7 segment displays [11]. The circuit is easier to design and its efficiency is greater and accurate. The main work is done by the temperature sensor (thermistor), ADC0804 and microcontroller AT89S51. The working principle of circuit is simple and reliable. It can be easily assembled in breadboard or PCB. The required body temperature is displayed in cathode 7 segment display.

IV. CIRCUIT DIAGRAM AND DESCRIPTION

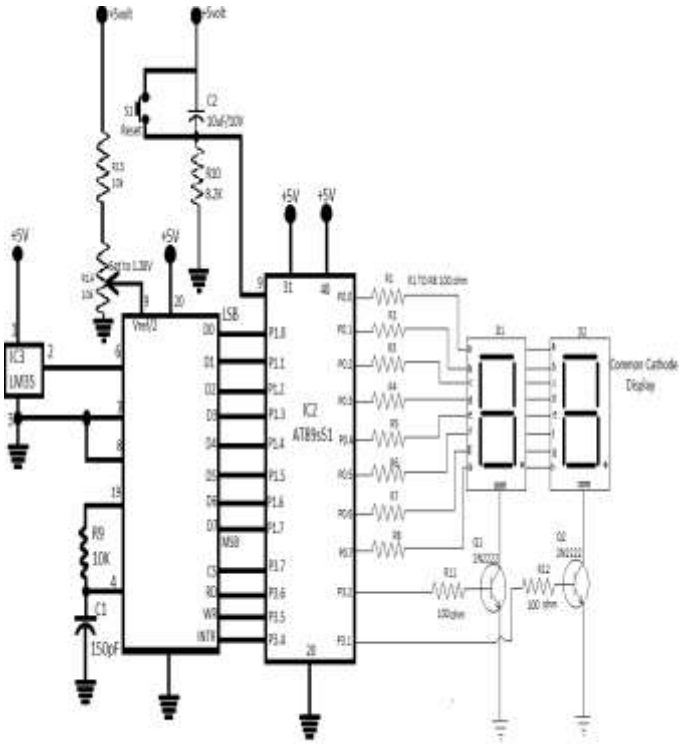

Fig.2 shows the Circuit diagram.

In this circuit the main temperature sensor is LM35 which when touched with finger generates a voltage which is 1MV increased per degree Celsius. It works as a NGT. Its resistance decreases with increase in temperature. The output voltage from LM35 through pin no 2 is fed to the analogue to digital converter 0804.

The analogue signal from LM35 is now received by ADC0804 which process the signal and converts it into digital signal. ADC0804 plays a major role in our circuit since microcontroller does not have internal analogue to digital converter hence an external ADC is used [8].

The digital signal obtained from ADC0804 is fed to the input ports,(that is P1.0 to P1.7 pins of the microcontroller). The AT89S51 process the digital signal and gives the signal to the 7 segment display through its output port that is, P0.0 to P0.7. The microcontroller also gives the signal to the transistor which activates the cathode 7 segment display in order to display the required body temperature of the person.

V. COMPONENT DETAILS

Sl/No	Items	Range/specification	Quantity
1	DC Battery	12V	1
2	Microcontroller	At mega 89S51	1
3	Heat sensor	IC LM35	1
3	Regulator IC	7805	1
4	Capacitor	150pf,10µf	3
5	Resistor	10kΩ,8.2kΩ,100Ω	7
6	Transistor	2N2222	2
7	Preset	10K(1/4 watt)	1
8	Cathode LED display	-	2
8	Reset switch	-	1
9	Connecting wires	-	1set

VI. CONCLUSION

This device is a better form to describe the advanced digital world. With a program run into it, this device can be of its own very kind. One can always know about the wellbeing rate of the body temperature with high accuracy and efficiency. Technologies upgrade due to the demand and this device once introduced will keep the demand on the good shape.

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