Temperature Detector for Premature Infant Incubator using AVR Microcontroller

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Abstract*—Babies born prematurely are generally kept in special chambers referred to as "incubators", which are enclosures with controlled temperature and humidity. Some newborn babies at the full term also need to be placed in the incubators for special treatment purposes. Since the introduction of neonatal incubators, the survival rate of premature births and newborns has increased significantly, making the incubators extremely important devices in neonatal care at --hospitals. Modern incubators are very expensive making it difficult for hospitals, especially small ones, to procure them especially with economic crunch and resource constraints for capital equipment. This paper provides the details an efficient and cost-effective incubator to meet the clinical needs at low budget hospitals.*

Keywords— Incubator**,** Sensor lm35, AT Mega 32

I.INTRODUTION

Infant incubator system is a vital and critical area because it deals with premature infant or illness baby. It is essential to detect any abnormal conditions occur in the infant incubator system as soon as possible. Temperature, humidity, and oxygen concentration are the main parameters must be control in the infant incubator system. This paper deals with the measurement of temperature inside the incubator as temperature is one of the most-measured process variable in human body. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature sensors are the key to read temperatures correctly and to control temperature in biomedical applications.

There are mainly five parts from which we can measure the temperature of new born baby.

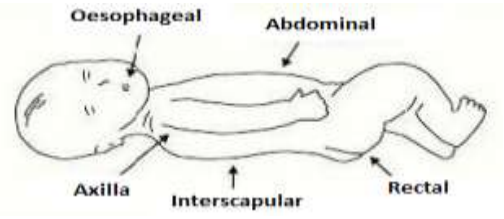

Fig.1 Temperature Measurement site of new born baby

A. Principle

The circuit works on the principle of analogue to digital conversion. The temperature is sensed by an analogue temperature sensor and this analogue value is converted to a digital value using an ADC. A microcontroller then processes the digital signal to display the temperature reading in Celsius on the display.

II.BLOCK DIAGRAM

The Figure shows the block diagram of temperature detector for incubator. Microcontroller ATMEGA, liquid crystal display (LCD), Sensor and analogue to digital converter are used. Designing the circuit mostly involves designing the microcontroller interfacing. Here the ADC and LCD need to be interfaced to the microcontroller ATMEGA.

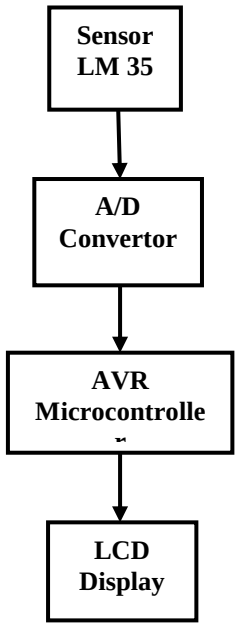

Fig.2 Block diagram of Temperature Detector for Incubator

A. Block Diagram Description

The LM35 is a precision temperature sensor IC. LM35 IC gives electrical output in proportional to temperature. The LM35 IC is sealed & hence not subjected to oxidation & other processes. With LM35 temperature can most accurately measured compared to thermistor. It includes features like low self heating

& does not cause more than 0.1 ^{0}C rise in temperature in still air.

The output of the sensor is given as an input to the analogue to digital converter. An analogue-to-digital (ADC, A/D, or A to D) is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude. The conversion involves quantization of the input, so it necessarily introduces a small amount of error. Furthermore, instead of continuously performing the conversion, an ADC does the conversion periodically, sampling the input. The result is a sequence of digital values that have been converted from a continuous-time and continuous-amplitude analogue signal to a discrete-time and discrete-amplitude digital signal.

The output from the A to D converter is given to the AVR Microcontroller which based on the stored program performs the operation on the received digital data and then send the result to the LCD for the display. LCD displays the temperature measured by the sensor on to the screen for the user. The heart of the system is the AVR Microcontroller.

Microcontroller can be termed as a single on chip computer which includes number of peripherals like RAM, EEPROM, Timers etc., required to perform some predefined task.

AVR Microcontroller is based on RISC architecture. AVR stands for Advanced Virtual RISC. AVR Microcontrollers are available in three categories: 1) Tiny AVR 2) Mega AVR & 3) Xmega AVR. They are fast: AVR microcontroller executes most of the instructions in single execution cycle. AVRs are about 4 times faster than PICs, they consume less power and can be operated in different power saving modes. Let's do the comparison between the three most commonly used families of microcontrollers. AVR is an 8-bit microcontroller belonging to the family of Reduced Instruction Set Computer (**RISC**). In RISC architecture the instruction set of the computer are not only fewer in number but also simpler and faster in operation. The other type of categorization is CISC (Complex Instruction Set Computers). Click to find out differences between RISC and CISC.

Atmega16 contains features like four 8 bit I/O ports, internal calibrated oscillator, 8 channels ADC with a resolution of 10 bit, Watchdog timer, two 8 bit & one 16 bit timer/counter, USART, SPI, ISP, TWI & three types of memory like Flash EEPROM, Byte addressable EEPROM & SRAM.

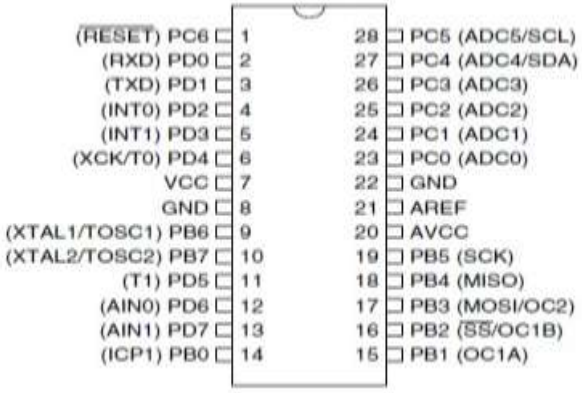

Fig.3 Pin Diagram of AT MEGA Microcontroller

III.CIRCUIT DESGIN

The temperature detector is using for the detection of the temperature of the incubator by using the lm35 sensor, A to D converter, AVR controller, LCD display. The temperature sensor lm35 senses the temperature and the output of the sensor is given to the A to D converter that converts the analog signal into digital signal and then it will goes to the microcontroller which process the digital signal because the microcontroller only reads the digital signal so we need the crystal pin in the project to run the micro controller.

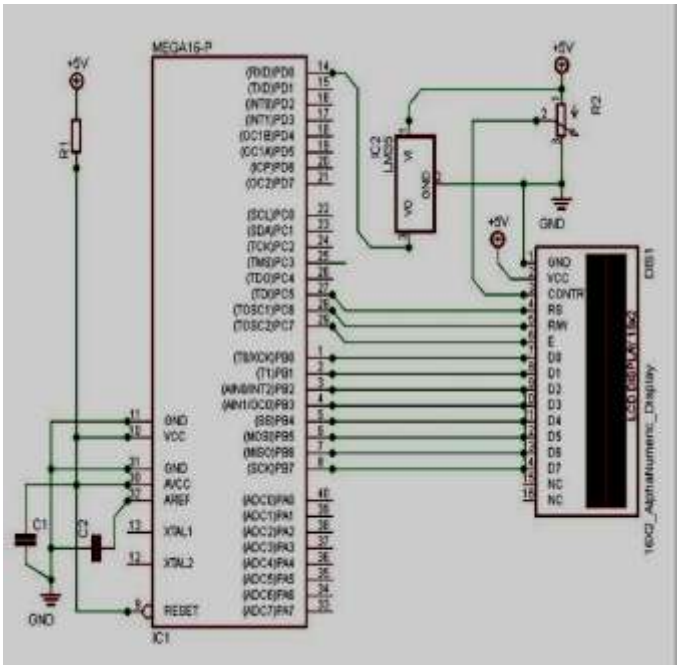

Fig.4 Circuit diagram of Temperature Detector for Premature Infant Incubator using AVR Microcontroller

The liquid crystal display is the output of the circuit that will shows the temperature display there are other components in the used in the circuit like

resistor capacitor etc. the resistor will oppose the current and the capacitor is used for filtering.

The circuit works on the principle of analog to digital conversion. The temperature is sensed by an analogue temperature sensor and this analogue value is converted to a digital value using an ADC. A microcontroller then processes the digital signal to display the temperature reading in Celsius on the display.

IV. RESULTS

The system designed for the temperature monitoring of the infant incubator worked successfully on a dummy model. The accuracy of the system is about 0.5°C as shown in Table I. Chart showing the Comparative Results between Thermometer Reading and LM 35 Reading in °C is as shown in figure 4. Chart showing Error between Thermometer Reading and LM 35 Reading in °C is also shown in figure 5. However the system is yet to be tested on practical incubator.

TABLE I
COMPARTIVE RESUTLS

Actual Temperature by Thermometer (in °C)	Measured Temperature by LM 35 (in °C)	Error (in °C)
30	30.3	0.3
35	35.7	0.7
40	40.4	0.4
45	45.6	0.6
50	50.4	0.4
55	55.7	0.7
60	60.6	0.6
65	65.3	0.3
70	70.6	0.6
75	75.4	0.4

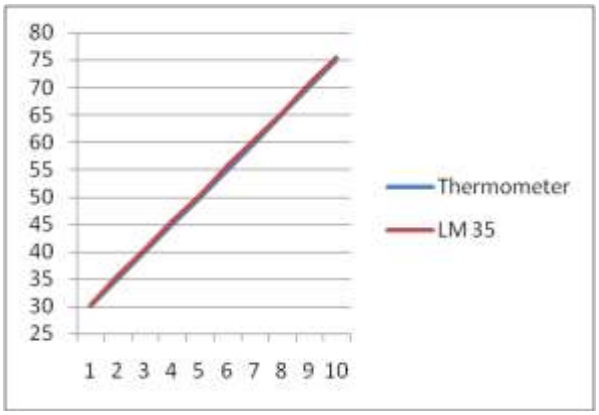

Fig.5 Chart showing the Comparative Results between Thermometer Reading and LM 35 Reading in °C

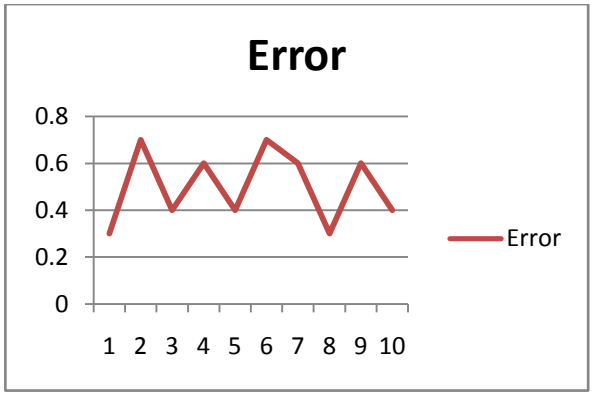

Fig.6 Chart showing Error between Thermometer Reading and LM 35 Reading in °C

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