Infant Incubator using RTD

Harsh Jadav[1], Amar Bansode[2] , Divya Sharma [3]

[1,2,3] *(Department of Electronics and Telecommunication, Atharva College of Engineering, India)*

Abstract : *There are four million babies worldwide who die in the first month of life, one million die on their first day. Preterm birth is attributed, either directly or indirectly, to at least 25% of neonatal deaths, and low birth weight (LBW) new-borns are at the greatest risk. About half of the worldwide total, or 1.8 million babies each year, die for lack of a consistent heat until they have the body fat and metabolic rate to stay warm. This paper helps to prevent the death of such babies. The microcontroller based baby incubator helps to all peoples, the cost this project is very less than today's baby incubator which are used in big hospital. So, everyone which belongs to economical backward also use of it.*

Keywords-New borns; Microcontroller; Baby Incubator; Preterm birth

I. INTRODUCTION

An incubator is a medical device which can maintain and regulate an appropriate environment for infants. This is a crucial device for preterm infants, which are infants born before 37 weeks of gestation. Their low birth weight and under developed organs make them very sensitive to environmental humidity, temperature, and infection. Preterm birth rates range from 5% in developed countries to 25% in developing countries. Furthermore, most births in developing countries do not occur in a hospital. The World Health Organization and Engineering World Health stress these facts and the need for a transportable infant incubator designed for use in developing countries. The incubator needs to be robust to withstand travel through difficult conditions and cost effective since it will be used in low resource areas. Parts need to be inexpensive and easily replaced in developing countries. Previous incubators were researched and the proposed project draws from the work of the Car Parts Incubator and Engineering World Health. The purpose of this research is to design a baby incubator system with the capability of monitoring and controlling its temperature effectively using PID control.

This project is to design a temperature controller to be used to control temperature of a small environment such as an infant incubator. The incubator is considered as an air conditioned room with special specification which we can control it with respect to the condition of infant incubator which case the air flowing to upper area so dismiss the CO2 from the special upper windows. Incubators are designed to provide an optimal environment for new-born babies with growth problems (premature baby) or with illness problems.

Premature infants are unable to keep themselves sufficiently warm. They are also very weak and prone to infections. An incubator is a special type of a cot which provides an ideal environment for the infant. It tries to stimulate the conditions as inside the mother's womb. Current studies relate infant death in some cases while being cared in incubator due to suffocation and malfunction of an incubator. This happen when the temperature in the incubator increases and causes the level of CO2 to increase too. In this paper, we implement PID control to a baby incubator with following specifications: set point is set to 32°C, using ATmega16, power maximum of the heater is 250 W and reference temperature is the temperature read from a temperature sensor PT100.

II. RELATED WORK

P. Jagadeesh, G. Karthick Kumar Reddy, S. Venkatramana Reddy in developed an Inexpensive Temperature Controller for an Infant Incubator in which ADT7410 is configured with one shot mode temperature conversion, so it converts at 240 ms every sample. The sensor present conversion temperature values are compared with the High and Low temperature limits, if found greater than the T high & T cric limit then INT, CT pins in ADT7410 goes to high state and relay position is switched to OFF the radiant warmer, and buzzer beeps indicate warning until it reach to low temperature limit. If the present temperature is lesser than the T low limit then only INT pin go to high state and relay position is switched to ON the radiant warmer and buzzer beeps indicate warning until it reach to high temperature limit. It shows the ON-OFF operation of radiant warmer with ADT7410 Sensor when the over/under

temperature limits are reached. The process is continued to monitor the infants in good environment for health recovery [1].

M. Suruthi, S. Suma in had designed the Microcontroller Based Baby Incubator Using Sensors keeping in mind the medical conditions available in rural areas. This Equipment can be effectively used by technicians in a small health care centre. It can be a lifesaving machine for low birth weight infants. The components can be easily fixed. The chamber is sufficient enough to accommodate the baby comfortably. As the electronic part is separated from the Baby's compartment baby can be assured safe. The temperature of the system can be understood. This project is simple and efficient in maintaining the temperature of the chamber irrespective of the outside temperature and is designed at a low cost [2].

Dhaval Kothiya, Arjun Chauhan, Twinkle Patel, Khushbu Shah, Shweta Patel, Supriya Singamsetty in designed the Temperature Controlled In Infant Incubator which uses microprocessor as main controller in digital signal processing combined with complex combinational logic circuit are redundant and needs to be improved in the sense of functionality. Replacement of microcontroller with a PIC controller is prudent action due to its efficiency and reliability especially in an incubator where the life of an infant relies on. A PIC controller has least complex circuitry has to be designed so that it saves space and be more reliable for an incubator. Therefore, it is highly recommended that the PIC controller has reduced circuit complexity and increase the control system action time response. PIC controller is the solution to all the problems since PIC controller offers more efficient, reliable and accurate control [3].

Zain-Aldeen S. A.Rahman, Farahan S. A. Hussain in developed a Smart Incubator Based on PID Controller which was implemented and applied to achieve smart incubator. Its need low cost and power when compared with classical systems. Also the controller economical in power consumption. This controller has this advantage, the system motes need low power. Finally, the system has the simplicity using by the customer [4].

Olson K.R., and Caldwell A.C. in created the Designing of an early stage prototype using readily available material for a neonatal incubator for poor settings which protects and incubates an infant while being transported to a hospital. The device needs to be economical, robust, and use easily replaceable parts. The heating mechanism will use computer fans, a humidifier, and car headlights to provide heat [5].

III. SYSTEM OVERVIEW

System overview contains block diagram, flowchart and working of the system.

A .Block Diagram

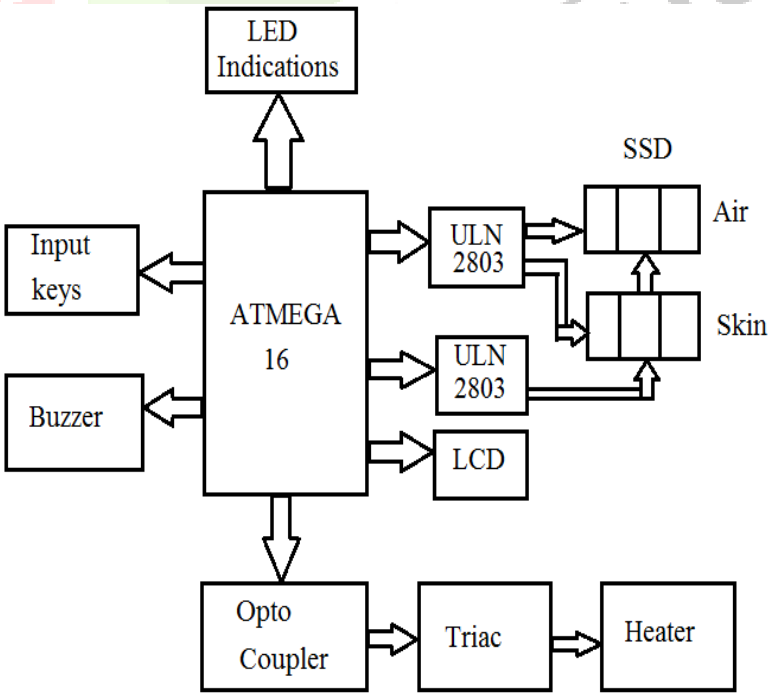

Fig 1.Block diagram of system

Infants have very low thermal regulation, hence not possible for body to cope with thermal loss. Hence, the body to be kept in moist condition. Therefore temperature is maintained with minimum variations. Air or skin temperature will be taken as reference. The threshold temperature is between 35°C to 37°C. Heat increases due to manual set temperature after turned off. Here, it is controlled by temperature sensors and adjusted according to threshold. Air temperature is monitored by temperature sensors and is adjusted by controlling the current to heater. If temperature increases above threshold, alarm beeps to maintain temperature. Seven segment display is used for skin and air temperature. LCD is used for setting parameters. If the probe fails, alarm will beep and is called fail safe alert..

B. Working

An incubator plays a vital role in saving premature babies. One of the main functions of infant incubator is temperature control which is required to achieve thermo-neutrality in infant's body. To serve this purpose we have designed a simple ON-OFF control circuit which will maintain the temperature of the incubator at a desired level (37°C). But there is a 3°C swing in temperature range against the set value. This could be due to the fact that, it takes time for the distribution of heat energy from the heater to the surroundings and there is a lag of response time for the temperature sensor to respond to the change in temperature. To overcome this problem an enhanced regulation system was developed based on a combination of a PWM circuit and an ON-OFF circuitry. The PWM circuit tapers off the energy supplied to heat the incubator as the temperature rises to 37°C. This reduces the thermal inertia when the heating circuit is then switched off. The temperature increased by only 0.5°C, i.e., to 37.5°C which is an acceptable value. While the incubator cooled off, the heater switched on again at 36.5°C. Thus using the enhanced control system, the temperature swing was only 1°C, which is satisfactory and acceptable for a neonatal incubator.

The linearization circuit made for the thermistor gave a satisfactory performance as can be seen through the measured values in the graphs. The linearity was good for the temperature range of 30°C 40°C which is acceptable for this application too. This allowed monitoring of the temperature directly using a simple millivoltmeter through appropriate voltage adjustment. The alarm circuit designed worked satisfactorily too. This produced a loud sound alarm to draw the attention of medical attendants if the temperature went above 38°C or went below 26°C.

In developing countries like ours frequent power cut occurs, it needs to be addressed for continuous operation of the incubator. A battery back up has been suggested to operate the incubator under such situations. A solar panel may also be used to provide the necessary power. Thus the present work paves the way to design and develop a complete incubator that could save lives in rural areas of developing countries.

C. Flowchart

Flow chart of the incubator system is as given in Fig 2.

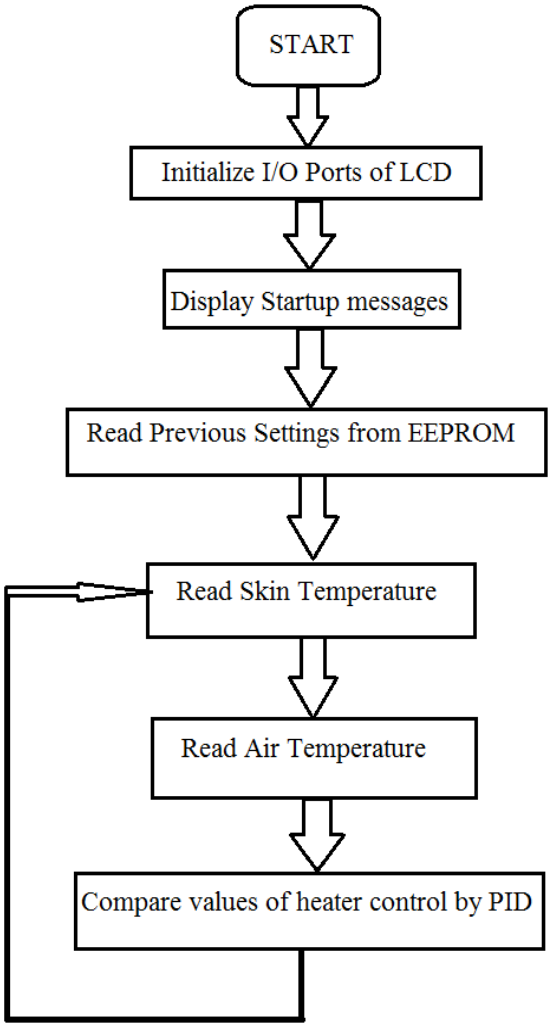

Fig 2.Flow chart

IV. RESULT

Parameters	Results
Temperature rise time 30°C to 37°C	60 secs
Temperature reading accuracy	± 0.1°C
Temperature overshooting & undershooting	± 1°C
PID control	Yes
Fail safe alert	Temperature probe disconnect alert & auto off heater
Power fail	Power fail indication & alert

The set points that included the temperature is set to be 37°C. The results are displayed by Seven Segment Display and LCD. The LCD interfacing with the microcontroller to display the sensed values which displays the required parameters for different states according to required threshold values of the temperature. The temperature rise time from 30°C to 37°C is in 60 seconds. The temperature reading accuracy is ± 0.1°C. If the probes gets disconnected then it sounds an alert and the heater gets off automatically. Also if the power fails then it is indicated by an alert.

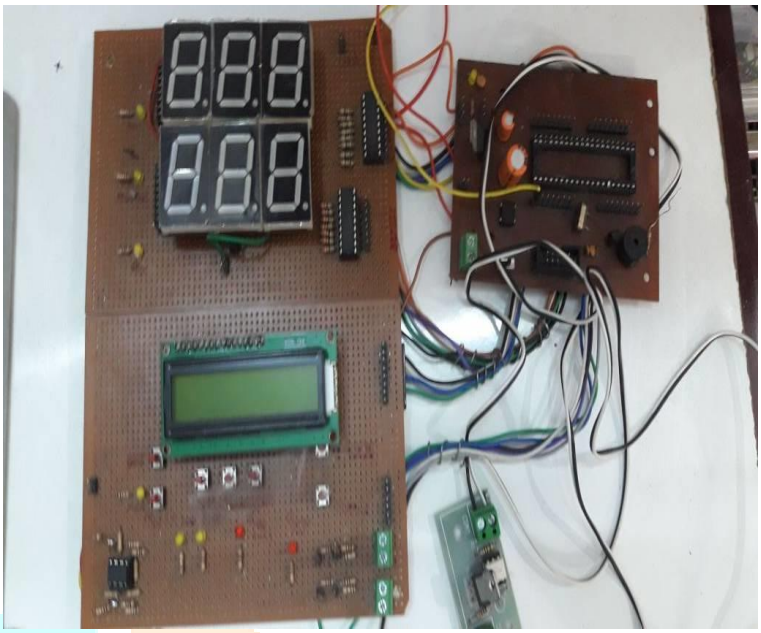

Fig 3. Implementation of circuit in real

V. CONCLUSION

This hardware along with the software can prove to be an effective system to make the life of an infant. The project is designed keeping in mind the medical conditions. It is efficient in maintaining the temperature of an infant. The aim of this system is to contribute to the society in a small way by setting out an idea for a system which could actually better the lives of millions of infants across the globe.

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