Biomedical Radiant Warmer Prototype Model

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Abstract— This paper presents prototype model of Radiant Warmer. This system is composed of 8051 Micro controller, LM35 temperature sensor, Analog to digital converter, Relay card for switching, Lamp as heating agent, Alarm. Radiant warmer is used to regulate temperature of widely for preterm (premature) infants or sometimes infants having low birth weight, ill infants.

Key words: Radiant Heater, Incubator, 8051 Controller, Medical Instrumentation, Bio-Medical Engineering

I. INTRODUCTION

Premature infants are babies born prior to the normal 36 to 37 days, so they are unable to control or regulate their temperature with outside world. Key concern of radiant warmer is to regulate the temperature of premature baby and give notification for abnormalities.

A. Heat loss in infant take place by four ways

1) Conduction:
Direct heat transfer from skin to object (eg mattress).

2) Convection:
Heat loss through air flow, also depend on air temperature.

3) Radiation:
Transfer of heat to cooler objects not in direct contact with infant.

4) Evaporation:
Heat loss when water evaporates from skin and respiratory tract.

B. Limitations of preterm in thermoregulations

Temperature regulation is one of the most important factors affecting survival in newborn infants. Premature infants, as compared to term infants, are at an even greater disadvantage in temperature maintenance, because of the larger skin surface area to body mass ratio, decreased subcutaneous fat, and low supplies of brown fat. Furthermore, the normal surge in metabolic rate that occurs after birth is reduced in preterm infants, resulting in limited heat production. So preterm babies at high risk of hypothermia and hyperthermia, after taking all care described in warm chain, and risk of infant death is increases. A series of measures taken at birth and during the first few days of life to ensure that the baby: Maintains a normal body temperature (36.5-37.5°C), Does not become too cold (<36.5°C = hypothermia), Does not become too hot (>37.5°C = hyperthermia). To protect infant child we must give infant Thermal protection.

In simple terms, Newborns need a warmer environment than adults. All health care providers need to be alert to the risk of hypothermia and hyperthermia. Both are dangerous and may cause the death of the baby, but are easily prevented, by using Radiant warmer. To give thermal protection Bio-Medical Engineers developed Radiant warmer. Radiant Warmer regulates the temperature of infant.

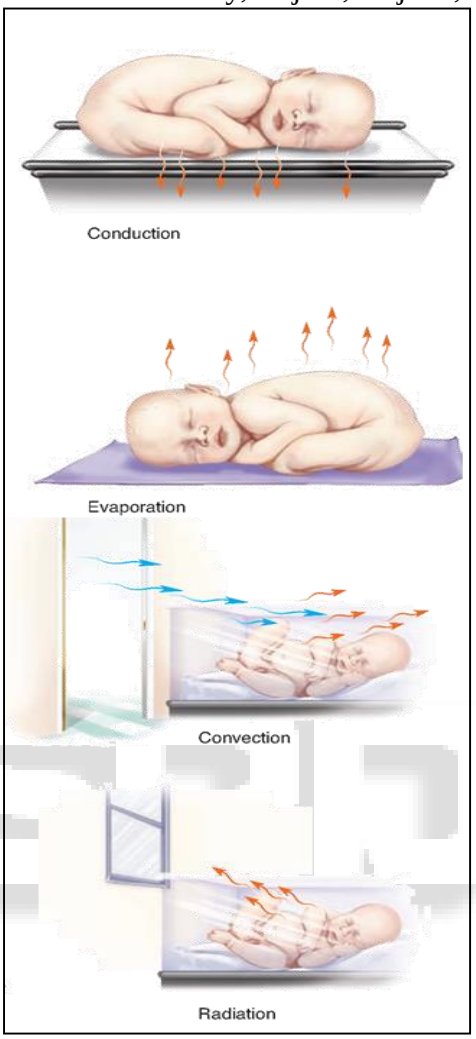

Fig. 1: Heat loss in infants

II. PRINCIPAL OF OPERATION

A heating element generates a significant amount of radiant energy in the far IR wavelength region (longer than three microns to avoid damaging the infant's retina and cornea). The radiant output of the heating unit is also limited to prevent thermal damage to the infant. The IR energy is readily absorbed by the infant's skin; increased blood flow in the skin then transfers heat to the rest of the body by blood convection (heat exchange between the blood and tissue surfaces) and tissue conduction (heat transfer between adjacent tissue surfaces).

III. AIM

We've set normal temp. at 36 °C, required for infants. If temperature of infant is below 36 °C than infant needs heat, for that heating agent should be turned on. We've used lamp as heating agent. And give notification at abnormality & abnormality is set below 35 °C and higher than 37 °C. Notification is given by an alarm.

IV. HARDWARE

To make prototype model of radiant warmer we've used is Philips (NXP) P89V51RD2BN micro controller, LM35 temperature sensor, Analog to digital converter ADC0804, Relay card for switching (12V DC), Lamp as heating agent, Alarm, LCD display to display output (16*2).

A. Circuit Description

A 12V DC adapter provides power to circuit which is connected with mains. IC 7805 is used to give output of 5V DC required for components. LCD is connected with port 2 of micro controller in 4-bit mode. LM35 temperature sensor gives analog output and o/p of LM35 (Pin no. 2) is given to ADC 0804 at pin no. 6 (Vin) which converts analog i/p into digital o/p. Write signal of ADC is controlled by port pin 0.1 & Interrupt is controlled by port pin 0.2. 10k variable resister is connected with ADC at pin no.9 (Vref/2) to change reference voltage. Digital o/p of ADC (D0 to D7) is connected with port 1 (P1.0 to P1.7) of micro controller. I/p of relay 1 is connected with port pin 0.6 & i/p of relay 2 is connected with port pin 0.7. Relay works on 12V DC, so 12V DC is given directly from adapter.

V. WORKING PRINCIPLE

LM35 gives linear analog o/p with respects to temperature, analog to digital converter convert this o/p into digital which is feed to micro controller through port 1. Equation of converting voltage o/p of ADC into temperature is

Temperature (ºC) = Vout * (100 ºC/V)

If temperature is below 36°C than lamp should be turned on. When temp crosses 36°C than lamp should be turned off. But if temperature is below 35 °C or above 37 °C than alarm should ring. Temperature is displayed on LCD. Condition of Lamp & Alarm is also shown on display. 2 Relays are used to run lamp or alarm. Relay is switch which controlled by small electrical signal given from microcontroller port pin 0.6 & 0.7.

Lamp is controlled with relay 2, and relay 2 is connected with port pin 0.7. Alarm is controlled with relay 1, and relay 1 is connected with port pin 0.6. Alarm and lamp both are connected with relay in normally open mode.

A. Block Diagram

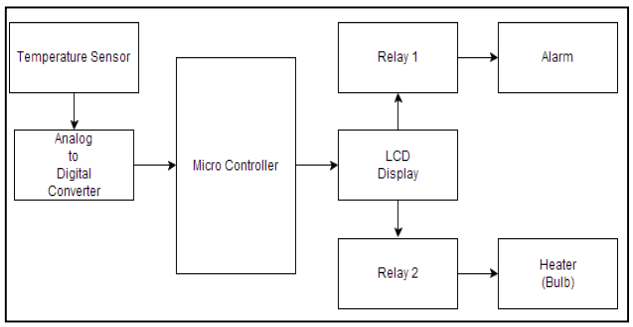

Fig. 2: Block Diagram of Radiant Warmer

VI. ADVANTAGES AND LIMITATIONS

A. Advantages

- Quick & easy access
- Good for performing procedure
- Complete visibility
- Rapid re-warming

B. Limitations

- Insensible water loss
- Radiant heat loss

VII. CONCLUSION

Hence the effort to create a prototype working model of biomedical radiant warmer is fulfilled. In future we will try to add other parameters like Heart rate monitor, SpO2 monitor & respiratory monitor.

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