

Implementation of Blood Warmer before Transfusion Process Using Microcontroller AT89S52

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Abstract— This paper focuses on an instrument Blood Warmer which is used in Biomedical field to warm the blood before transfusion. The instrument warms human packed blood from 4oC to 37oC that is to a temperature that is safe for infusion. Usually blood is stored at 4oC in cold storage. If we transfuse cold or high temperature blood into the human body then it would cause to high fever to patient which may cause death to the patient. To avoid such conditions we use blood warmer. While warming the blood, blood components should not be warm by putting blood bag on to warm water, in micro-oven or we cannot use the radiation type of heating because it will damage the blood components.

Key words: Blood Warmer, AT89S52

I. INTRODUCTION

Conventional way of blood warming is to putting blood bag into the warmth water for approximate period of time. There are no such measurements of blood temperature, so many times temperature of blood exceeds the desired limit or many times not even reach to desired temperature rate of rise of temperature also plays the important role in blood warming. Blood should be warm up to body temperature in specific time duration (8-10minutes). If temperature rises too fast that would damage the red blood cells and plasma content of blood at the same time. We need to warm a blood in lowest possible time period, so we need a device which warms the blood gradually and precisely. Red blood cells and plasma exposed to temperature over 40oC may cause severe transfusion reactions. To achieve all above objectives we need a controlled heating system so the blood warmer will increase the blood temperature up to 37oC in 8-9 minutes.

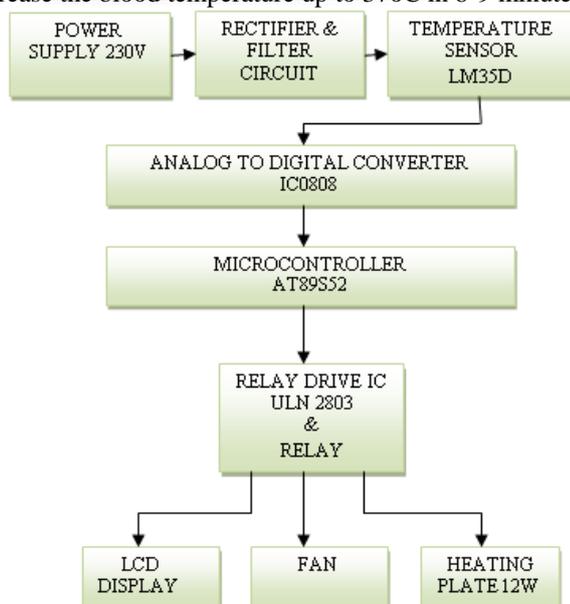


Fig. 1: Block Diagram of Blood Warmer

Design of this module is so compact and easy to operate that it can be easily installed in ICU rooms and can be moved anywhere by just removing the power cord if necessary. Convection heating is used to warm the blood as

the conduction and radiation heating may damage the blood content that is we increasing the temperature of surrounding air inside the box which will then cause to rise the temperature inside the blood bag.

II. BLOCK DIAGRAM DESCRIPTION OF BLOOD WARMER

For working of blood warmer, we take a 230 Volt AC (Alternating Current) power supply directly from MSEB (Maharashtra State Electricity Board). To convert this into pure, filtered and constant DC (Direct Current), we use step down transformer, rectifier, filter and regulator respectively. For sensing the temperature we use temperature sensor LM35. It gives its output in an analog form. To convert it into digital form, we use analog to digital converter (ADC). Output of ADC is given to a microcontroller AT89S52 which is used to control and process the operation of blood warmer. It is programmed in such a way that our project works properly. Output of microcontroller goes to relay drive IC ULN 2803 which drives the relay. Basically there are two stages of relay. When it is normally opened (NO) fan turns on for heat dissipation and when relay is normally closed (NC) heating plate of 12Watt stops heating. Relay is also connected to the LCD display for indication purpose.

III. WORKING OF BLOOD WARMER

A. Heating Chamber:

Heating plate of 20 Watt is fitted at the bottom of the heating chamber and power supply of 230V 50 Hz is connected to heating plate which is electronically controlled through relay. Basically warming module is controlled temperature loop, when we places blood bag and turn on the power supply heating plate starts to heating the surrounding environment that is convection type of heat transfer is used.

B. Controller:

As soon as we turn on the power supply temperature sensor start sensing the temperature. LM35 gives output of 10mv/oC which is then feed to analog to digital converter. Analog to digital converter used for interfacing of temperature sensor and microcontroller. Output of analog to digital converter is then given to microcontroller. Microcontroller is programmed in such a way that it will continuously read data from analog to digital converter and accordingly control the power supply to heater by means of controlling the relay supply of relay. Output of microcontroller is interfaced to relay through relay drive IC ULN 2803 which turn on and off the relay. Controller is programmed to turn on and off the relay for 1 minute at regular temperature intervals to achieve the objective of gradual heating, once temperature reach to the 36 degree controller gives signals to relay to turn off power supply to heating plate. Even if power to heater is off its still going on increasing temperature by 1-1.5 degrees depend upon surrounding temperature. When temperature reach to desired level controller give indication on LCD display.

C. Algorithm:

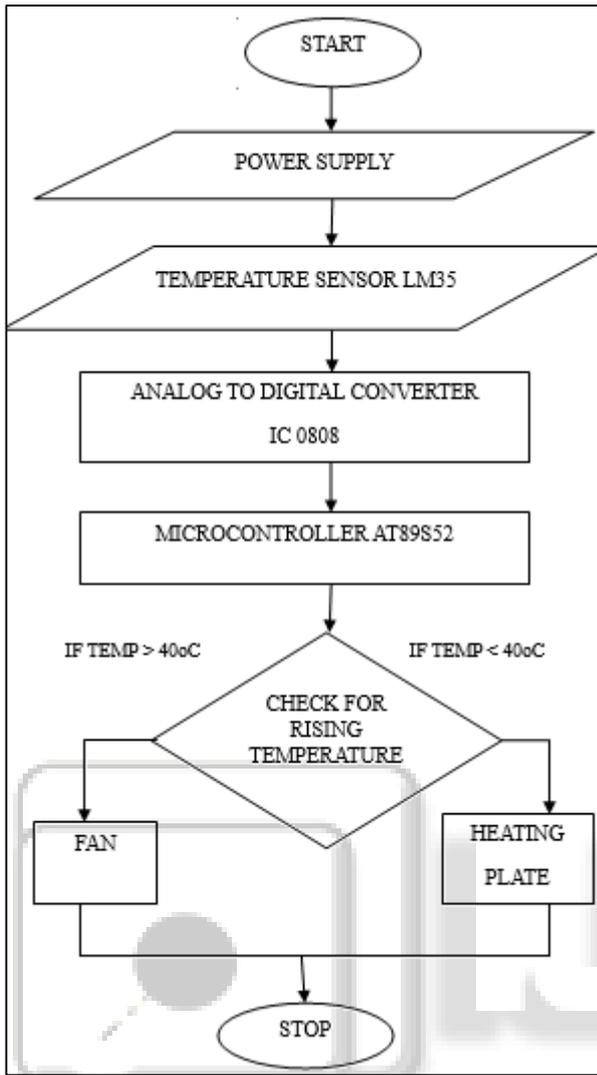


Fig. 2:

IV. RESULT

To check working of our project as well as accuracy of it we have taken temperature readings versus time that is we calculate the temperature inside the box as time span increases. As time passes temperature inside the box increases which is indicated on LCD display. When temperature goes above 40oC heating plate stops getting heated and fan gets on to remove the excessive heat inside the box. When temp inside the box that is outside the blood bag is 40oC at that time temp of blood inside the bag is approximately 36.5oC. It means there is difference of 4.5oC. After observation, it is concluded that the whole blood in the bag is warmed to appropriate point within 13 minutes only. In emergency cases when patient need blood urgently then it will become very useful.

The readings and respective graph is as shown below

Time (minutes)	Temperature (oC)
1	27
2	25
3	25
4	25
5	27

6	29
7	31
8	33
9	35
10	35
11	37
12	39
13	41

Table 1: Readings: Temperature Vs Time

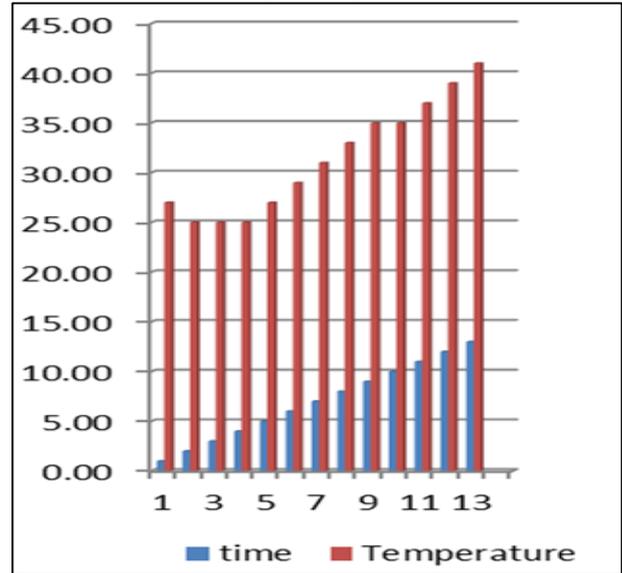


Fig. 3: Temperature versus Time graph plot

V. SYSTEM SETUP



Fig. 4: Inner view of Heating Chamber



Fig. 5: Outer view of heating chamber

VI. CONCLUSION

This project is mainly used to warm a cold blood corresponds with body temperature with minimum risk of cellular damage, hypothermia and hyperthermia. The main purpose of this instrument is to save a life of patient in case of emergency. The Blood Warmer module is a very useful key in the future developments of blood warming solutions without using bulky devices. It can also reduce the power consumption to a great extent. This project is just a stepping stone in the wide prospects of this technology. This project shows how a module can be controlled and used for a desired warming purpose. By some improvisation it can be built for multiple blood bags heating. It warms the blood up to human body temperature in desired time period, so in some emergency cases of blood transfusion it can be a life saving device.

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