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Microcontroller Based Portable Paramedic Blood Warmer for Transfusion

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Abstract: ***Temperature maintenance is the major consideration for the effective and safe handling of the patient. Mistakes regarding to it can lead to life-threatening condition for the patient. The normal body temperature of human is 37.5 °C. The blood from blood bank is stored at lower temperature about 2 °C – 6 °C. It is dangerous to directly infuse cold blood in to the patient. To avoid hypothermic effects in the patient body during transfusion, both the blood bag temperature and patient body temperature is monitored and accordingly heating is provided. The present system involves warming of blood using water bath which takes 15-20min to warm the cold blood. Therefore we introduce microcontroller based portable paramedic blood warmer which aims to decrease the time for warming the blood by providing controlled heating. LM35 precised temperature sensor is used to measure blood bag temperature. It sends the output to microcontroller, inbuilt with ADC (Analog-to- Digital Converter). Hot air drier is used to heat the blood to meet the required temperature difference which is controlled using PIC microcontroller. Thus the temperature is maintained at 37°C .The output is given to LCD display unit which monitors the heat. This is a novel method as it helps to ensure that there are no aftershocks from the patient as the difference in temperatures can be quite deadly to an extent that it can lead to death sometimes.***

Keywords: hypothermic effects, transfusion, paramedic

I. INTRODUCTION

The adult has total blood volume of approximately 5 liters, which contains about 8% of the body's weight. Blood transfusion is a medical treatment that replaces blood lost through injury, surgery, or disease. There are several methods to warm IV fluids and bloods are currently available. These include immersing coiled IV tubing in a water bath, microwaving the bag of fluid to be infused, adding heated saline to blood to be infused, passing the IV tubing through a heating block or through a plastic tube warmed with forced air, passing the IV tubing through a conductive surface interfaced with a counter current heated water bath, magnetic induction, pre-warming fluids in a convection oven or in a microwave oven. But all these methods consume time and are not safe. To overcome this we introduce Microcontroller based portable paramedic blood warmer for transfusion.

The normal human body temperature is 37.5°C. The blood is stored at lower temperature to lower the metabolic rate and bacterial growth. After a unit of blood is collected, it is prepared and then cooled for storage in the blood bank. when many units of cooled blood are given in a short time, body temperature may drop to threatening level, a condition called hypothermia. Hypothermia is due to the use of anesthetics and cold intravenous fluids. Also, maintaining a surgical patient's normal body temperature has been shown to reduce infection, speed healing, shorten hospital stays, and diminish the

chance of serious heart injury. The motive is to measure the temperature accurately. The procedure is minimally invasive, portable and time saving and hence useful in emergencies.

II. Design Of Blood Warmer

The blood bag is kept inside a fiber box where hot dry air is blown and transfer of heat occurs. The patient temperature is set as 37°C as default and blood bag temperature is sensed continuously using temperature sensor. A PIC microcontroller is used which is connected to LCD for display and hot air drier. The microcontroller controls the working of the drier according to the sensed temperature. Blood in the blood bag is heated till 37°C and it does not exceed above. Controlled heating is provided by this approach.

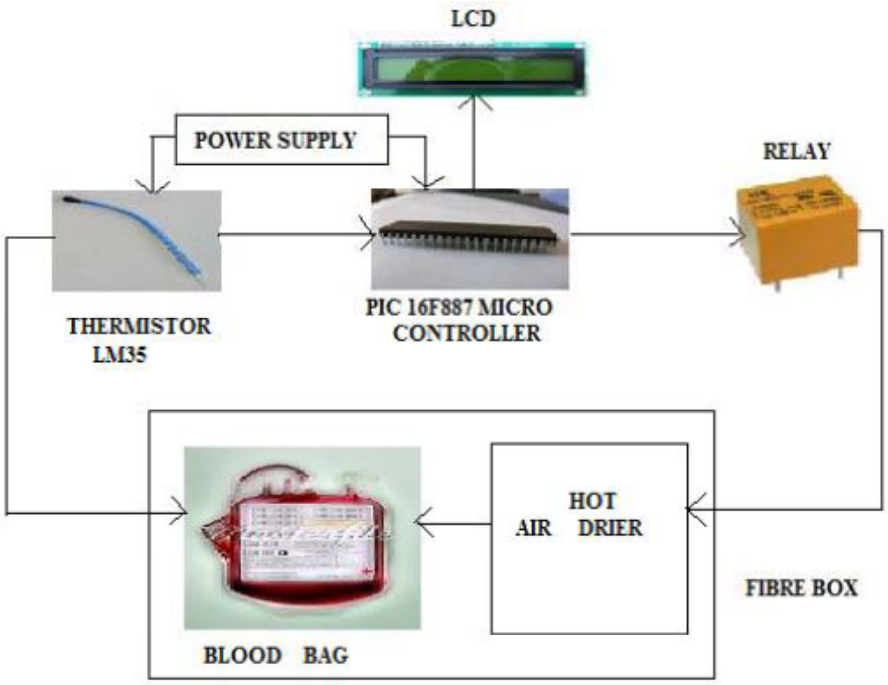

Fig.1. Block diagram of microcontroller based portable paramedic blood warmer for transfusion

III. Materials Used

A. Blood bag

The Blood bag used is disposable.tha capacitive of the bag varies from 100-500ml.The Bag is made up of PVC (Polyvinyl chloride), which contains DEHP (Diethylhexylphthalate) .The blood bag is kept inside the fiber box, which is warmed by the hot air drier.

B. Temperature sensor

A thermistor (LM35) is used to measure temperature changes, which is placed over the blood bag which senses the temperature continuously and its output is given to microcontroller.

C. Microcontroller

PIC16F887 microcontroller is used to find the difference between the temperature of blood in the blood bag and the human body temperature and controls the heating temperature. It is programmed such that it stops and controls the power supplied to the hot air drier once when it reaches the 37° C.

E. Liquid Crystal Display

Here Liquid Crystal Display (LCD) is used to Display the temperature variations in the blood bag continuously. LCD is interfaced with PIC microcontroller. The temperature sensor which is kept over the blood bag, continuously

senses the temperature and it is displayed on the LCD. When the temperature reaches 37°C , the LCD displays as "temperature is equal" and the hot air drier turns OFF which is controlled by microcontroller. The hot air drier turns ON when the temperature goes below 37°C and the LCD displays as "temperature is not equal".

Fig.2. LCD display when the temperature is below 37°C *Fig.3. LCD display when the temperature is above 37°C*

F. Relay

A relay is an electrically operated switch. Relays use an electromagnet to perform switching mechanism mechanically, but other operating principles are also used. Relays are used to control a circuit by a low-power signal, or several circuits must be controlled by one signal.

G. Hot air drier

A hot air drier is an electromechanical device designed to blow hot air over the cold blood bag, in order to accelerate the evaporation of water particles and heat the blood bag. Most models use coils of wire that have a high electric resistivity and heat rapidly with an electric current. A fan usually blows ambient air pass the hot coils resulting in heated air effective for drying. The heating element is a coiled nichrome wire that is wrapped around insulating mica heating boards. It is placed inside the fiber box. The ON and OFF of the drier is controlled by PIC microcontroller that is connected to it.

IV. Conclusion And Future Scope

The proposed project has successfully used to warm the blood bag under controlled manner. The temperature is measured accurately. The procedure is minimally invasive, portable and time saving and hence useful in emergencies. The novel project explicated here finds its feasibility and application in blood banks and hospitals. Efforts must continue to improve the safety of warming fresh whole blood transfusion for patients when it is required in emergency situations. Alarm system and air emboli detectors can be added to the hardware which increases the safety.

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