

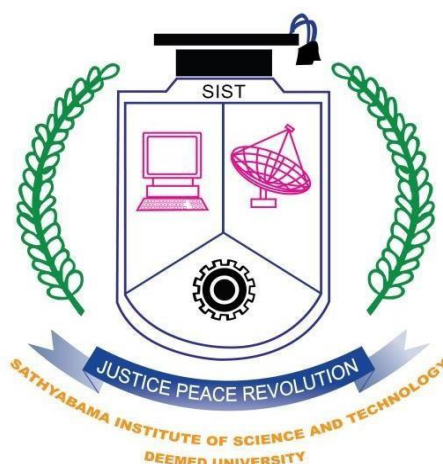
BLOOD INFUSION WARMER

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

By

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

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MAY 2022



SATHYABAMA

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **KOWSALYA K (38140021)** and **LALITHA S (38140024)** who carried out the project entitled "**BLOOD INFUSION WARMER**" under my supervision from November 2021 to May 2022.

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DECLARATION

We, **KOWSALYA K (38140021)** and **LALITHA S (38140024)**, hereby declare that the Project Report entitled “**BLOOD INFUSION WARMER**” done by us under the guidance of **Dr. S. Radhika**. Is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

DATE:

PLACE: Chennai

1.



2.



SIGNATURE OF THE CANDIDATES

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ABSTRACT

Main aim of this project is to heat the stored blood by using warmer based on the patient's body temperature. Temperature maintenance is an important consideration for effective and safe patient treatment. Failures in them can lead to dangerous conditions for the patient. The normal human internal temperature is 37.5-degree C. Blood from the blood collection center is stored at about 2-degree C 6-degree C lower. Here two temperature sensor are being used where one is to detect the body temperature and another sensor to detect the blood bank temperature. In this manner, we present a handy microcontroller based medical blood warmer that aims to reduce the ideal chance of warming blood by inducing controlled warming. The findings of both sensors are sent to the microcontroller, which is linked to the ADC (Analog to Digital Converter). Peltier is a gadget that can be utilized either for warming or for cooling. It can likewise be utilized as a temperature regulator. Transfer driver is utilized to control the vibration because of unusual state of the patient. The results are transmitted to the LCD display unit that monitors the temperature. To avoid the negative effects of hypothermia on the body of the patient during binding, the blood bag temperature and the patient's internal temperature are continuously correlated, while warming is required. In spite of the fact that blood hotter enjoys benefits of no tainting, simple control, transportability, clear computerized temperature sign, with quick outcome it has additionally constraints and provokes like powerlessness to cool the warmed blood and utilizing limitation. The parts of part determinations, precision, dynamicity and appearance might contrast from the genuine gadget.

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LIST OF ABBREVIATIONS

ADC	-	Analog To Digital Converter
RF	-	Radio Frequency
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
PIC	-	Peripheral Interface Controller
RFID	-	Radio-Frequency Identification
RS	-	Register Select Signal
RW	-	Read and Write Signal
DB	-	Data Bus Line
SW	-	Switch
ACD	-	Analog to Digital Converter
ABO	-	Adaptive Binary Optimization
ROM	-	Read Only Memory
RCB	-	Red Blood Cells

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CHAPTER 1

INTRODUCTION

The average interior temperature of a human is 37.5° C. The blood is stored at a lower temperature to slow the metabolic rate and prevent bacterial growth. For successful and safe therapy, it's crucial to keep the patient's temperature stable. Mistakes in this area can put the patient in a perilous situation. Warmed blood is required the accompanying clinical conditions: (I) A grown-up getting as often as possible in excess of 50 ml/kg/h blood; (ii) A youngster getting in excess of 15 ml/kg/h blood; (iii) Blood trade in children; (iv) a patient with dynamic cold agglutinin; (v) cut off types of nighttime paroxysmal haemoglobinuria; (vi) blood bonding from focal veins (intentionally and without hesitation could cause arrhythmias and cardiovascular arrest).The system is insignificantly obtrusive, compact and efficient and consequently valuable in crises Patients who have significant injury have chances of getting impacted by Hypothermia.

The central point that hypothermia contributes are seriousness of injury, and sedation/sedation specialists. Un-warmed blood and crystalloid mixture results in coagulopathy, modifications because of pharmacological specialists, cardiovascular arrhythmias which brings about existence misfortune. Keeping these factors in mind, it is usually necessary to warm the intravenous liquid before handling the patients. After a unit of blood is collected, it is prepared and refrigerated in the blood donation centre to ensure capacity. When a large amount of chilled blood is given in a short period of time, the internal heat level may decrease to dangerous levels, a condition known as hyperthermia. The combination of sedatives and cold intravenous solutions results in hypothermia.

Additionally, keeping a careful patient's typical internal heat level has been displayed to lessen contamination, speed recuperating, abbreviate clinic stays, and reduce the opportunity of genuine heart injury. The thought process is to precisely quantify the temperature. Over the most recent forty years, bonding rehearses in injury and other clinical circumstances (for example obstetrics, medical procedure, concentrated care) have convert altogether. Rama krishnan and Catta manchi present

an contour of those progressions along with feature of those hypothermia be as yet a significant issue because of hypovolemia and enormous bonding of without remorse items. Keeping up with the temperature of the blood conveyed to the patient is vital on the grounds that when blood temperature decreases it can bring about hypothermia and consolidating this with the two different dangers of coagulation of blood and acidosis, this structures what is known as the ternion of death.

The blood imbuelement hotter has a radiator that heats up the blood and afterward the blood will be alright for bonding. Blood warmers utilize various components to warm up the blood including water shower, intravenous cylinder hotter, dry-heat plate hotter, and constrained air hotter. The motivation behind this undertaking is to bring down the wellbeing risk that patients are confronted with because of blood misfortune, hypothermia, transportation of the patient, or an abrupt blood misfortune in the careful activity unit. The principle idea of this venture is to create, make, and plan a superior gadget that is more minimal and more dependable. So cool refrigerated blood that is put away in the room is to be warmed up utilizing a dry-heat plate blood hotter made in this task. Furthermore, one of the fundamental goals is to have a steady blood temperature and a stream rate. This interaction will decrease the chance of the patient having hypothermia.

Blood implantation warmers can save lives and increment the opportunity of the patient to live. A huge bonding is generally characterized as a patient being bonded with at least ten stuffed red platelets (RBCs) inside the initial 24 hours. Elective criteria, such as a bonding of three or four unit's north of 60 minutes, have been used as a result of the appearance of more rapid therapy. Because blood components are stored at temperatures between 1 and 6 degree Celsius, their bonding in the human body may contribute to hypothermia, which can affect digestion and induce an arrhythmia or coronary infarction.

The use of blood warmers has become more widespread in order to combat this problem. In any event, the risk of hemolysis is increased when blood components are heated. Fever, renal disappointment, hypotension, and dispersed intravascular coagulation are the most common outcomes in patients bonded with hemolyzed blood components. These concerns raised the question of whether heat and hemolysis

increased the mechanical delicacy of red cells. In fact, the American Association of Blood Banks defines signals for Warming blood items in its "Rules for the use of blood warming devices". In any case, these criteria provide no indication of the appropriate temperature for warming blood products or the tension that can be applied. It was recently stated that heating to a temperature higher than 37° C can trigger hemolysis.

In actuality, a level of hemolysis greater than 0.8 percent is considered to be dangerous to the patient's health. Taking into account that the delicacy of the RBC layer increment with temperature warming and that any strain applied on it can possibly create hemolysis, it is critical to analyse whether to warm a blood item at a high temperature during monstrous bonding with a pressure sleeve can produce hemolysis at a rate higher than those universally conceded. Albeit out the extent of out paper, we ought to likewise specify that different variables than hypovolemia and enormous bonding can add to hypothermia, in particular, in the prehospital stage, the seriousness of injury Limits old enough, wet gear, general sedation, and pre-medical clinic intubation (for example, head injuries, spinal line injury, shock), wet apparel, general sedation, spinal anaesthesia all contribute to hypothermia in the emergency room.

Here, various warming strategies have been utilized to control hypothermia: taking off wet apparel, warming covers use, warmed inflatable cushion, hot packs, liquid warmers, body pit lavage, humidified gases and persistent arteriovenous rewarming. As a matter of fact, hardly any investigations have tried the impact of high tension related to RBCs warming, and nobody was with a blood hotter set at a temperature higher than 39.8°C. In these investigations, a manual strain siphon or a pressure sleeve/pressure injector were utilized. These gadgets apply a positive strain on the stuffed blood item which for the most part courses through a tubing that is embedded in the blood hotter. In any case, in certain examinations, the blood item was pre-warmed before the tension tests. The concentrate by Du Plessis and showed that bonding of pre-warmed blood (32-36°C) produced essentially considerably less haemolysis than bonding of with a savage cruelty at 80-120mmHg. Notwithstanding, no distinction was seen when blood at encompassing temperature (18-20°C) was utilized.

When the blood pressure is 300 mmHg, the distinction between hemolysis with blood at room temperature and preheated blood is the basis of the latter. In any case, this summary does not provide immediate test results between different blood pressure levels with similar blood composition. Linko then showed that blood preheated to 37 ° C at various blood pressure ratios had no hemolytic swelling, but did not clearly indicate these ratios. She is matital. She studied the effects of tension at 300 mmHg and 600 mmHg on various catheters with warmer blood placed at 36.7 ° C. They found a slight increase in free hemoglobin (about 10%) between the two strains tested for exhaled breath, but that was not significant. For Papas et al. They showed no true excessive swelling of plasma hemoglobin at 300 mmHg on blood warmers set 39.8 ° C above baseline (eg, pretest work). Kim and his friends. In addition, no significant increase in hemolysis was observed at blood pressure of 37 ° C and 300 mmHg from baseline. Finally, Kim dothers. When warm blood was adjusted to 39 ° C, old squeezed red blood cells packed at 300 mmHg sess hemolysis than baseline.

In this review, we used a blood warmer with a countercurrent heat exchanger set at 41.5 ° C to investigate how the stress on the blood product at the pressure cuff significantly affects the degree of hemolysis. Two pressure levels of 150 and 300 mmHg have been tried. The primary purpose of this study was to determine if the use of pressure cuff blood warmers set at 41.5 ° C was a safe strategy for induced hemolysis and motor discrimination. Next, we estimated the source temperature of the heating device and investigated the potential risk for patients with hypothermia. The temperature needs to be accurately quantified. Maintaining temperature is the best idea to treat patients effectively and safely.

CHAPTER 2

LITERATURE SERVEY

Roxby D, Sobieraj-Teague M, von Wielligh Jetal., (2020) depicted warming blood preceding bonding utilizing inactive hotness. This paper makes sense of the idle hotness liquid warmers expanded the temperature of red cell units to around 35°C. There were no tremendous contrasts in haemolysis markers following warmed and unwarmed bondings, and no defilement of red cell units by super-cooled fluid was distinguished. Significant injury is related with blood misfortune and hypothermia. It is normal to supplant lost liquid with red cells put away at 2-6°C, as well as colloid/crystalloid liquid put away at encompassing temperature, hence expanding hypothermia risk. At injury and clinical recovery locales, mains power fueled liquid warmers can't be for the most part utilized. Inactive hotness gives an other useful strategy for compact temperature-controlled intravenous liquid warming. This work examines the wellbeing and viability of a liquid hotter controlled by inactive hotness. The idle hotness liquid hotter was displayed to securely warm bonded blood in a controlled clinical setting.

Smiths Medical et al., (2018) talked about HOTLINE® Blood and Fluid Warmer. This paper conveys standard thermic liquid at routine stream rates. The exceptional triple-lumen tubing configuration wipes out understanding line cool down and conveys warm liquids to your patients. Dispensable set up is simple and quick, and requires less preparing volume than other routine stream liquid warmers. The one of a kind triple-lumen tubing configuration takes out quiet line cool down and conveys warm liquids to your patients. Expendable set up is simple and quick, and requires less preparing volume than other routine stream liquid warmers. Keeps blood and liquids warm, between 37 - 42°C, conveying warm liquids to the patient at stream rates up to 5000 ml/hr. Beats hotplate advancements in 91% of surgeries. Simple to utilize: less opportunity to set up and simple to disengage from the patient. Once-a-year repository support convention contrasted with hotplate warmers, which might require upkeep up

to 12 times each year, implies lower support costs. Diary: Clinical Monitoring and Computing.

Amigo Lite et al., (2020) recorded vital techniques in the paper "Compact IV and Infusion Pump". This paper discusses the conveyance of intravenous(vein) treatment. A mixture siphon draws liquid from a standard pack of intravenous liquid and controls the pace of stream. An imbue ment siphon is a clinical gadget that conveys liquids, like supplements and drugs, into a patient`s body in controlled sums. Implantation siphons are in far reaching use in clinical settings like clinics, nursing homes, and in the home. Typically, an implantation siphon is performed by a prepared customer, who programs the flow rate and transit time of the fluid through an implicit programmable connection of points. Impregnated siphons offer huge advantages over manual fluid organization, including the ability to transport liquids in small volumes and the ability to transport liquids with automatic or modified flow rates. forever. They may infuse supplements or prescriptions, for example, insulin or various chemicals, antitoxins, chemotherapy drugs, and pain relievers. Journal: British Journal of Nursing.

Jose Fernandes Saa Pimenta Filomena O. Soares Graca Minas et al., (2014) proposed a whole blood collection device for automatic detection of agglutination based on absorption spectroscopy. This paper presents a compact utility for human blood components ABO, Global Rh, Reverse and Cross Match, based on spectrophotometric method for agglutination identification, with fast reaction time (results). results in ≤ 5 minutes). These strengths enable the utility to operate in mobile crisis units, outside of conventional clinical laboratories, and in close proximity to patients. It maintains a strategic distance from the conflict bets between donor and recipient blood, further developing quality in healthcare management. Ensuring blood grading is an important clinical test that should be performed prior to blood collection. In all cases, in a crisis situation, due to the patient's condition, there may not be sufficient opportunity to decide on the patient's blood classification. In these cases, the O-negative blood type classification is controlled, as it poses less risk of abnormality to the patient. Logs: IEEE Transactions on Instruments and Measurements.

Ahmad Khanifar , Elham Khanifar et al.,(2017) presented radio recurrence liquid hotter. The current development is by and large a radio recurrence contraption for warming liquids like IV liquids. In model epitomes, a uniform warming of liquids is accomplished by uncovering a liquid conveying cylinder to Radio Frequency (RF) energy. The RF energy might be provided by a RF generator, which is coupled to a waveguide. The waveguide regularly incorporates a gulf into which a liquid cylinder might be presented. Inside the waveguide, a pathway might be shaped wherein the liquid cylinder might rest in a foreordained position. In commendable epitomes, the pathway directs the situating of the cylinder along a transmission-line length of the waveguide, in a way to such an extent that the cylinder bit by bit moves toward an electromagnetic field inside the waveguide and ways out at a subsequent terminal finish of the waveguide. Having assimilated energy provided from the RF generator, the liquid inside the cylinder leaves the device warmed to an ideal temperature. Diary: Obstetric Anesthesia Critical Care.

CHAPTER 3

SCOPE OF THE PRESENT INVESTIGATION

3.1 SCOPE OF THE PROJECT

In this paper, we present a microcontroller-based compact medical blood warmer that is designed to lower the optimal likelihood of warming blood by causing controlled warming. Temperature sensor LM35 with high accuracy for measuring blood bag temperature. It transfers the findings to the ADC-integrated microcontroller (Analog to Digital Converter). The blood is warmed using a hot air drier, which is controlled by a PIC microprocessor to achieve the desired temperature contrast.

3.2 OBJECTIVE

Heat the put away blood by utilizing Peltier in light of the patient's internal heat level. Here, two temperature sensor are being utilized where one is to distinguish the internal heat level and one more sensor to recognize the blood pack temperature. With the assistance of Peltier module, we can adjust the temperature and inject the blood to human body.

3.3 ADVANTAGES:

- Convection method that does not cause any damages to the blood components.
- Cost is low and efficient.
- Clear digital temperature indication.
- Fast result.

3.4 EXISTING SYSTEM:

There are a few methods for warming IV liquids and bloods that are now available. These include submerging wound IV tubing in water, microwaving the liquid to be injected, adding warmed saline to blood to be mixed, passing the IV tubing through a warming square or a plastic cylinder warmed with constrained air, passing the IV tubing through a conductive surface interacted with a counter momentum warmed water shower, attractive acceptance, and pre-warming liquids in a convection broiler or an oven. Regardless, such a vast number of ways takes time and is unreliable. We describe a Microcontroller-based compact paramedic blood hotter for bonding to combat this.

The current creation is for the most part a radio recurrence contraption for warming liquids like IV liquids. In excellent exemplifications, a uniform warming of liquids is accomplished by uncovering a liquid conveying cylinder to Radio Frequency (RF) energy. The RF energy might be provided by a RF generator, which is coupled to a waveguide. The waveguide ordinarily incorporates a delta into which a liquid cylinder might be presented. Inside the waveguide, a pathway might be framed wherein the liquid cylinder might rest in a foreordained position. Having ingested energy provided from the RF generator, the liquid inside the cylinder leaves the contraption warmed to an ideal temperature. *Diary: Obstetric Anesthesia Critical Care.*

An adaptable device for ABO, Rh total, banter, and Cross-matching human blood forming, considering a spectrophotometric approach of the agglutination area, with a fast response time (results in ≤ 5 min). These components license the contraption action in compact emergency units, outside customary clinical examination communities, and close to the patient. It avoids the bet of logical inconsistency between the patron's and receptor's blood, further fostering the quality in clinical consideration organizations. In any case, in emergency conditions, due to the patient's condition, there may not be adequate chance to choose the patient's blood arrangement. In these cases, the O negative blood order is directed, considering the way that it causes less incongruence peril to the patient. *IEEE Transactions on association and reach.*

An implantation syphon pulls fluids from a typical intravenous fluid pack and regulates the flow rate. An imbuelement syphon is a medical device that delivers liquids into a patient's body in regulated amounts, such as nutrients and medications. In therapeutic settings such as emergency clinics, nursing homes, and the home, implantation syphons are often used. A prepared client, for the most part, operates a mixture syphon, programming the rate and span of liquid conveyance through an inbuilt programming point of involvement. Imbuelement syphons provide several advantages over manual liquid organisation, including the ability to transport liquids in small amounts and the ability to deliver liquids at precisely regulated or programmed rates. They can transport supplements or prescriptions such as insulin or other chemicals, anti-toxins, chemotherapy drugs, and pain relievers, among other things. Warming blood using traditional methods.

Temperature support is an excellent idea for a patient's feasible and safe therapy. Because the average interior temperature of a human is 37.5 degrees Celsius, mixing chilly blood in a clear comprehension is exceedingly dangerous. Part determinations, accuracy, dynamicity, and appearance may differ from the actual device. This undertaking, on the other hand, is sufficient to provide utilitarian reproduction to the true continual demand for blood infusion.

Because blood is so precious, this enterprise will use water or dextrose instead of blood. Blood might be warmed either before or after it passes through the conveyance framework and intravenous tubing. Warm water showers, brilliant, and microwave warmers are all used for pre-bonding warming. It was also usual to add warm saline to blood (admixture) to boost its temperature. The feasibility of pre-bonding warming is severely limited during fast bondings, since the temperature of circulating blood is directly proportional to the rate of bonding of the cold. As a result, when the mixing paces are slower or if the mixing is postponed, the temperature of the warmed blood rapidly declines toward the room.

One of the following standards governs blood warming via inline strategy: (1) immersion warming (2) dry hotness warming (3) counter current warming. Intravenous tubings are created to pass through warm water baths using inundation procedures.

Slenderer walled tubings with higher hotness move limits are appealing here. Long tubings, which are supposed to provide appropriate hotness trading, nonetheless, hinder the framework's productivity during quick bondings. The risk of disease arises if the power supply ports come into contact with contaminated water in the showers, and overheating can cause haemolysis are two further drawbacks of inundation warming. As the snaked tube passes through an aluminium warming component, dry hotness warming avoids the tempting difficulties. Current leakage and temperature control issues, on the other hand, are not unusual associated snafus. A counter-momentum stream of warmed water is circulated around or interdigitated with the intravenous tubings in counter-momentum warming frameworks. In contrast to the other two procedures, counter flow allows for the rapid infusion of warm blood while recovering haemorrhagic shock survivors. In comparison to other frameworks, counter current inline warmers are often more expensive.

3.5 MICROCONTROLLER BASED PORTABLE PARAMEDIC BLOOD WARMER FOR TRANSFUSION

The blood is warmed in this project utilising a water bath, which takes 15-20 minutes to reheat the frozen blood. As a result, we describe a microcontroller-based portable paramedic blood warmer that uses controlled heating to try to minimise the time it takes to warm blood. An LM35 accurate temperature detector is used to turn up the temperature of the blood bag. It then transfers the result to a microcontroller that has an ADC (Analog-to-Digital Converter). A hot air dryer, controlled by a PIC microcontroller, is utilised to reheat the blood to the necessary temperature contrast.

3.6 INTRODUCING TWO NEW DEVICES FOR BLOOD WARMING

Endlessly blood items ought to be kept in cool temperatures to keep away from haemolysis and save sterility and utilitarian trustworthiness of blood parts. Patients requiring enormous bonding require the blood to be warmed at bedside to keep away from heart and general hypothermia. Hypothermia because of huge and fast bonding in sick and harmed patients is related with unfavorable incidental effects which are undeniably challenging to be turned around. Here in, we depict two developments of versatile warming gadgets for endlessly blood items and liquid arrangements.

3.7 PROPOSED SYSTEM ADVANTAGES

The various advantages of proposed system are listed below;

- Changing the temperature during process of infusion.
- Misleading can be notified with the help of vibration sensor.
- Blood temperature can be changed during the process of infusion.

CHAPTER 4

EXPERIMENT, MATERIALS AND METHODS

4.1 DESCRIPTION OF THE PROJECT

Our methodology we are utilizing two LM35 temperature sensors to distinguish the internal heat level and blood temperature. Vibration sensor is utilized to observe the any strange condition like fits stage while bonding of blood. A PIC microcontroller is utilized which is associated with LCD for show. The two sensors send the result to microcontroller, inbuilt with ADC (Analog-to-Digital Converter). Peltier a gadget that can be utilized either for warming or for cooling. It can likewise be utilized as a temperature regulator. Hand-off driver is utilized to control the vibration because of unusual state of the patient. During strange circumstances the bonding is ended as recognized by the vibration sensor. The general interaction is finished via naturally or physically. For manual activity we can utilize keypad.

4.2 BLOCK DIAGRAM

Block Diagram:

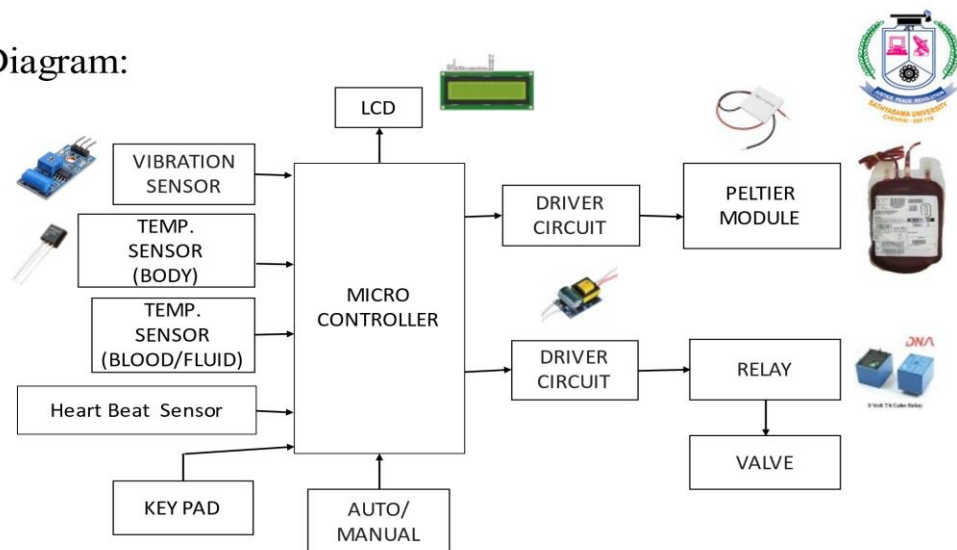


Fig.4.1 Block Diagram

4.2.1 Liquid Crystal Display (LCD)

Liquid gem (LCD) is a refined electronic image interpreter that utilizes the light modulation properties of liquid gem (LC). LCs do not release light in a predictable way. They are used for a variety of purposes including TV screens, dashboards, aircraft cockpit displays, and more. LCDs have built-in cathode ray tubes (CRTs) for many applications. They are typically smaller, lighter, more flexible, more affordable, and more powerful.

BATTERY DESCRIPTION (A):

The most commonly used LCD on the market today is a 1, 2 or 4-line LCD with a single modifier and full support of 80 characters, although the LCD screen supports more than 80 characters. characters using the tuner 2HD44780. Plus, LCD with 1 14-pin regulator and LCD with 2 16-pin regulators we can use the keyboard.

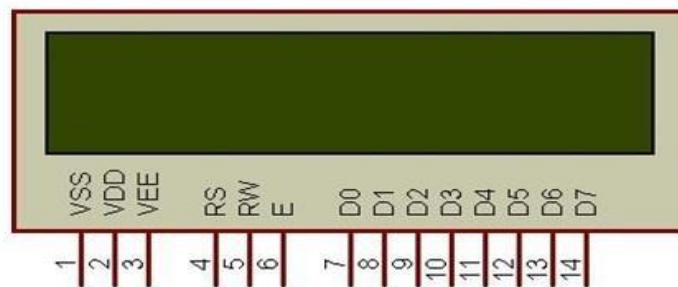


Fig. 4.2 Pin diagram of 2x16 LCD

Table 4.1. Pin details

PIN NO.,	SYMBOL	FUNCTION
1.	Vss	GND
2.	Vdd	+3V or +5V
3.	Vo	Contrast Adjustment
4.	RS	H/L Register Select Signal
5.	R/ $\hat{W}$	H/L Read and Write Signal
6.	E	H→L Enable Signal

7.	DB0	H/L Data Bus Line
8.	DB1	H/L Data Bus Line
9.	DB2	H/L Data Bus Line
8.	DB3	H/L Data Bus Line
11.	DB4	H/L Data Bus Line
12.	DB5	H/L Data Bus Line
13.	DB6	H/L Data Bus Line
14.	DB7	H/L Data Bus Line
15.	A/Vee	+4.2V for LED/Negative Voltage Output
16.	K	Power Supply for B/L (0V)

4.2.2 Temperature Sensor

High Accuracy Temperature Detector LM35:

GENERAL DESCRIPTION: The LM35 family temperature sensors are precision integrated tour of duty with an output voltage proportionate to temperature in degrees Celsius (degrees Celsius). Therefore, the LM35 has an additional benefit over a straight Kelvin-aligned temperature sensor because the customer does not need to have a large fixed voltage drop to achieve good scaling performance. To achieve distinctive accuracy of 14°C at room temperature and 34°C in the 55 to 150°C temperature range, the LM35 requires no external calibration or management. Managing and adjusting the water level ensures the lowest possible cost. The low result impedance, direct result, and precise inborn adjustment of the LM35 make communication with readout or control hardware a breeze. It's possible to use it with just one person.

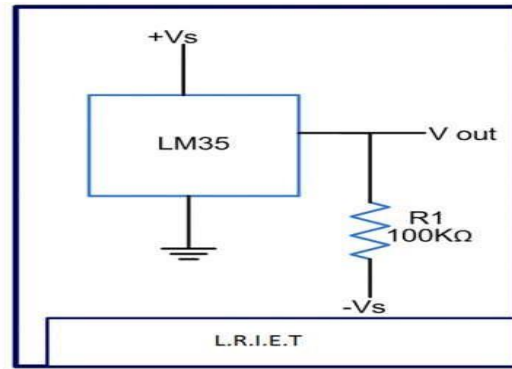


Fig. 4.3 Full-Range Centigrade Temperature Sensor

4.2.3 Peltier Module

When electric current passes through a circuit with two separate conveyors, one intersection cools while the other rises in temperature. The Peltier effect is a temperature adjustment that occurs at junctions. Peltier (thermoelectric) module is a warm control module with both warming and cooling effects. It is possible to change the surface temperature and retain it at the objective temperature by running an electric current through the module.



Fig. 4.4 Peltier Module

4.2.4 Vibration Sensor

The vibration switch of the vibration sensor module SW420 depends on the vibration sensor SW420 and comparator LM393 to assume that there is excess vibration. The limit can be changed using the built-in potentiometer. Whenever there is no vibration, this module provides LOW justification, the panel shows LEDs, as well as the other way around. The sorts of vibration sensors incorporate the accompanying. This sensor is utilized for general purposes like vibration and shock. These sensors are utilized for bended surfaces. Whenever mass and size are huge, then strain information is required.

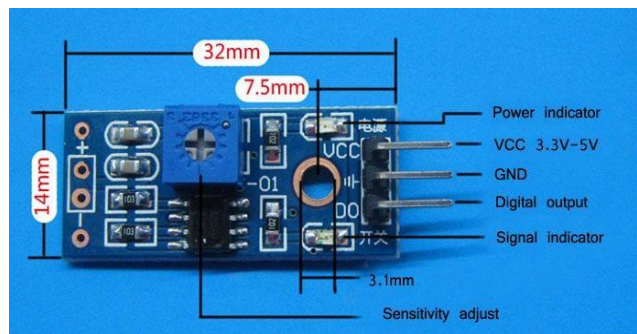


Fig. 4.5 Vibration Sensor

4.2.5 Relay

Main Features: RW series relays have 10A exchange limit and are small in size to suit the choice of many customers. RWH is an approved CUL and TÜV health standard. Reasonable working plastic material is applied under the condition of high temperature and different compound arrangement. Fully developed defense is for residuals and soldering. Whenever necessary, a plastic fixation can be used for the washing technique. 12A at 120VAC for RW and 12A at 240VAC for UL listed RWH.

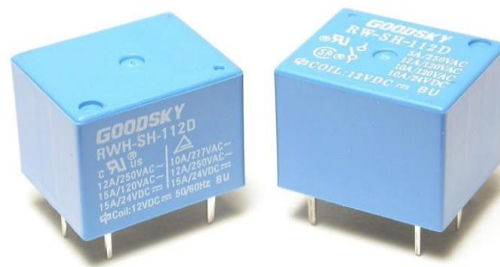


Fig. 4.6 Relay

4.2.6 Solenoid Valve

Standards of activity: In conservative solenoid valves, the solenoid curl is mounted straightforwardly on the encasing tube, fixed and indispensable with the valve body. The moveable unclogger is allowed to move in the end tube and is ordinarily stood firm on in foothold by a push (or return) spring. At the point when the solenoid curl is empowered, the unclogger is drawn in by the impact of the attractive field and the seat, basic with the unclogger, opens (or shuts) the valve or the valve pilot. Electromagnetic transfers might be created with attractive parts, electrical parts and additionally mechanical parts. They may likewise have mechanical contacts and working curl contacts. On the off chance that an inventory framework were to initiate the curl, it would open or close the mechanical contacts. DC or AC power supplies can be utilized for electromagnetic transfers.

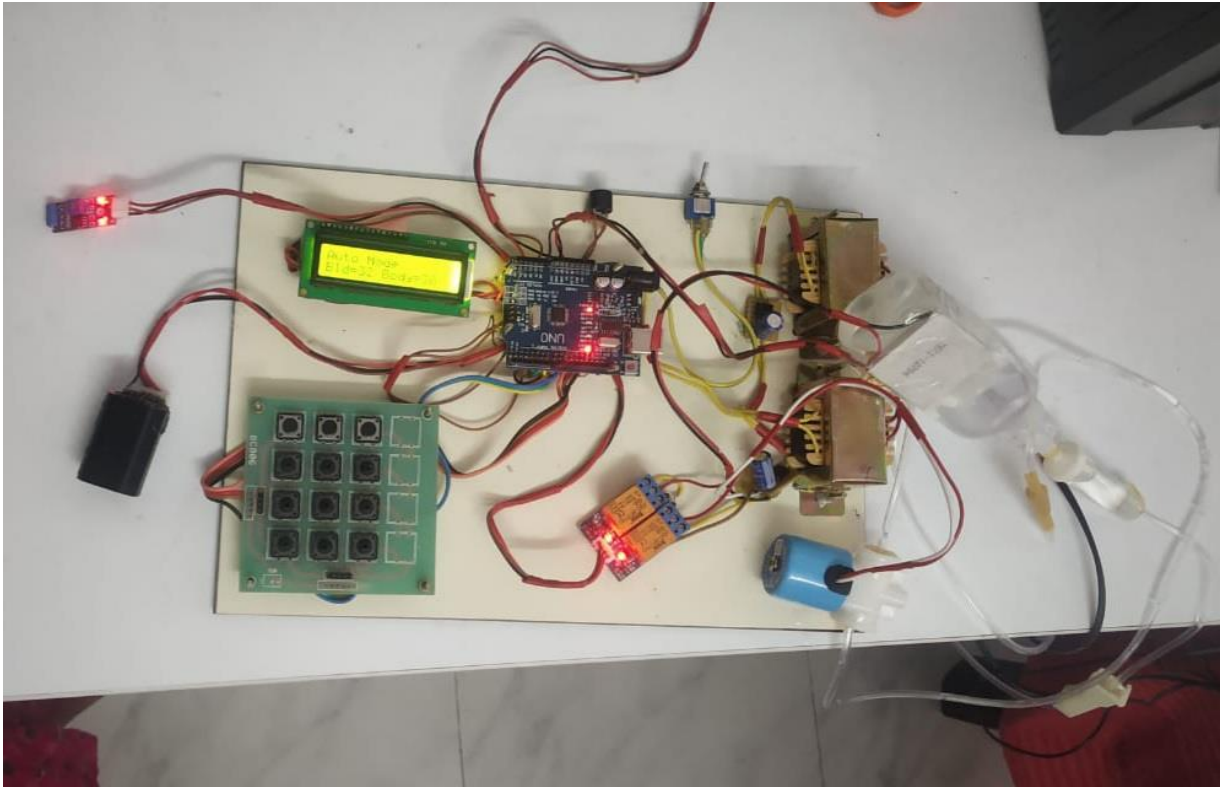


Fig. 4.7 Solenoid Valve

4.2.7 Heart Beat Sensor

An individual's pulse is the valves in his/her's heart contracting or growing as they force blood starting with one locale then onto the next. The times the heart beats each moment (BPM), is the heart beat rate and the thump of the heart that can be felt in any conduit that falsehoods near the skin is the beat. +5V DC managed voltage was determined. Current 100 mA, Output Information Level 5V TTL. The LED exhibits heart rate detection and high pulse generation, 660nm super red LED light source.

5.1 HARDWARE DESCRIPTION



In our project, Blood Infusion Warmer, we have used Arduino Uno board in ATmega 328 controller is used. We have set a toggle switch to switch the modes. we have used two step down transformer, when the input 230 V is given from power supply. One step down transformer, steps down the voltage from 230V to 12V and the rectifier will convert the AC current to DC current and it is transferred to Arduino board, keypad and LCD. Other transformer steps down the voltage to 12V and the rectifier converts the AC current to DC current and it is given to solenoid valve and the Peltier device. Relays are used to stop the flow of blood in solenoid valve and to on and off the Peltier device. Keypad (3×4) is used to enter the temperature manually during the

process. The whole process of hardware done the warmed blood. The patients are make sure that the details are updated in the hospital data list then only the management track the detail and import the blood to the operating system. Then the main hero(Peltier) done the part to warm the blood and maintain the temperature to the human body. If any misleading occurs like fix, the flow of blood is stopped with the help of solenoid valve. The whole process make nature friendly and very affordable one to make everyone use it in the crucial moment.

5.2 SOFTWARE REQUIREMENT

5.2.1 Arduino – 1.8.5

Arduino is a basic hardware and programming electronics platform that is free and open-source. Inputs like light from a sensor, a finger on a button, or a tweet may be transformed into actions like starting a car, turning on a light, or publishing anything on the internet using Arduino sheets. You can operate your board by sending a sequence of commands to the board's microcontroller. To do this, you'll need to use the Arduino programming language (in combination with Wiring) and the Arduino Software (IDE) in combination with Processing.

5.2.2 EMBEDDED C

The C standards board added inserted c to the C programming language to solve common feature difficulties that emerge between C expansions for implanted frameworks differences. C programming in its most common form necessitates non-standard C language extensions to help with colored elements, for example, concatenating fixed-point numbers, specific multiple memory banks, and operations. Basic I/O.

Installed C uses many punctuation and semantics of the C standard, for example, main job(), variable definitions, type information messages, random declarations (if, switch, case), loops loops (while, for), functions, exposures and sequences, designs and associations, cycle tasks, macros, and more.

5.3 SOFTWARE SIMULATION

5.3.1 OFF/ON MODE

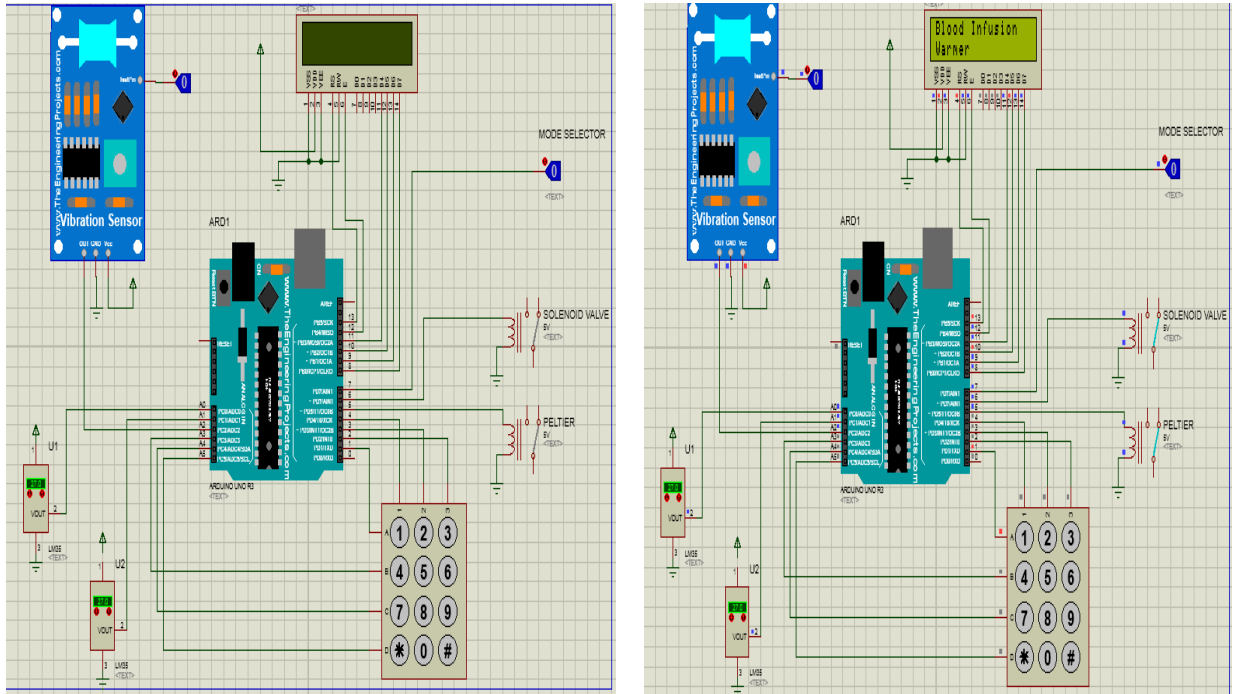


Fig. 5.2 OFF/ON Mode in Proteus software

The previously mentioned figure, outline the on and off method of blood implantation hotter. On/Off mode figure, the feeling is showed utilizing Proteus programming. The programming language utilized in blood mixture hotter is Embedded C. In these feeling, we have utilized two LM35 temperature sensor, two transformers a chip, a vibration sensor, a keypad, two transfers, a solenoid valve, a pettier gadget and a LCD show. The association is given and it is shown in the above figures.

5.3.2 AUTO MODE

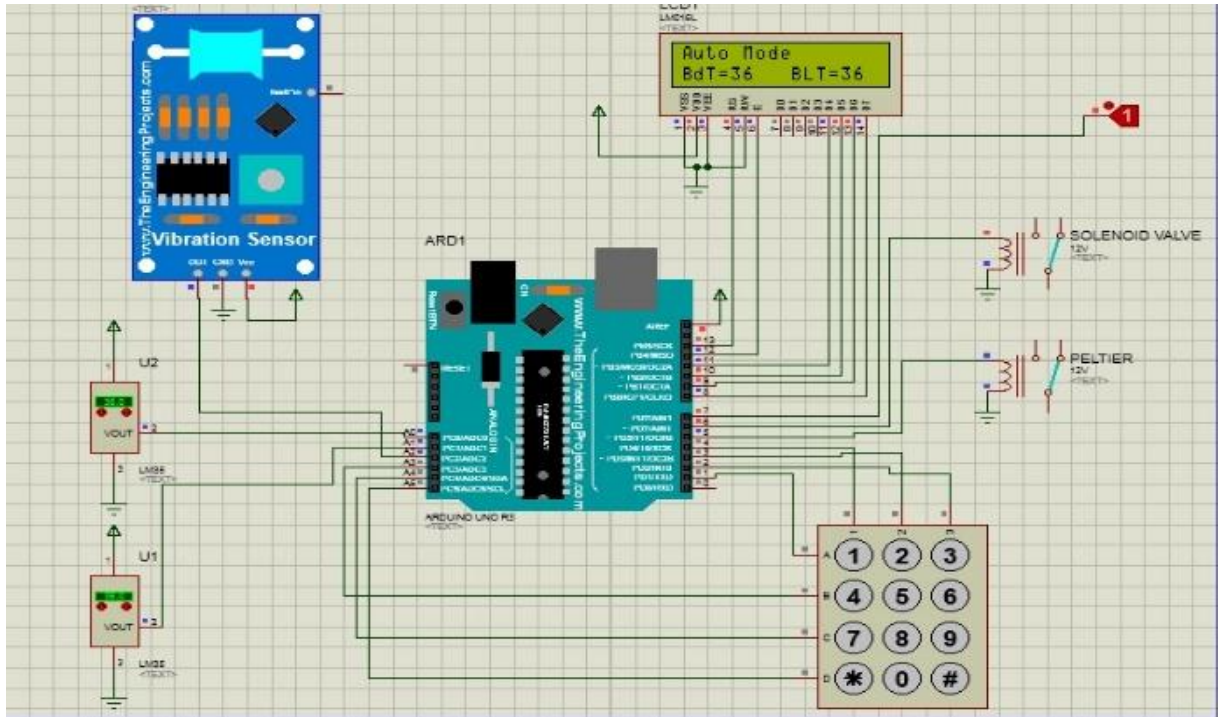


Fig. 5.3 Auto Mode in Proteus software

In Blood Infusion Warmer, we can utilize two modes one of the mode is called auto mode. In auto mode, the temperature sensor will naturally gauge the body and the blood temperature during the imbuelement and the Peltier will begin to make the temperature of blood and the body equivalent and keep up with the indistinguishable temperature.

Here, auto mode is to make the interaction naturally without the assistance of human to fix the temperature what the patient need it will consequently approach the temperature with particular human temperature. What's more, the stream rate is keeping up with by Peltier the legend of our task. It is the most viable work done in the working room.

5.3.3 MANUAL MODE

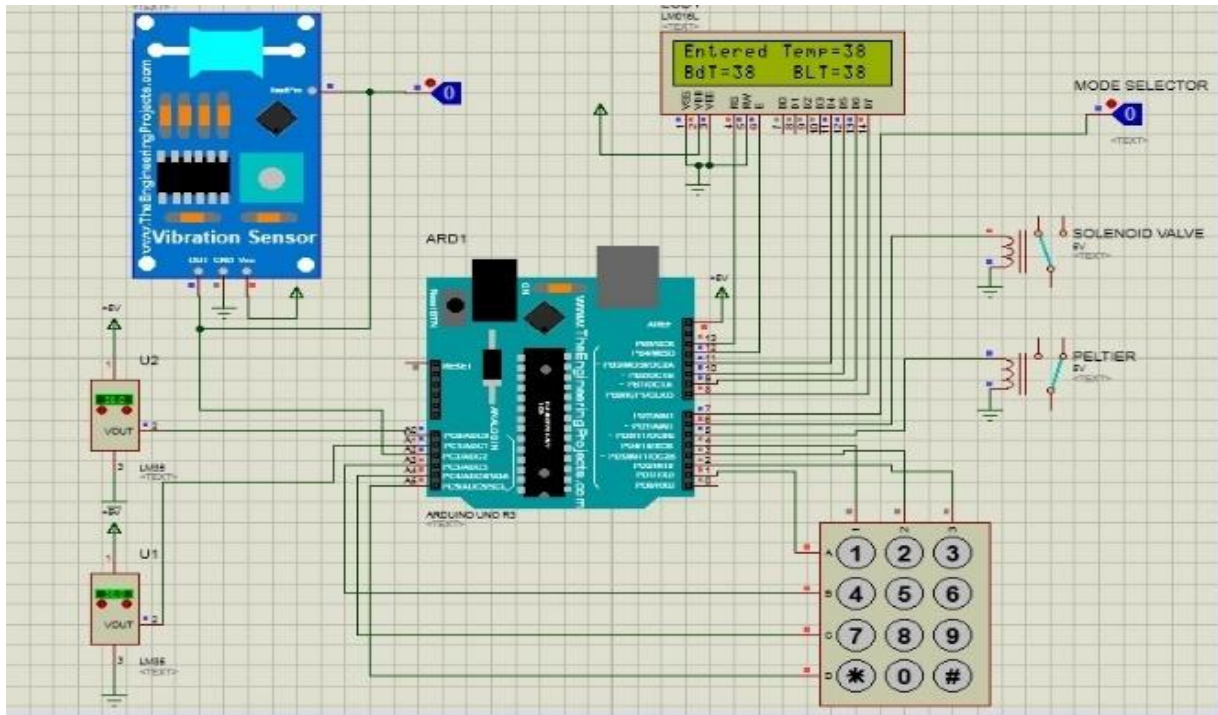


Fig. 5.4 Manual Mode in Proteus software

In our task, we have fixed flipped switch. utilizing flip switch we can change to manual mode. In manual mode, we have utilized a keypad and utilizing it. we can enter our internal heat level and the Peltier will begin to make the temperature of blood and the body equivalent.

Here, we are utilizing manual mode to put the temperature what we wanted. The benefit is on the off chance that we really want the temperature higher than the human temperature, we can fix it as well as to lessen the temperature too. It is easy to understand and utilize this with hyperthermia patients, they have exceptionally complex in temperature they get abrupt down temperature then we can fix it by the temperature what they need for the patient.

5.3.4 DETECTION OF VIBRATION SENSOR

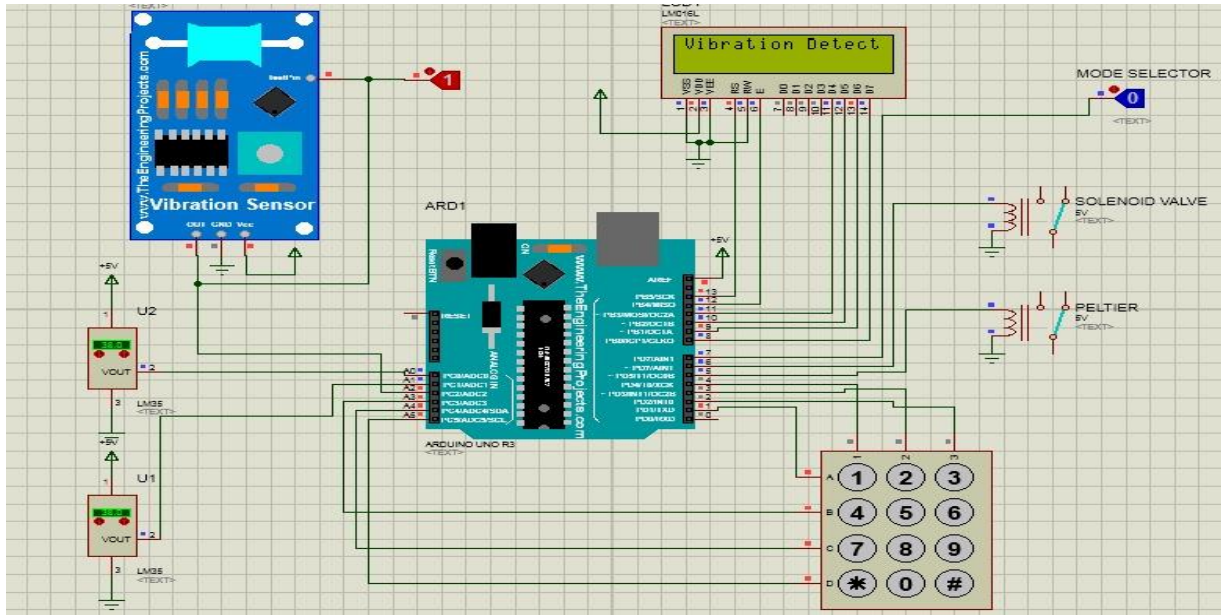


Fig. 5.5 Detection of vibration sensor in Proteus software

The previously mentioned excitement address, the recognition of Vibration sensor. During the interaction, assuming any deceptive happens, the vibration sensor will work and it will toss a signal sound and the progression of blood will consequently stop. along these lines, from this we can distinguish the vibration sensor without any problem.

5.4 DISCOURSE AND ANATOMIZATION OF THE PROJECT

Philip Syng Physick, an American doctor, performed the first human blood transfusion in Philadelphia in 1795. Despite the fact that he did not make this information public. An English obstetrician named James Blundell performed the first successful transfusion of a patient for postpartum haemorrhage in 1818.

1907 Hektoen proposes that transfusion safety could be enhanced by cross-matching blood between donors. Patients and doctors worked together to remove incompatible combinations while still acknowledging the "universal" benefit of group O donors. The evaluation of transfusion is currently being developed, and in our research, we plan to incorporate a Peltier device that will heat or cool the blood to match the human temperature. This technology allows us to raise or lower the temperature of fluids, so we can use it.

5.5 VALIDATION

Table 5.1 Validation of be living and advanced methods

Existing Mode	Proposed Mode
• Temperature is Programmed.	• Change the temperature during process.
• Misleading can't be notified.	• Misleading can be notified with the help of vibration sensor.
• Blood temperature can't be changed during the process.	• Blood temperature can be changed during the process.

CHAPTER – 6

SUMMARY AND CONCLUSIONS

6.1 CONCLUSION

Blood warmers were strong to warm crisp RBCs to 37.5°C or more with human temperature independently, used connected with an imbuelement direct at stream rate up to 600 ml/h. The use of a blood hotter is acclimated to which temperature we need is presumably the most ideal decision for diminishing the gamble of hypothermia for the patient without producing haemolysis since we screen the temperature and investigate the temperature with human body separately. The interaction, actually look at the patient and take the data and important bodily function and enter the data in the clinic framework. The clinic sends a notice to blood donation center research facility and afterward the blood unit send from bank then we put a blood unit in a Peltier gadget box, then, at that point, the activity begins. In any case, we ought to be mindful of the utilization of an imbuelement siphon for RBC bonding, especially at high stream rates. During warm bondings, the patient's physiological signals were stable, and no holding responses were seen. Fluid warmers raised the temperature of red blood cells to that of the human body. Result we will do this interaction in people for an extraordinary assistance. In blood bonding methods, it is important to ensure that every patient really gets the blood unit which has been allocated to him, so mis-bondings are stayed away from. Hence, prior to beginning the organization, across-check including the patient and the bonding unit codes should be done at bedside. In order to conduct these tests in a secure and timely manner, a few electronic arrangements based on standardised tag names and RFID labels have been adopted in recent. In any case, most dependable outcomes are as yet gotten through hindrance frameworks, for example mechanical gadgets that forestall the utilization of units until the cross-check. So a much higher wellbeing degree is attainable along with basic and quick use.

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APPENDIX

```
#include <LiquidCrystal.h>
#include <Keypad.h>
LiquidCrystal lcd(13,12,11,10,9,8);
const byte ROWS = 4;
const byte COLS = 3;
const int temp1 =A0;
const int temp2 =A1;
int t1v,t2v,f = 0;
char overf=0;
float value = 3035;
const int am =1;
const int val =7;
const int pel =6;
const int vib = A5;
//const int hbpin = 3;
char ckey, keyval[4]={0};
int am_count,a_count,m_count,i,diff,tset_f = 0;
unsigned int pulse,bpm,kval,time_count =0;

volatile int state = LOW;
char hexaKeys[ROWS][COLS] = {
{'1','2','3'},
{'4','5','6'},
{'7','8','9'},
{'*','0','#'}
};
byte rowPins[ROWS] = {5,A4,A3,A2};
byte colPins[COLS] = {2,3,4};
Keypad customKeypad = Keypad( makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);
void setup() {
lcd.begin(16, 2);
pinMode(am, INPUT_PULLUP);
pinMode(pel, OUTPUT);
pinMode(val, OUTPUT);
digitalWrite(pel, LOW);
digitalWrite(val, HIGH);
lcd.print("Blood Infusion ");
lcd.setCursor(0,1);
lcd.print("Warmer");
delay(2000);
```

```

lcd.clear();
lcd.setCursor(0,0);
lcd.print("Select The Mode");
}
void loop() {
int v = analogRead(A5);
if(v>1000){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Vibration Detected");
digitalWrite(val,LOW);
delay(20000);
}
else{
digitalWrite(val,HIGH);
}
//-----Mode Select-----
if(digitalRead(am)){
if(a_count==0){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Auto Mode");
delay(1000);
a_count =1;
}
at();
}
if(!digitalRead(am)){
if(m_count==0){
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Manual Mode");
delay(500);
m_count=1;
}
ml();
} }
void at(){
t1v = analogRead(temp1);
t1v = t1v*4.88;
t1v = t1v/10;
//f = (t1v*1.8)+32;
t1v = (t1v-32)*0.5555;

```

```

t2v = analogRead(temp2);
t2v = t2v*4.88;
t2v = t2v/10;
t2v = (t2v-32)*0.5555;
delay(300);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Auto Mode");
lcd.setCursor(0,1);
lcd.print("BdT=");
lcd.print(t1v);
lcd.setCursor(9,1);
lcd.print("BLT=");
lcd.print(t2v);
diff = t1v-t2v;
diff = abs(diff);
if(diff>1){
digitalWrite(pel,HIGH);
delay(500);
}
else{
digitalWrite(pel,LOW);
delay(500);
}
delay(500);
}
void ml(){
lcd.setCursor(0,0);
lcd.print("Enter Temperature");
lcd.setCursor(0,1);
lcd.print("Value:");
if(customKeypad.getKey()){
do{
char ckey = customKeypad.getKey();
if(ckey){
keyval[i] = ckey;
lcd.setCursor(6+i,1);
lcd.print(keyval[i]);
delay(500);
i++;
}
}while(i<2);
kval = atoi(keyval);

```

```

keyval[4] = {0};
tset_f = 1;
}
if(tset_f == 1){
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Entered Temp=");
  lcd.setCursor(13,0);
  lcd.print(kval);
  delay(1000);
  t1v = analogRead(temp1);
  t1v = t1v*4.88;
  t1v = t1v/10;
  t1v = (t1v-32)*0.5555;
  t2v = analogRead(temp2);
  t2v = t2v*4.88;
  t2v = t2v/10;
  t2v = (t2v-32)*0.5555;
  //delay(100);
  //lcd.clear();
  lcd.setCursor(0,1);
  lcd.print("BdT=");
  lcd.print(t1v);
  lcd.setCursor(9,1);
  lcd.print("BLT=");
  lcd.print(t2v);
  char mdif1 = 0;
  mdif1 = t1v - kval;
  mdif1 = abs(mdif1);
  mdif1 = kval - t2v;
  //mdif1 = abs(mdif1);
  delay(1000);
  if(mdif1 > 1 ){
    digitalWrite(pel,HIGH);
  }
  else{
    digitalWrite(pel,LOW);
  }
}
}
}

```