

# Peltier Jacket

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**Abstract**— Any person who intends to travel outdoor must be prepared to deal with all sorts of weather starting from the dry hot condition to the chilled coolness. Battery power heating and cooling jacket in which the user can regulate the temperature by circulating water through the jacket with the help of peltier module, microcontroller, Bluetooth module, micro water pump and temperature sensor. This system is thus an efficient solution to the drastic change in weather which cause many ill effects to human.

**Keywords:** Bluetooth module, microcontroller, module micro water pump, Peltier module, temperature

## I. INTRODUCTION

Both very cold and very hot temperatures could be dangerous to health. Excessive exposure to heat is referred to as heat stress and excessive exposure to cold is referred to as cold stress. In a very hot environment, the most serious concern is heat stroke. At very cold temperatures, the most serious concern is the risk of hypothermia or dangerous overcooling of the body. The new system Peltier Jacket, in which user can regulate the temperature of the jacket through his mobile. After initialization temperature sensor measures the wearable coat temperatures according to person's surroundings. The jacket to a mobile app via Bluetooth. The mobile app will display the current body temperature has tools to vary the temperature of the jacket according to users need. We can perform both heating and cooling as per the requirement. People, whos penda lot of time outdoor, in cold or hot weather conditions, are familiar with the difficulties related to temperature variations. Any change in temperature that might make people unpleasant, can be eliminated by introducing a suit that regulates the temperature and act as a mobile solution for the user and exclude the usage of many layers.

Here a jacket that can act as both heating and cooling system is introduced. When it is too hot, the system cools down the body and when it is too cold, the system heats up the body. By using this, the user is able to eliminate the heat related inconveniences and maintain a comfortable temperature level as per the user requirement. For this, the user has to just wear the proposed jacket. This system helps people to survive and work in cold countries as well as in hot ones. This jacket acts as a guard against the temperature variations and helps people to work comfortably irrespective of the weather conditions. It gives better protection to the soldiers and workers who are working in extreme weather conditions and also acts as a guard for the mountain climbers keeping their body temperature at a prescribed level. It allows the monitoring of internal temperature from higher temperature to lower temperature depending on the climate. It also eliminates the addition or subtraction of layers of clothing and act as a user friendly system that provides a mobile solution to the inconveniences.

## II. EXISTING SYSTEM

Existing system is a heating/cooling jacket, in which the user can control the temperature through control and thermo-electric devices that are embedded in the suit. The functionality of the suit is, once turned on, the devices display the temperature of the inside of the suit in an LCD displays. Initiating the hot or cold functions are as simple as pushing a button, and a rotary knob to allow the users to control the internal temperature of the suits. To undertake this project and conduct useful research that would yield a successful design challenges had to be taken into account.

The design cannot be hazardous, and the product shouldn't burn or shock the user. Therefore parameter limitations and proper wiring encasement procedures ought to be implemented. There is a cost limitation on the project so our design could not exceed that cost. None of the current system contains IOT. Connectivity, transfer of heat or cold is either through copper tubes, through thermo conductive fluid. Existing system are all manual, either the jacket is controlled through knobs or on and off switch.

## III. PROPOSED SYSTEM

The proposed system is a battery powered system that provides both heating and cooling effect simultaneously as per the user requirement. It has in built temperature sensor stomeasure the internal suit temperature. The heating and cooling effect is provided by a peltier module. The peltier module is embedded inside the proposed jacket. Since it provides both heating and cooling effects, it has several advantage compared to other system. It is user friendly, comfortable, convenient and can measure wide range of temperature change.

The temperature sensor measure the temperature of the user and displays it on the mobile screen. The heater and cooler in turn will help user to provide warming or chilling effects inside the proposed jacket which helps the soldiers, mountaineers, riders to withstand any kind of external environmental issues, which helps to work efficiently without heat or cold stress. Using the mobile itself, the user can select the temperature level which is more comfortable and the heating and cooling system gets activated as per the temperature. Due to this features, the system can work in summer mode and winter mode. The block diagram of the proposed system is shown infig.1.

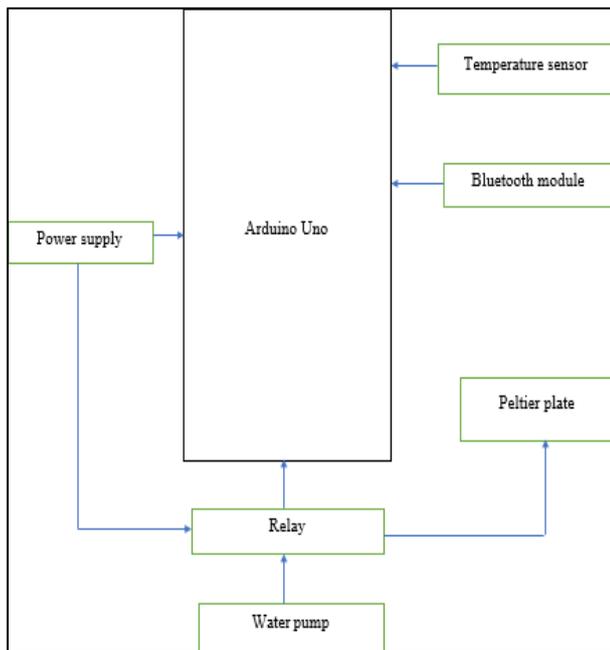


Fig. 1: Block Diagram

Major elements used in the system includes:-

#### A. Microcontroller

ATmega328p microcontroller is used to control the heating and cooling system. Microcontroller is a dedicated computer which is placed on a single integrated circuit. It is a high performance 8 bit microcontroller that combines 32kb ISP (Internet Service Provider) flash memory with read-write capabilities, 2kb static RAM(Random Access Memory), 23 input ports.

#### B. Temperature Sensor

The degree of hotness of the body which is a measure of heat content in the body is known as temperature. Temperature sensor is a device that measures the hotness or coolness of an object and produces an electrical signal with respect to the measured temperature. LM35 can be used to measure the internal temperature. It has an electrical output proportional to the measured temperature in Celsius.

#### C. Peltier Module

Peltier module is the heating and cooling component which is compact, easy to carry and not movable. Peltier effect is an effect where in when a plate is subjected to a voltage due to which one side of the plate will get cooled and other will be heated. Heat is given out or absorbed when an electric current passes across a junction between two materials. Here TEC1-12706 module is used. TEC or Peltier create a temperature difference between sides of the module.

#### D. Bluetooth Module

Bluetooth module is used to connect with a mobile phone. It is used to display the measured temperature in the mobile phone and to receive the temperature that user requires. It consists of a transparent wireless serial connection. HC-05 module which is a bluetooth SPP (Serial Port Protocol) module, developed for wireless serial communication between the system and the bluetooth device. It has auto-

connect option for power ON to the last device by default. It allows paired device to connect automatically.

#### E. Water Pump

In this circuit a submersible micro water pump is used to circulate water throughout the jacket. This is low cost, small size submersible pump motor which can be operated from 2.5V~6V power supply .It can take up to 120liters per hour with very low current consumption of 220Ma. Just connect tube pipe to the motor outlet, submerge it in water and power it .Make sure that water level is always higher than the motor. Dry run may damage the motor due to heating and it will also produce noise. Motor was needed to push the water throughout the vest system by using tubes which was attached to the suit.

#### F. Relay

The 4 -channel relay driver module makes it simple and convenient to drive load such as 12V relays from simple 5V digital outputs of your Arduino compatible board or other microcontroller. Each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller. Relay is act as a switch. Relays are used to control the circuit with low power signal or several circuits must be controlled by one signal.

## IV. METHODOLOGY

The proposed system working can be classified into two parts namely;

- 1) Cooling System
- 2) Heating System

The basic working principle in the system is the peltier effect which produces both heating and cooling effect. The Peltier effect states that when a voltage is applied between two electrodes connected to a sample of semiconductor material a temperature difference is created. If the heat needs to be transferred from one medium to another on a small scale, this phenomenon can be used. To create a heat flux between the junctions of two different types of materials, peltier effect is used. Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which depends on the direction of the current and transfers heat from one side to the other side of the device, with consumption of electrical energy. The major application is cooling, but it can be either used for heating or cooling. It either heats or cools, and hence can be used as a temperature controller.

The proposed work is Temperature program able suit by using Arduino Uno and peltier cooler. This system is based on liquid cooling and heating jacket. This jacket will use tubes to circulate the water throughout vest and have a heat exchanger that pre-cools and recycled water using thermoelectric cooler which was attached to the jacket. The heart of this circuit is microcontroller. The code for the microcontroller is programmed to measure the temperature of the suit and a push button has been added to control the internal temperature of the jacket. The main objective of this jacket is creating the most comfortable thermal environment for the user and measuring the internal temperature of the jacket. The heating and cooling of the jacket is done by

distributing the water through the suit with the help of pipes, peltier cooler and heat exchanger. The temperature sensor helps to sense the temperature and thereby adjusting the suit temperature. The mini water pump helps to push the water throughout the vest system by using tubes which was attached to suit. The relay act as a switch. Relays are used to control the circuit with low power signal or several circuits must be controlled by one signal. Here a 4-channel relay is used and a mini water pump is attached to it. Bluetooth module is interfaced with microcontroller. Here a HC-06 is a class 2 slave Bluetooth module is used and allows paired device to connect automatically. It has four buttons for selecting which mode is used. It's a 4mechanical relays with status indicator LED and operational level is digital 5V.

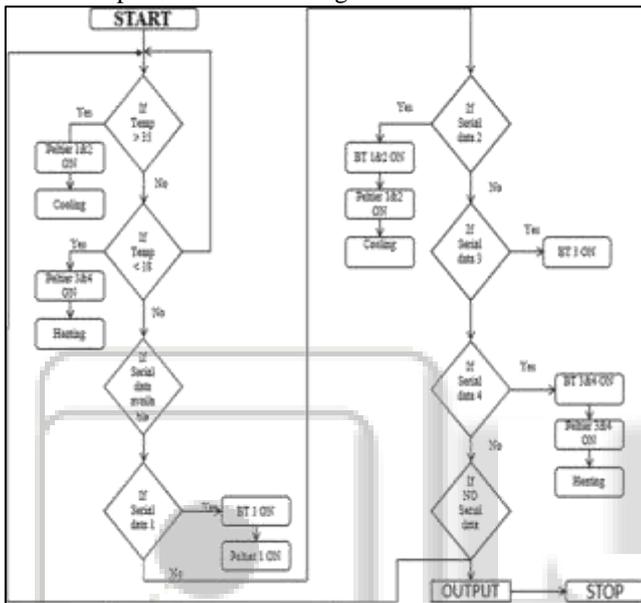


Fig. 2: Flow Chart

Fig.3 shows the flow chart of the switching. The temperature values is given as 18°C and 35 °C.

The software implementation of the system is done by using Arduino software. The code is written for the microcontroller diagrammatically represented above, first the code starts with initialization of the temperature sensor. Next read the temperature sensor if the temperature is above 35 °C peltier module 1 & 2 gets ON and relay switch to cooling mode. If the temperature is below 18°C peltier module 3&4 gets ON and relay switch to heating mode. If serial data 1 available, the Bluetooth button 1 gets turn ON which relay drives peltier module 1. If serial data 2 available, the Bluetooth button 1&2 turn on and relay drives peltier module 1 & 2 and cooling is achieved. If serial data 3 available, the Bluetooth button 3 gets turn ON which relay drives peltier module 3. If serial data 4 available, the Bluetooth button 3&4 turn on and relay drives peltier module 3 & 4 and heating is achieved. Temperature sensor senses the temperature. When the temperature is above the critical temperature, the relay switch the peltier to cooling mode. When the temperature is below the critical temperature, there lay switch the peltier to heating mode. Here four peltier module is used. Two of them is used for cooling and other two is for heating. The other side of the cooling peltier gets heated and this heat must be transferred out by using a heat sink and a fan. The water is circulated throughout the jacket through the tubes provided in

it. Heat sink is attached to the peltier. If cooling is required, the cooling peltier will work and the heat is transferred out by using a heat sink and fan. Hose goes through the peltier and other side is connected to a mini water pump. The mini water pump helps to pump the water and it is circulated through the hose. Thereby providing the users a comfortable temperature.

## V. RESULTS & DISCUSSIONS

Experiment is done using peltier module, microcontroller, Bluetooth module and switching circuitry.



Fig. 3: Peltier box

This module is the temperature controlling part. Here two peltiers are used for the cooling of water inside the tube and two peltiers are used for the heating of water inside the tube inside the jacket. Here all the four peltier are inserted into a box and sealed with adhesive to avoid leakage. A heat sink with fan is attached to the peltier to carry heat away from the peltier box



Fig. 4: Controlling part

The controlling part is mainly the microcontroller based programmed part. It contains sensors used in the proposed system. The sensors are connected to the Arduino Uno and programmed accordingly. The upper temperature is set to 35 degree Celsius so that cooling part will start. The lower temperature is set to 18 degree Celsius so that heating will start. It can be controlled manually using an Arduino Bluetooth application using mobile

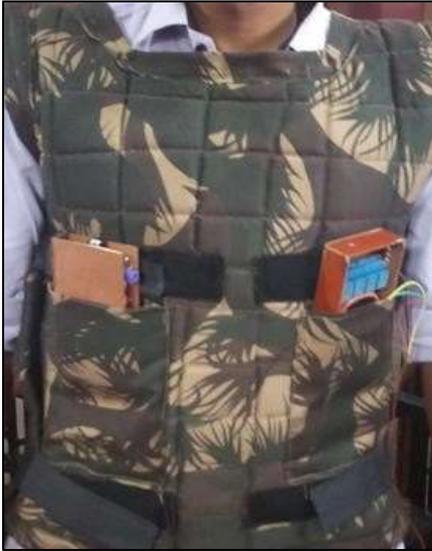


Fig. 5: Proposed Jacket

Here four peltier module is used. Two of them is used for cooling and other two is for heating. The other side of the cooling peltier gets heated and this heat must be transferred out by using a heat sink and a fan. The water is circulated throughout the jacket through the tubes provided in it. Heat sink is attached to the peltier. If cooling is required, the cooling peltier will works and the heat is transferred out by using a heatsink and fan. Hose goes through the peltier and other side is connected to a micro water pump. The micro water pump helps to pump the water and it is circulated through the hose. Thereby providing the users a comfortable temperature.

#### VI. CONCLUSION & FUTURE SCOPE

The gadget with multi features for different applications describes the integration of new technologies, offering ease of maintenance. The portable jacket is used to monitor and maintain the body temperature and pressure conditions of user according to surrounding environment of that user. A Peltier system can be implementing wearable jacket can provide to lerable and controlled temperature to the people wearing it. The work can be also extended by using increased merit of peltier module and efficient temperature exchange technology. The jacket allows the user to monitor and control the internal body from higher temperature to lower temperature depending up on the climatic conditions. It definitely protect the user from heat stroke and other health issues caused due to temperature variations. It also act as a guard for all users keeping the body temperature at a certain level.

Future work is to make it light weight. Decrease the weight of the equipment and jacket much further adding pulse monitoring system and GPS location system to the implement. Decreasing the cost of the equipment used and make it affordable to the common uses. Future work will be the inclusion of pressure sensing system in top the current system so that both temperature and pressure can be monitored simultaneously and approximate variations could be made in the human body.

#### REFERENCES

- [1] RajuPoykayil, Jeffy Francis, DeepaSaju, Akhil Suresh, JobinVarghese "Peltier Integrated Heating And Cooling Jacket" 2017 International Conference of Electronics, Communication and Aerospace Technology (ICECA), 260- 263, 2017
- [2] Brogan, Q, O'Connor, T and Dong Sam Ha, "Solar and thermal energy harvesting with a wearable jacket" IEEE International Symposium on Circuits and Systems (ISCAS) 1412- 1415, 2014.
- [3] Goldsmid, H. J, "Timeliness in the development of thermoelectric cooling" Seventeenth International Conference on The Thermoelectric. ProceedingsICT98, 25-29, 1998
- [4] KHemavani, V.Saikumar, Dr. S.A.K.Jilani, (2015) "Temperature Programmable Suit using Thermoelectric Cooler/Heater" ISSN: 2348 – 8549, SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE) – Volume 2 Issue 7–July 2015."
- [5] "Solar Powered Thermal Jacket For Soldiers in Extreme Temperatures", A Peer Reviewed Open Access International Journal. ISSNNo: 2348- 4845, Issue No: 6 June 2015. International Journal & Magazine of Engineering, Technology, Management and Research, Volume No: 2(2015).
- [6] "An introduction to Bluetooth modules (HC-05&HC- , datasheet.
- [7] "Peltier effect (physics)." Encyclopedia Britannica, 13 Dec2013.
- [8] "TEC1-12706 Datasheet." HEB. N.p., n.d.Web. 13 Dec.2013.
- [9] <http://www.hebeiltd.com.cn/peltier.datasheet/TEC112706.pdf>