

Soldier Protection Vesture

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Abstract—Soldiers are the pride of a nation. They are disciplined, courageous and selfless. Their life is full of challenges and they face each challenge in any weather conditions. In serving the job to the nation Soldier may face troubles in extreme hot and cold weather conditions. Both very cold and very hot temperatures could be dangerous to health. High altitude pulmonary oedema, acute mountain sickness, memory loss, nausea are some of the most common health problems are faced by soldier in very cold condition. Very hot temperature causes heat stroke, heat edema, heat exhaustion on soldier's body. So to protect the soldiers from extreme weather condition, here we present the 'SOLDIER PROTECTION VESTURE'. This vesture will increase in efficiency of work of soldier and protect from extreme weather conditions. This vesture operates in two modes summer mode & winter mode by using Peltier Plate. Additional facilities to the vesture are GPS tracking system and Heart Beat monitoring system.

Keywords—Peltier Plate, extreme weather condition, soldier protection vesture, GPS, piezoelectrical material, peltier effect, control center, Heart Beat Monitoring.

I. INTRODUCTION

Soldiers are the backbone of the country. They provide security to the nation in any extreme weather conditions like very hot temperature conditions in deserts & very cold temperature condition like in hilly areas. In our paper, we are presents the Soldier Protection Vesture which protects the soldiers from extreme weather conditions. In this vesture we are providing heating and cooling system by using Peltier plate. Peltier plate in the vesture is used to protect from extreme weather condition and increasing the capability of this Soldier Protection Vesture more effectively. These peltier plates are capable of providing temperature range from -40°C to $+200^{\circ}\text{C}$.

This peltier plate works on two modes summer mode and winter mode. The heating and cooling effect using peltier plate are based on peltier effect. When peltier plate acts as cooling device, then it is called as thermoelectric cooler (TEC). When peltier plate acts as heating device, then it is called as thermoelectric heater (TEH) [1].

Another feature of this vesture is that it provides the current location of soldier by using GPS tracking system as well as heart beat status of soldier whether he/she will die or alive. This is achieved with help of arduino uno, GSM

module, heart beat sensor, LCD display. Power supply to this whole circuit is providing by either solar panel or piezoelectric shoes.

II. EXISTING SYSTEM

A. Indian Army Camouflage

The Indian Army camouflage consists of shirts, trousers and cap of a synthetic material. Shirts are buttoned up with two chest pockets with buttoned up flaps. Trousers have two pockets, two thigh box pockets and a back pocket. The Indian Army Jungle camouflage dress features a jungle camouflage pattern and is designed for use in woodland environments. The Indian Army Desert camouflage, which features a desert camouflage pattern, is used by artillery and infantry posted in dusty, semi-desert and desert areas of Rajasthan and its vicinity.

B. All Purpose Environmental Clothing System (APECS)

This parka and trouser made with GORE-TEX® fabric provides exceptional comfort and protection with a lighter-weight, less bulky construction. This multi-purpose garment is designed for use in even the harshest conditions. Features include new n-IR signature reduction technology, which is durable for the life of the fabric. The construction uses a proprietary GORE-TEX® fabric that is 40-percent softer and quieter than previous fabrics to help you operate more effectively. Increased breathability provides comfort across a broader temperature range. The wearer stays drier longer and in higher levels of activity. For more than 30 years, W. L. Gore & Associates, Inc. has developed high-performance fabrics that withstand the harsh environments military, law enforcement, fire and rescue professionals encounter on their missions [3].

C. Extended Cold Weather Clothing System (ECWCS)

The Extended Cold Weather Clothing System (ECWCS) is a protective clothing system developed in the 1980s by the United States Army Natick Soldier Research, Development and Engineering Center, Natick, Massachusetts. The first generation ECWCS consisted of parka and trousers plus 20 other individual clothing, hand wear, headwear and footwear items which are used in various combinations to meet the cold weather environmental requirements of Soldier. The third generation 3G or GEN III Extended Climate

Warfighter Clothing System is a radical re-design of the system. It features seven new layers of insulation including three Polartec fabrics: two layers of Polartec Power Dry and a layer of Polartec Thermal Pro High Loft. It has also featured PrimaLoft® Silver Insulation USA in the extreme cold weather parka and trousers.

III. BLOCK DIAGRAM & IT'S DESCRIPTION

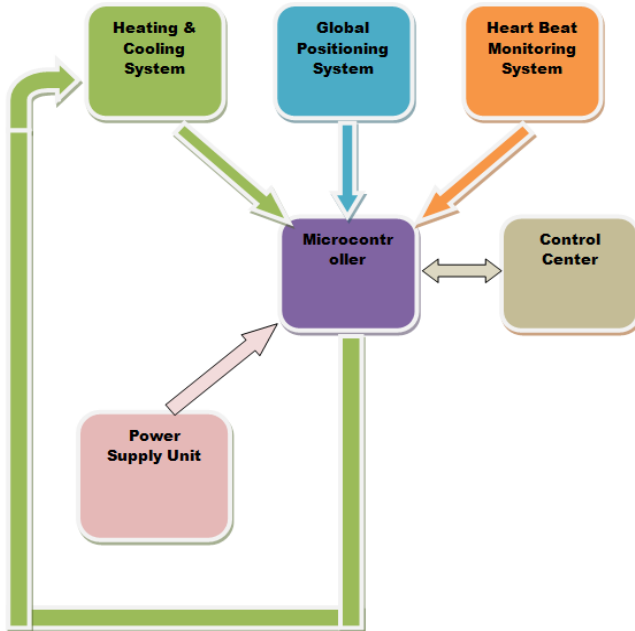


Fig: - (1)

C. Heart Beat Monitoring System

- A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.
- Principle of Heartbeat Sensor:** - The heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region). In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses.
- There are two types of photoplethysmography:
Transmission: Light emitted from the light emitting device is transmitted through any vascular region of the body like earlobe and received by the detector.
Reflection: Light emitted from the light emitting device is reflected by the regions.

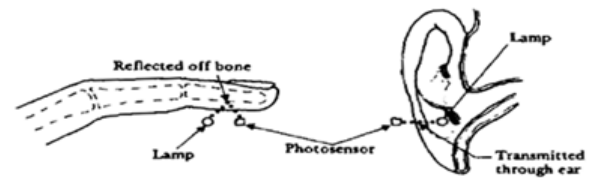


Fig: - (2)

- Working of a Heartbeat Sensor:**-The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a photodiode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate. This signal is actually a DC signal relating to the tissues and the blood volume and the AC component synchronous with the heart beat and caused by pulsatile changes in arterial blood volume is superimposed on the DC signal. Thus the major requirement is to isolate that AC component as it is of prime importance. To achieve the task of getting the AC signal, the output from the detector is first filtered using a 2 stage HP-LP circuit and is then converted to digital pulses using a comparator circuit or using simple ADC. The digital pulses are given to a microcontroller for calculating the heart beat rate, given by the formula-

$$\text{BPM (Beats per minute)} = 60 * f \quad (1)$$
 Where f is the pulse frequency

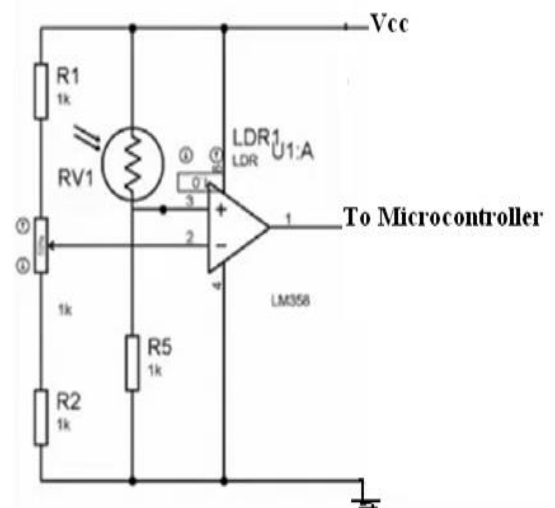


Fig: - (3)

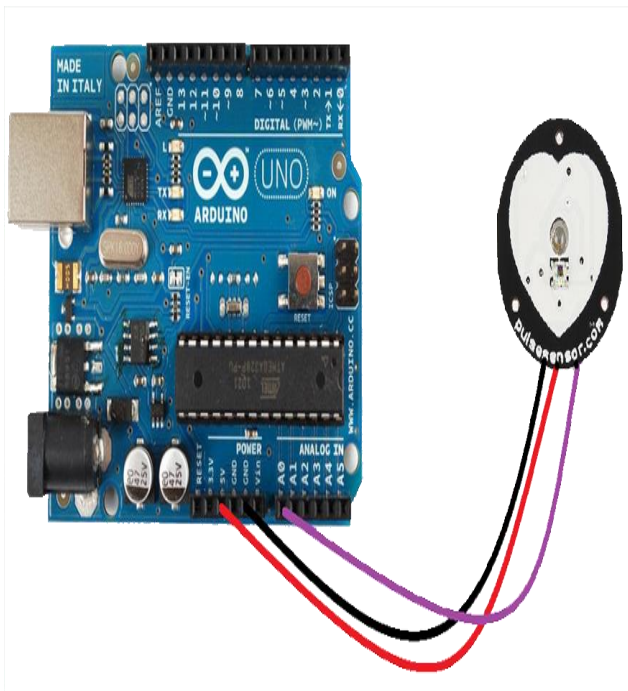


Fig: - (4)

D. Global Positioning System

- Global Positioning System is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars and trucks also. The system gives critical abilities to military and civilian users around the globe. GPS provides continuous real time, 3-dimensional positioning, navigation and timing worldwide.
- GPS consists of three segments such as space segment, control segment, user segment.
- **Working:-**The working of Global positioning system is based on the 'trilateration' mathematical principle. The position is determined from the distance measurements to satellites. From the figure, the four satellites are used to determine the position of the receiver on the earth. The target location is confirmed by the 4th satellite. And three satellites are used to trace the location place. A fourth satellite is used to confirm the target location of each of those space vehicles. Global positioning system consists of satellite, control station and monitor station and receiver. The GPS receiver takes the information from the satellite and uses the method of triangulation to determine a user's exact position [4].

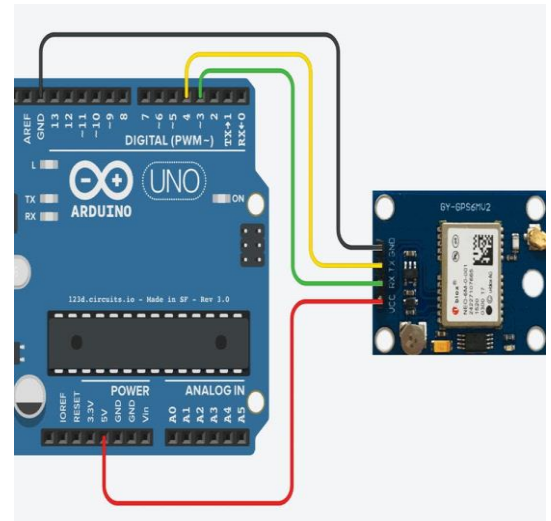


Fig: - (5)

E. Heating & Cooling System

- Peltier Plate operates according to the Peltier effect. The effect creates a temperature difference by transferring heat between two electrical junctions. A voltage is applied across joined conductors to create an electric current. When the current flows through the junctions of the two conductors, heat is removed at one junction and cooling occurs. Heat is deposited at the other junction.
- The main application of the Peltier effect is cooling. However the Peltier effect can also be used for heating or control of temperature. In every case, a DC voltage is required.
- The array of peltier plate elements is soldered between two ceramic plates, electrically in series and thermally in parallel. Solid solutions of bismuth telluride, antimony telluride and bismuth selenide are the preferred materials for peltier effect devices because they provide the best performance from -40°C to +200°C and can be made both n-type and p-type [2].

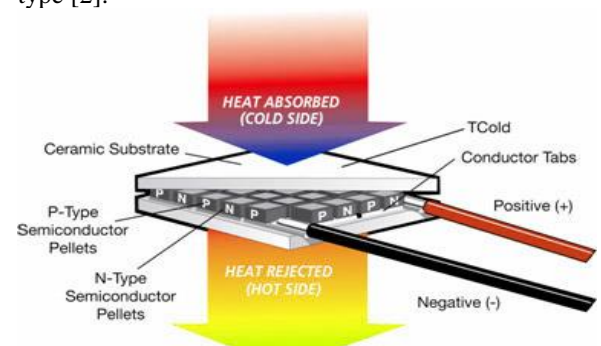


Fig: - (6)

F. Microcontroller

- In this paper we use Arduino UNO as microcontroller. The Arduino UNO is an open-source microcontroller board based on the microchip ATmega328P microcontroller.

- The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.
- It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes preprogrammed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 programmed as a USB-to-serial converter.

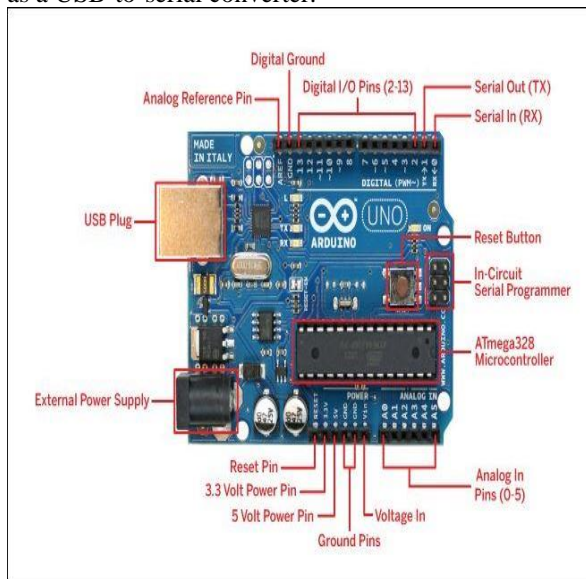


Fig: - (7)

G. Power

- Power supply to whole internal circuit of vesture is provided with help of piezoelectric shoes as shown in Fig.(9).
- **Piezoelectric Effect:** - The piezoelectric effect occurs through compression of a piezoelectric material. Piezoceramic material non-conductive piezoelectric ceramic or crystal is placed between the two metal plates. For piezoelectricity to be generated, it needs that material to be compressed or squeezed. Mechanical stress applied to piezoelectric ceramic material generates electricity. As shown in Fig. (8), there's a voltage potential across the material. The two metal plates sandwich the piezo crystal. The metal plates collect the charges, which creates/produces voltage i.e., piezoelectricity.

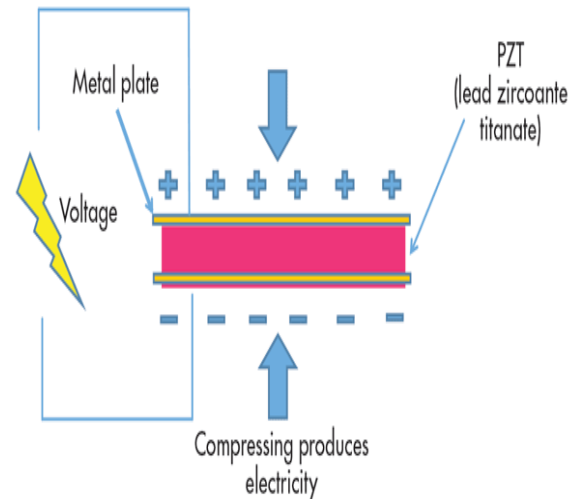


Fig: - (8)

- **Piezoelectric Material:**-Piezoelectric materials are materials that can produce electricity due to mechanical stress, such as compression. These materials can also deform when voltage (electricity) is applied. All piezoelectric materials are non-conductive in order for the piezoelectric effect to occur and work. They can be separated into two groups: crystals and ceramics.
- Some examples of piezoelectric materials are PZT (also known as lead zirconate titanate), barium titanate, and lithium niobate. In this design we use the PZT material.
- PZT is created and produced (under high temperatures) with two chemical elements lead and zirconium and combined with a chemical compound called titanate. PZT can produce more voltage for the same amount of applied mechanical stress as compared to quartz [5].

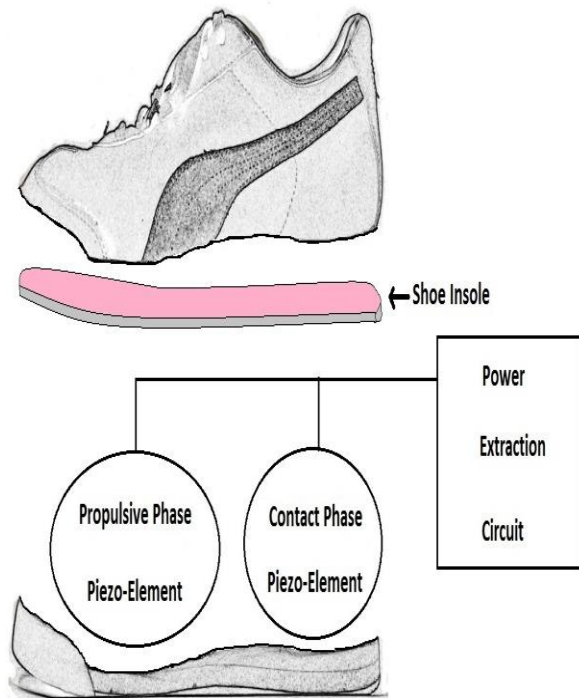
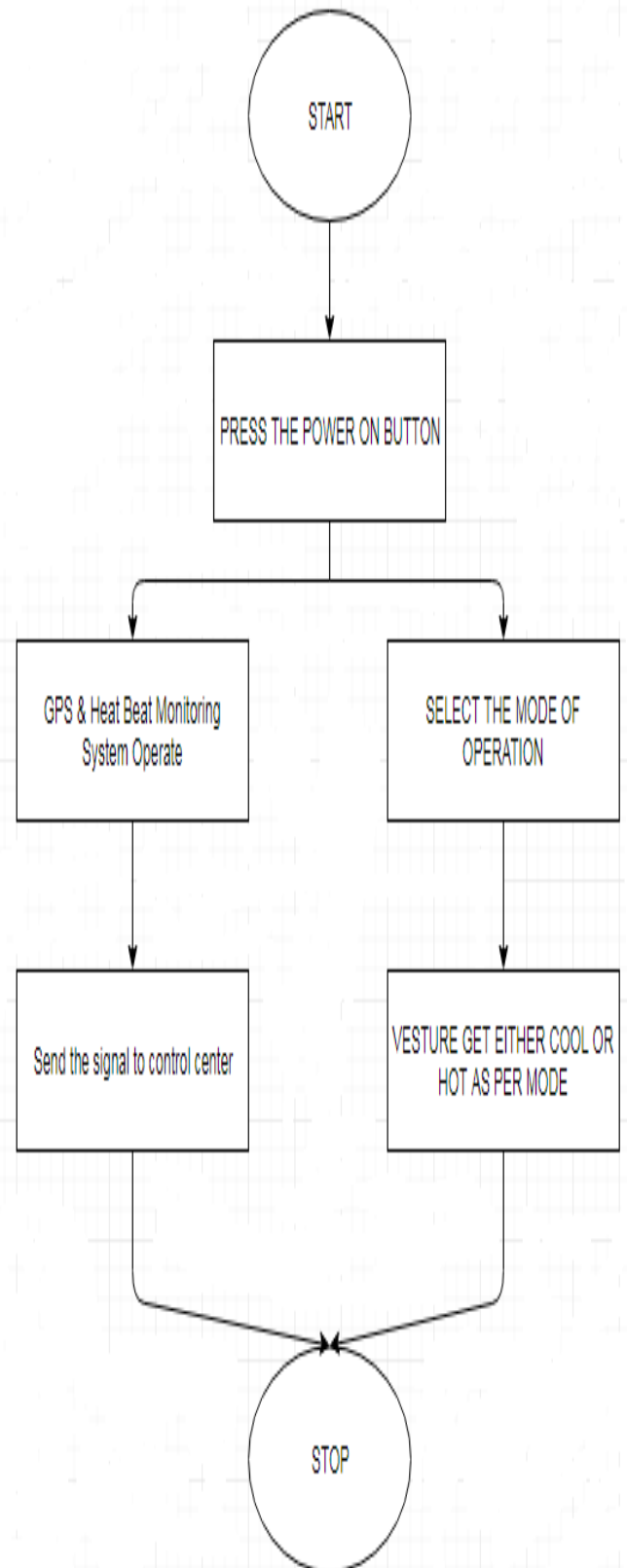


Fig- (9)

H. Control Center

- Control Center is monitoring station. It monitors the movement of soldier and checks the health monitoring system of soldier. From control center we can send the any command to the soldier. Soldier can also contact the control center if any emergency condition occurs.

IV. FLOWCHART



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