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MULTI PURPOSE SUIT

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Abstract— *A stable core body temperature is essential for proper and optimal function .In extreme hot and stressful environment this can often to be difficult for individuals without proper cooling mechanism. The human body have its own cooling mechanism to regulate temperature, sweating. But temperature related inconvenience such as heat stroke, heat rash, frostbite, hypothermia and others have been a persistent problem for human throughout the history. Current technological solutions made to keep people thermally comfortable such as air conditioning and heating units and have been successful in helping people comfort in their dwellings (eg. home or car).But are not personal mobility solution. This is why a heating or cooling suit is beneficial for us. Creating the most comfortable thermal environment for the user within an enclosed space while providing comfort practicality and mobility is the objective of this suit.*

Keywords—Thermoelectric cooler,heating/ cooling suit,garment for cooling vest

I. INTRODUCTION

The proposed solution is an application specific dual powered heating/cooling suit, in which user can control the temperature inside the suit through regulator and thermo electric device that are embedded inside the suit. Ultimately, we set out to achieve a body suit that is easy to wear, comfortable, and provide simple and adequate controls that allow for any user utilize it, their needs.

Global warming is the global problem which pulls out many drastic changes all over the world. As a result of it, not only the industrial sector, schools, public places are propelled to keep shut, due to the increased atmospheric temperature. This scenario had driven away many lives of people especially in India. So the suit can be designed according to the area where it is going to be implanted

The technologies that are preferred today definitely advocate the thermoelectric cooling. Even though these technologies do not provide the at most easiness to industrial sector, technologies which propagates thermoelectric cooling should be implanted with ways which are application specific. So, suit is such a design which can be developed in different model varieties that can be utilized in industrial sector wisely. Places which are extremely cold or hot , the places which creates polluted atmosphere like mines, chemical factories or nuclear power plants can be placed with suitably designed suit to detect atmospheric pollution contents, heart rate, body temperature ;where in construction sites ,suit can be placed which can utilize solar energy to the maximum.

II. BACKGROUND

A. Peltier Effect

This application requires a development of a system that ensure the heating and cooling. There is a very interesting device that produce heating and cooling simultaneusly on a small scale called thermo electric device or thermo electric cooler. Thermoelectric cooler is a solid state heat pumpmade of high efficiency semiconductor material that creates a difference in temperature in its two sides when a voltage is applied and current run through it . A p type and n type semi conductor material that enclosed between two ceramic plates. This phenomenon is called the Peltier effect. 17^{th} Century French Physicist Jean Peltier concluded that when a current flows through a junction between two different conductors (from a battery or other voltage source), heating and cooling occur because charge carriers diffuse to opposite sides. This is the reverse of the Seebeck effect (Thomas Seebeck, Germany, 17^{th} Century), which states that a difference in temperature of adjacent conductors generates a voltage. This effect is very strong when used in systems with many semiconductors, as is the case with the thermoelectric cooler. These effects, collectively known as the thermoelectric effect, note a correlation between voltage and temperature of conductors.

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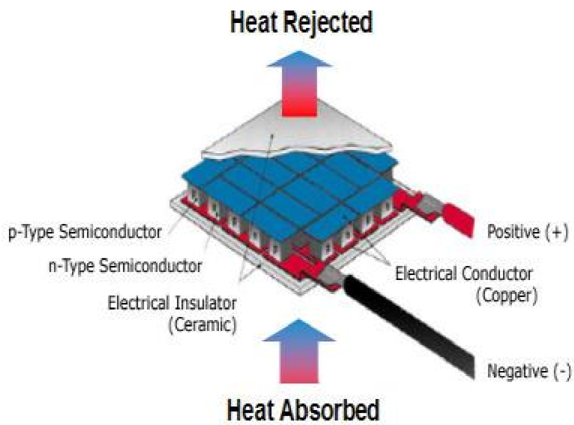

Figure 1: Comprehensive diagram of TEC. (Peltier Effect)

III. DESIGN

To undertake this project and conduct useful research that would yield a successful design, several design challenges had to be taken into account. A primary obstacle was coming up with a delivery method to spread the heat/anti-heat to as much of the garment as possible. The safety of the potential user is also important. The design cannot be hazardous, and the product shouldn't burn or shock the user. Therefore parameter limitations and proper wiring and encasement procedures ought to be implemented. There is also a cost limitation on the project so our design could not exceed that cost. The design considers size limitations of garments worn by people and avoids excess bulk, weight, waste, and user uneasiness, all at a low cost.

A. Proposed model

To undertake this project and conduct useful research that would yield a successful design, several design challenges had to be taken into account. A primary obstacle was coming up with a delivery method to spread the heat/anti-heat to as much of the garment as possible. The safety of the potential user is also important. The design cannot be hazardous, and the product shouldn't burn or shock the user. Therefore parameter limitations and proper wiring and encasement procedures ought to be implemented. There is also a cost limitation on the project so our design could not exceed that cost. The design considers size limitations of garments worn by people and avoids excess bulk, weight, waste, and user uneasiness, all at a low cost.

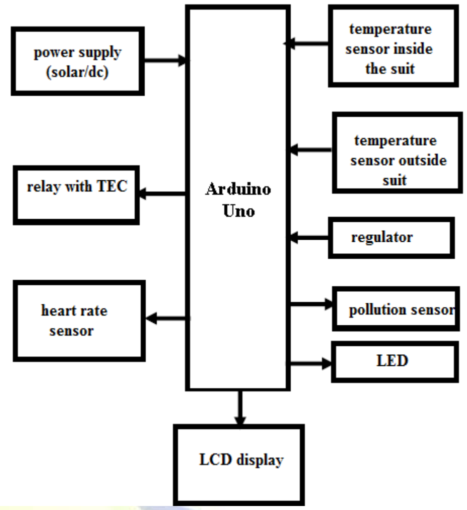

Figure 2: Block Diagram of the Final Design

The proposed model is a microprocessor based system that heats and cools one side of several TECs by using a relay circuit that is enabled and controlled by "hot and cold" pushbuttons and a rotary variable resistor. The voltage across this variable resistor is used to pulse width modulate the signal to the relay, allowing the user to adjust the gradient temperature that the TECs generate. The TECs will ultimately come out of the circuit via their wires and be attached that are placed in strategic places within the suit. The system also uses a temperature sensor, and an LCD module to continuously sense and display temperature in Fahrenheit or Celsius. This design was chosen because it is effective, lightweight, impressive and within our budget.

B. Final proposed design

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

C. Arduino uno

The Arduino Uno is a microcontroller on a circuit board based on Atmega328. It has 14 digital input and output pins in which 6 can be used as PWM outputs. It also has 6 analog inputs, a USB connection, a power jack, a 16MHZ ceramic resonator, an ICSP header and a reset button. The Arduino Uno has Flash memory is 32KB ,SRAM is 2KB, EEPROM is 1KB and the Clock speed is 16mhz.The Arduino Uno can be powered through the USB association or with an external power supply. The power source is chosen naturally.

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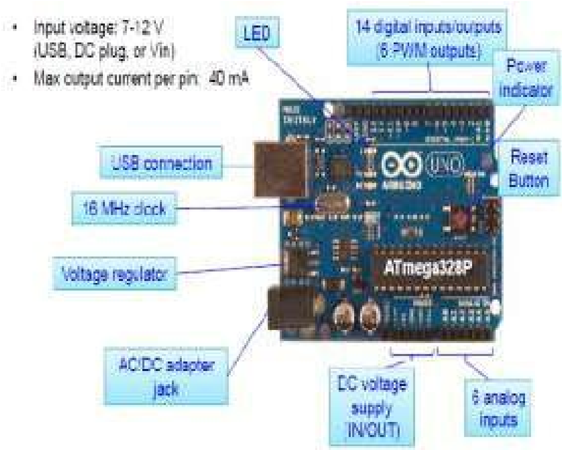

Figure 3:Arduino board

D. Thermoelectric cooler

This application requires the development of a system that requires both warming and cooling. The thermoelectric cooler is an interesting device that allows the dual functionality such as heating and cooling simultaneously. The thermoelectric cooler (TEC) is also called as peltier cooler. The peltier cooler is a solid state heat pump which uses the peltier effect to move heat.

Figure 4: Thermo electric cooler/heater

E. Temperature sensor

The LM35 sensor is a precision integrated circuit temperature device with an output voltage is linearly proportional to the centigrade temperature. It would be connected to the microcontroller.. As a temperature sensor, the circuit will read the temperature of the surrounding environment, is converted from binary to decimal via programming of the microcontroller which we will be able to read from the computer of the Arduino serial monitor. Here two temperature sensors are used for sensing internal and external temperature of the suit. This is achieved through the code loaded into the Arduino Uno board.

F. Relay

A Relay is acts as a switch. Relays are used to control the circuit with low power signal or several circuits must be controlled by one signal. In this circuit we are using a Double Pole Double Throw (DPDT) relay.It has 2 terminals and 4 connectors. A 12V battery is connected to relay and applying the load such as TEC across the relay. When internal temperature sensor is greater than potentiometer value then the TEC will becomes cool. Otherwise the relay switches the load. Then the TEC will becomes hot.

G. Power supply

A 3.7V lithium ion battery is selected as power supply to this circuit. The Arduino Uno can be powered through the USB association or with an external power supply. The power source is chosen naturally. Adding a solar panel to the suit is optional but it will help with powering the suit. It is recommended that you use a flexible solar panel, so that it is more bendable with the clothing and will be more comfortable to wear. Purchase a solar panel that has more voltage than the battery that powers your Arduino. The solar panel in the picture gives about 8 volts. No more than 8 volts is needed to charge the battery to the Arduino. Also the Li Power charger and 3.5 volt lithium polymer battery is required to store the solar power.

H. Meterials

We use mesh lined vest as material for making the suit for specific applications. Mesh lined vest is an alteration of a jacket with mesh lining inside. In mesh lined structure excess materials was removed to allow large open areas for air to be removed from the location of the armpits.

IV. SOFTWARE IMPLIMENTATION

The software implementation of the heating and cooling system is done by using Arduino software and Mat lab. The flow for the following programming methodology is shown in fig.2

The circuit is powered by a 3.7 v lithium ion battery. To turn on and off the circuit, a toggle pushbutton switch is between the power supply and the rest of the circuit and acts as an on/off switch. The voltage of the microcontroller is regulated by a voltage regulator which is in the range of operation for the ATmega16. This voltage regulator is the KA7805, it is capable of regulating high voltage sources to approximately 5 V when we choose solar power. (5.2V max, the ATmega16 can handle 5.5V max).

For temperature sensing, the LM34 Precision Fahrenheit Temperature Sensor was selected and would be connected to the microcontroller. The LM34 is an easy-to -use sensor that does require external calibration, but is able to output a

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voltage that is linearly proportional to the Fahrenheit temperature, and can provide typical accuracies of +/- 0.5 F at room temperatures over a -50 to +300 F temperature range.

The code is written for the microcontroller is diagrammatically represented. First the code starts with initialization of the temperature sensor. Next read the internal temperature sensor, external temperature sensor and temperature control potentiometer. Then compare the internal temperature with the control potentiometer value.

If internal temperature sensor value is higher than the control potentiometer value then the TEC will become hot. If internal temperature sensor value is lower than the control potentiometer value then the TEC will become cool. Hence calculate the PWM based upon temperature difference. This makes the voltage for the TEC is linearly proportional to the duty cycle of the pulses sent to the relay circuit. This allows for change in output voltage for the TECs, thus a change in temperature. However the system continuously reads and displays the internal temperature of the suit.

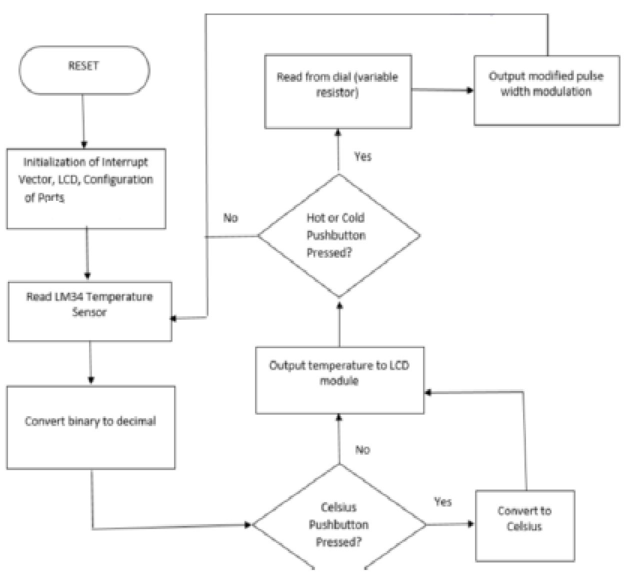

Figure 5: Block Diagram of the heating/cooling system

V. SOFTWARE DOCUMENTATION

A. *Heating/cooling system*

The code for the microcontroller is programmed in the following manner. First, the code starts with the initialization of the interrupt vector table (in order for the interrupts to be properly handled), the configuration of the ports (in order to see which pins are inputs and outputs), and initialization of the stack pointer, interrupt controls, and LCD module. Next, the main loop of the code checks the input pin for the LM34 sensor for temperature information. The suit's current temperature is converted from binary to decimal and parsed and stored for display. Next, the Celsius/ Fahrenheit push button pins are checked to see whether the temperature should be displayed in the default Fahrenheit scale or converted into the Celsius temperature scale. If the Celsius scale is selected, the main loop of the code calls the conversion routine where the parsed data from the temperature sensor is converted and then returned back to the loop.

The temperature sensed by the LM34, is converted from binary to decimal via programming of the microcontroller, and through further coding will be displayed on a LCD module that would display real time internal temperature of the suit in decimal numbers. The LM34, like the TECs will come out of the circuit via its wires and be attached to the mid-section of the inner layers of the suit to measure temperature. In addition to the display, a push button has been added to allow the user to alternate between Fahrenheit and Celsius on the display. This is achieved through assembly language code loaded into the microcontroller.

B. *Pollution sensor*

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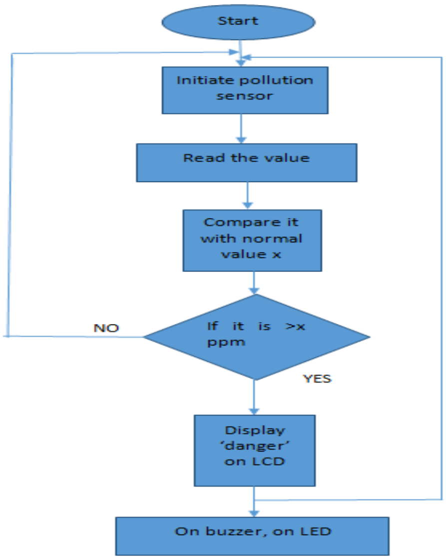

Figure 6: Flow chart for pollution sensor

The pollution sensors such as co2 sensor methyl sensor ammonia sensor dust sensor etc. can be used. The type of pollution sensor used is determined by the area of application.

First, the pollution sensor is initiated. Then the obtained/measured value is compared with the normal value of the pollutant in the atmosphere. If the compared value is greater than X ppm, then display the value and print 'DANGER' in the LCD, and ON the buzzer and LED. Then repeat the process. If the compared value is less than X ppm, then repeat the process continuously.

C. Heart beat sensor

Heart beat sensor is used blood pressure and body temperature are very important parameters to known for human body. We go to doctors that use different kinds of apparatuses to know the heart beat of a human. Here, a sensor monitors the heartbeat of the worker that is wearing the suit at all time .The sensor used is Arduino compatible.

We can assess the health status of the worker by monitoring the heart beat and necessary remedies can be taken in case of any cardinal or health emergencies. We will make an Arduino based heart beat sensor that tell us the number of pulses in a minute when we will place a finger on it.

First, the pulse sensor is initiated. Then, read the value of heart beat per minute. Compare the value with the normal value (90/min). If the obtained value of heart rate is greater than 90 or less than 60 then display the value and print DANGER on the LCD, and ON the buzzer and LCD. The process is repeated again. If the obtained value of heart rate is between 60 and 90 then display the value on LCD. The process is repeated continuously.

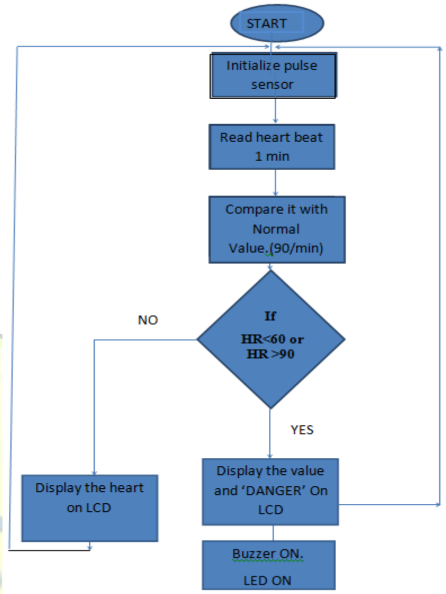

Figure4. Flow chart for heart beat sensor

VI. CONCLUSION

The final design of the project will be an arduous journey that will require intense research and hard work. The sensors and components will vary according to application. For instance, sensors used in the suit for a nuclear power plant will differ from the sensors used in suit for mining conditions. The pollutants are different in the two cases so the sensors used are CO_2 sensor and Uranium sensor. Global warming has elevated the atmospheric temperature and has adversely affected the working conditions that are already in peril. Thus we designed a system that would maximize the functionality of the TECs through the thermoelectric effect.

References

[1] "7805 Datasheet - 5V DC Voltage Regulator Data Sheet / Specs." *7805 Datasheet 5V DC Voltage Regulator Data Sheet / Specs*. N.p., n.d.Web.13Dec. 2013. <http://www.electrokits.com/Datasheets/7805-Datasheet>.

[2] "ATmega16 Datasheet." *Atmel*. N.p., n.d. Web. 10 Dec. 2013.<http://www.atmel.com/Images/doc2466.pdf>

[3] "Cool Vest with 3 portable reservoir options for hot and humid days-stay dry & keep cool!." *Veskimo Personal Cooling Systems*. N.p., n.d. Web. 13 Dec. 2013. <http://www.veskimo.com/>.

"THERMOVELOCITY PROTECTIONâ„¢." *Gerbing Thermovelocity Protection*. N.p., n.d. Web. 11 Dec. 2013. <http://www.gerbing.com/>.