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Smart Jacket for Health Monitoring and Controlling

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Abstract

Due to drastic changes in climatic conditions, winters are getting much colder, summers are getting much hotter. Uttermost hot or cold conditions are greater threat to health. These circumstances might cause genuine medical problems. At very high temperature most common problem is heart attack and overcooling of body is major problem during extreme colder conditions. As the application of technology has increased in every sector, it has also been introduced in textiles too. Electronics textiles in general referred as smart fabrics are quite trendy now. The main motto of this is to design a smart jacket which aims for providing reliable health during all the climatic conditions and can also sense the temperature using sensors. The major application for smart jacket is that it can be used for soldiers as they are triumph in war. This jacket helps in areas to find the temperature control and health monitoring. These jackets are not only useful for common people, but also to physically challenged people to make their life easier. Consequently for monitoring health and heart rate of body health monitoring apparatus have been established in the jacket as well.

Keywords: Smart fabrics, Heating/ Module, Heart rate, health monitoring, ECG.

INTRODUCTION

Soldiers are most important assets of country. They are the crucial part to safeguard the country. They are always ready to hold the tougher tasks during extreme hot/cold climatic conditions. As of now these extreme weather conditions are threat to their livelihood. These specially designed smart jackets will provide a better protection to the soldiers working in extreme conditions. Introduction to technology to textile has a better application in designing of jackets [1]. Smart textiles are broadly divided into two categories: aesthetic and performance enhancing.

Aesthetic fabrics are of light that can change color. Then these are performance enhancing smart textiles, which have a huge impact on military industries. These fabrics help to regulate body temperature, which is majorly benefit for and athletic. Other fabrics have been developed to protect against extreme environmental hazards like radiation etc. Health industries are also taking advantage of these innovations to design a fabric with moisturizer and many more [2].

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The above applications of technology in textiles have motivated to develop a smart jacket and to illustrate the integration of textile and electronics [3]. We have been using three modules namely heart rate monitoring module, heating and cooling module and automation module to provide the applications of health monitoring and many more.

Heart Rate Monitoring Module

This module helps to monitor heart rate of person wearing smart jacket. Heart rate [4] varies accordance with body's physical needs, oxygen levels etc. Normal heart rate of healthy person lies between 60-100bpm. Above 100bpm it is called as

fast heart rate known as tachycardia and below 60bpm it is termed as slow heart rate known as bradycardia. During sleep heart rate lies between 40-50bpm and it is considered to be normal. Arrhythmia referred as heart beat which is not in regular pattern. A lot of medical treatments have introduced to measure heart rate continuously. This idea can be also implemented in smart jackets and can measure heart rate whenever required.

Heating and Cooling Module

The major criteria used here is heating and cooling. In adverse climatic conditions it is difficult to adjust. Therefore for the comfort of human body heaters are used in winters and air conditioners are used in summer. These ideas are lead to applications of heating and cooling in smart jacket. Peltier plates which have the capacity to heat and cool themselves are used in these applications. These are placed in jacket and temperature of body can be monitored. By wearing this jacket human body can hold out against extreme climatic condition.

Device Control/Automation Module

Device modulation can be implemented in smart jacket. To one of the arms of the jacket this system is embedded and by sitting at one place electric appliances like fans etc., can be controlled [5], [6].

LITERATURE SURVEY

One of the most inhospitable battle fields in world is Siachen Glacier. In those extreme cold conditions our soldiers are brave enough to keep control of it. The temperature of Glacier can plunge to -50^0C in winter, and 10 m or more is the normal snowfall. A count of 800 soldiers had died in Siachen Glacier.

There were many technologies that were developed in e-textile. The article describes about heating and cooling phenomenon in smart jacket. It also includes heat sinks, which are used to increase the efficiency of cooling. In the year 1968, museum of contemporary craft in New York City held an expo which describes the relation between technology and apparel [7].

The pulse sensor which is placed at the breast of the jacket gives the information of heartbeat. The processing 3 version developed by Casey Reas and Ben Fry as helped as to stimulate real time heart rate pulse. Technology has helped us in finding new ways for connections of equipment, avoiding short circuit.

HARDWARE CIRCUIT DESIGNS

Heating/Cooling Block Diagram

By peltier plates we can bring out heat & cold effect, these are stitched inside a heat resisting panel and placed in these manner that the heat/cold is felt by thermal points of our body as shown in Figure 1. The change in direction of current, decides heating or cooling effect. The power source used is a Lithium Polymer battery, which outputs three different voltages constant current rates, hence, plates are placed in parallel to each other.

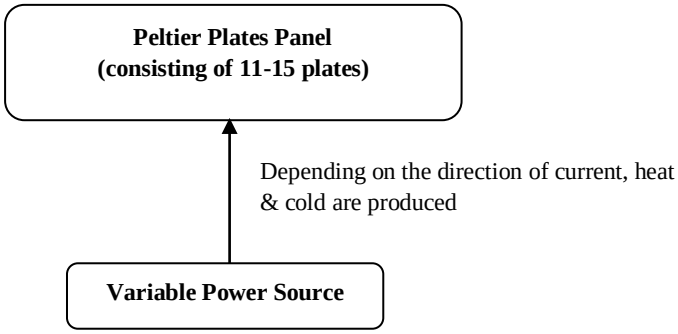

Figure 1. Heating/Cooling Block Diagram.

Heart Rate Monitoring Circuit

The main apparatus for heart rate monitoring system are pulse sensor, Arduino and LCD. As shown in Figure 2, these two apparatus are directly connected to Arduino [8–10] and the pulse sensor is placed on a body to detect the heartbeat.

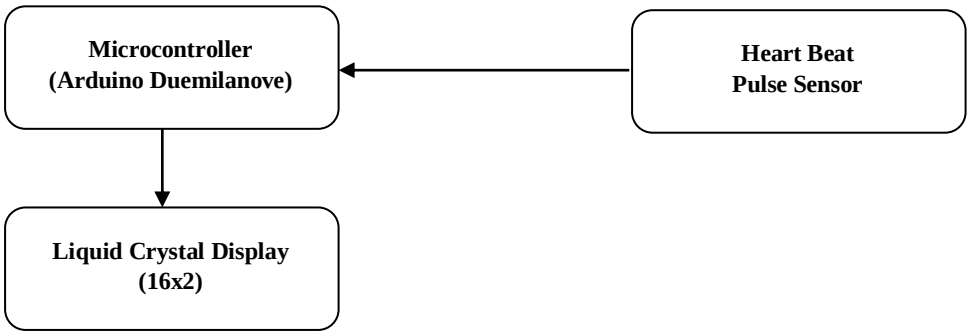

Figure 2. Heart Rate Monitoring Block Diagram.

Device Control/Automation

The equipments for a device automation system are equipped with RF transmitter and receiver switches or installed at transmitter side where the parallel data is converted into serial data by encoder as shown in Figure 3. These converted signal data is converted into RF signals and is received by RF receiver. Using decoder this serial data is converted into parallel data. Using a 5v led we can demonstrate whether the bulb is on or off.

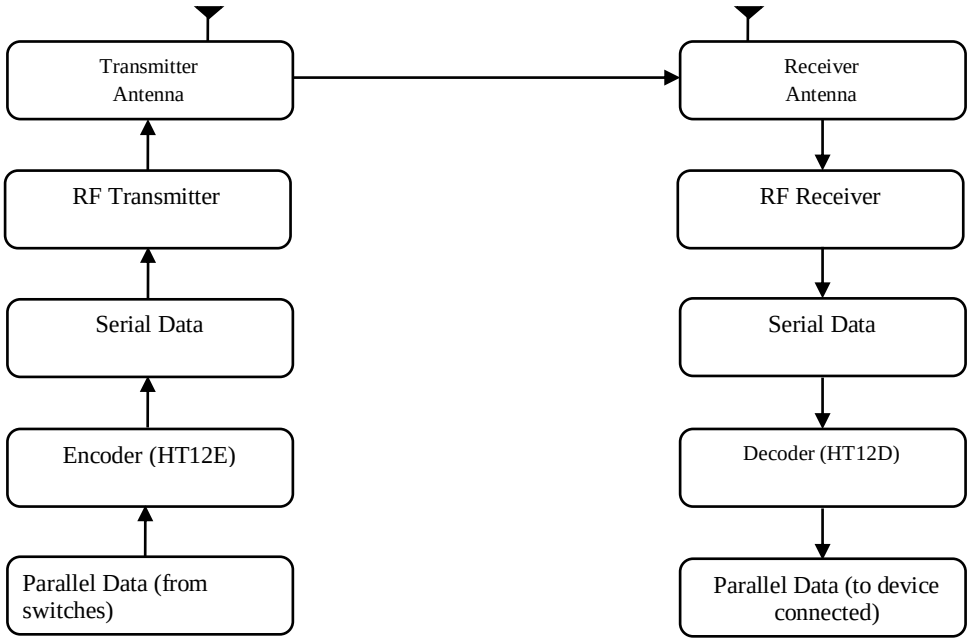

Figure 3. Block Diagram for device control/automation.

Heating/Cooling Panel

Peltier plates are connected to a battery source as in Figure 4, where we can obtain reverse current. Direction of current produces heating or cooling effect is produced when positive terminal is connected to cathode and negative is connected to anode were as vice-versa for heating effect.

Device Control System

The transmitter (Figure 5) consist of switches connected at 10,11,12,13 of encoder HT12E which is powered by 9v and LEDs are connected to respective pins. Practical length of antenna is estimated to

be 13cms and frequency operators at 434MHz. The transmitter circuit is stitched to one arm at the jacket and the devices at receiver side can be controlled. This method can be implemented for both common people and patients.

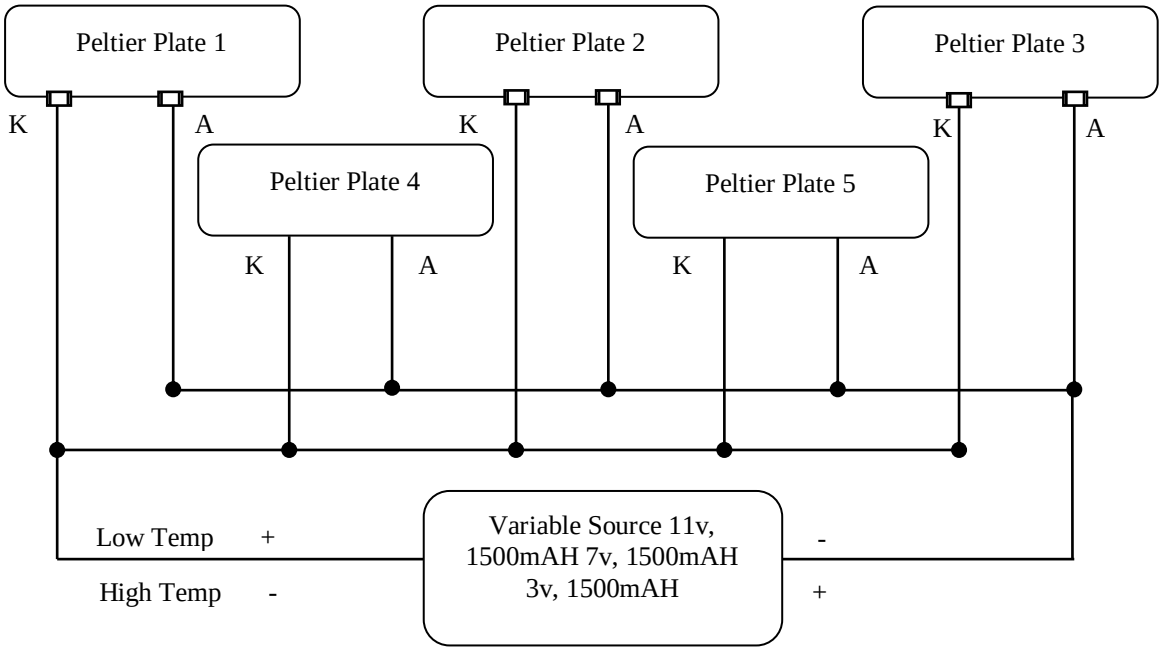

Figure 4. Circuit Diagram for Heating/Cooling Panel.

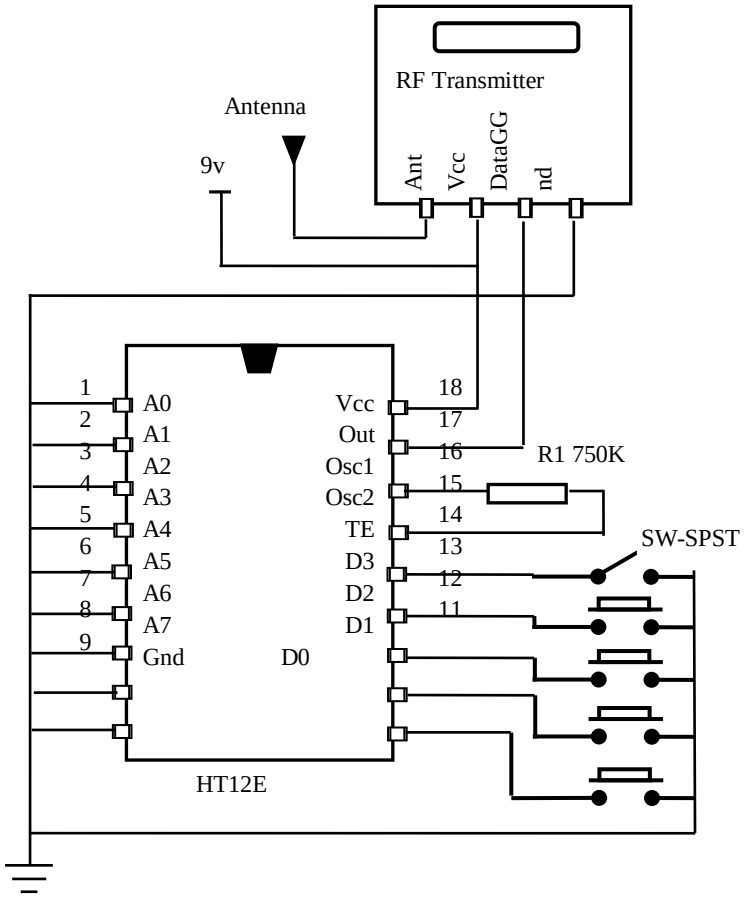

Figure 5. RF Transmitter Circuit.

Heart Rate Monitoring System

The heart rate monitoring system is equipped with pulse sensor connected Arduino and is interfaced with LCD. Sensors the beats and give data to Arduino and displace the result in LCD in these way heart rate can be continuously monitored. The Figure 6 depicts the logic for Heart Rate Monitoring program.

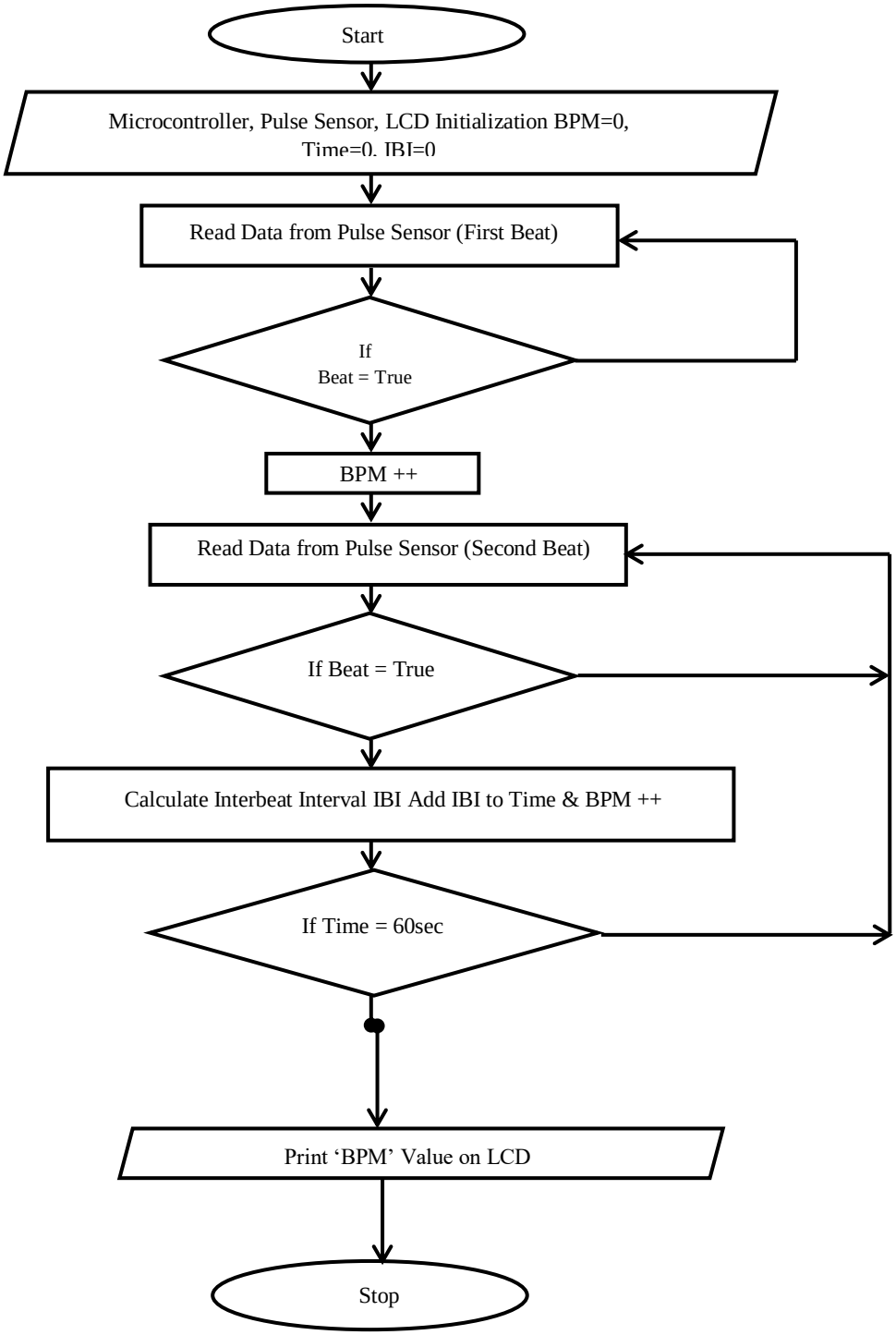

Figure 6. Heart rate monitoring.

IMPLEMENTATION

As shown in the above circuit diagrams, the peltier plates are packed inside a plastic panel which is stitched inside the jacket at the thermal points of body. Those points consist of thick arteries, such that the effective blood is sent to heart and pumped to other parts of body. In this format heating or cooling effect is developed in jacket.

Making of heating/cooling panels

Peltier plates are located in a heat proof and breathable cool mesh. The big rectangular mesh is placed at the back and two small rectangular meshes are placed on the soldier as shown in Figure 7.

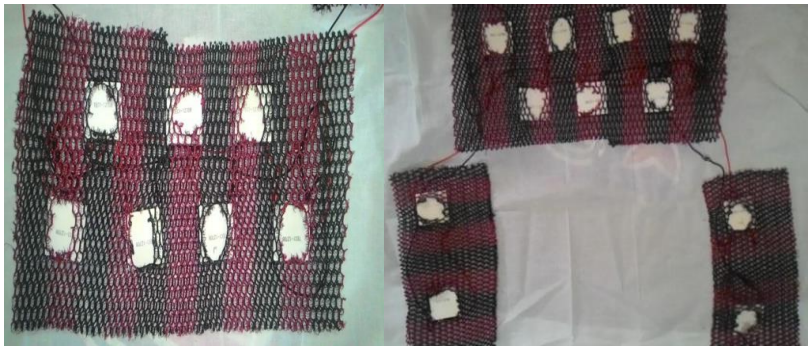

Figure 7. Peltier Plate Panels Connected.

Making of Heart Rate Monitoring System

The heart rate monitoring system is depicted from the circuit diagram. The LCD wires are extended to reach the wrist and the pulse sensor is also placed near the wrist which can be hold by figure from monitoring. The output is processed and displayed in the LCD.

Heart Rate monitoring real time simulation on a PC.

The heart rate monitoring can also be done by software known as Processing which is an open source programming language and integrated development environment (IDE). A connection should be established between Arduino and computer; the respective connection port must be specified in processing code.

Making of Device Control/ Automation

For the controlling of the electronic devices up to 100m, the device control module which is equipped RF transmitter and RF receiver is placed in the jacket. At the other wrist of the jacket the transmitter module is placed with push buttons. The receiver module is illustrated (Figure 8) by receiver circuit. The simple 5V LED represents the connected devices.

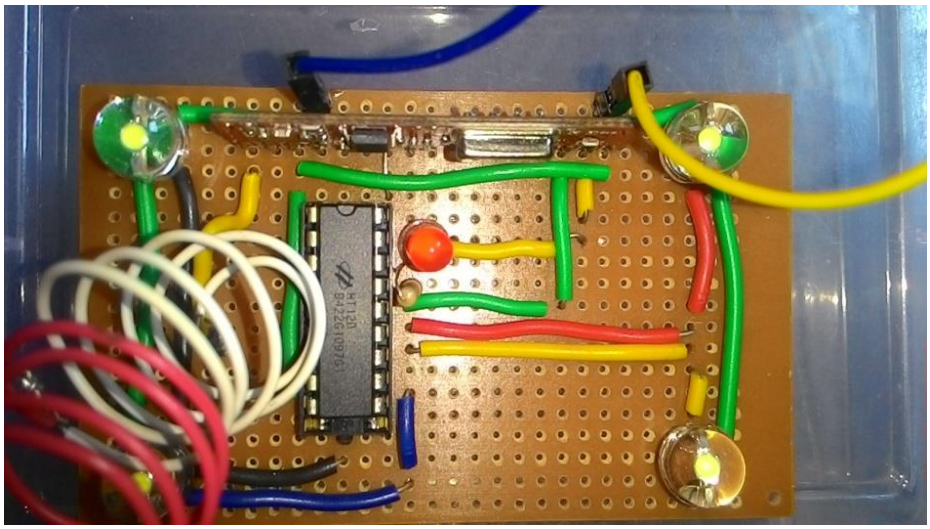

Figure 8. RF Receiver module.

The Final Smart Jacket

By presenting three diverse modules – Heating/Cooling effect, Heart rate monitoring, Device control into an attire. As the advancement of technologies, it can be used even more elegant applications.

Figure 9. Final Smart Jacket Prototype.

In Figure 9 the right arm is equipped with LCD & pulse sensor and left hand is equipped with RF Transmitter module. The Upper back & chest sides of the jacket are equipped with peltier plate panels.

RESULTS

The scope of module alters from 40 degree Celsius – 25 degree Celsius, which can be easily worn for our daily usage and could be the best textile at extreme high and low climate conditions. The Figure 10 shows the changes in the temperature at peltier plate locations.

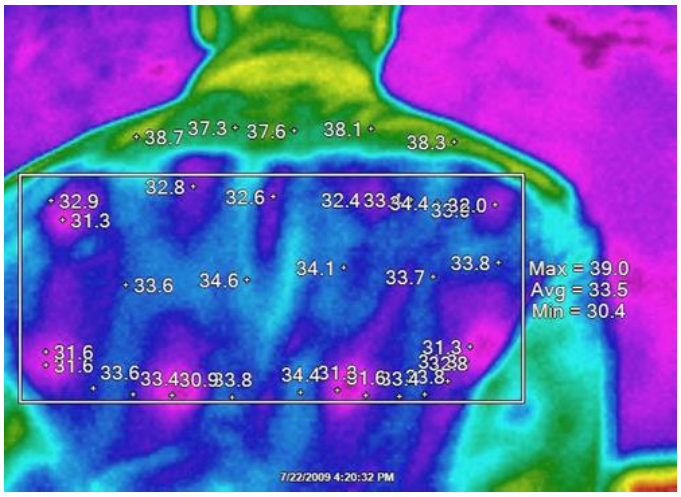

Figure 10. Change in the temperature at Peltier Plate locations.

The monitoring systems are practically tested on both hardware and software. Figures 11 and 12 depicts the result of a 25 years and 20 years person's heart pulse rate respectively.

Figure 11. 25 years aged person's heart pulse rate.

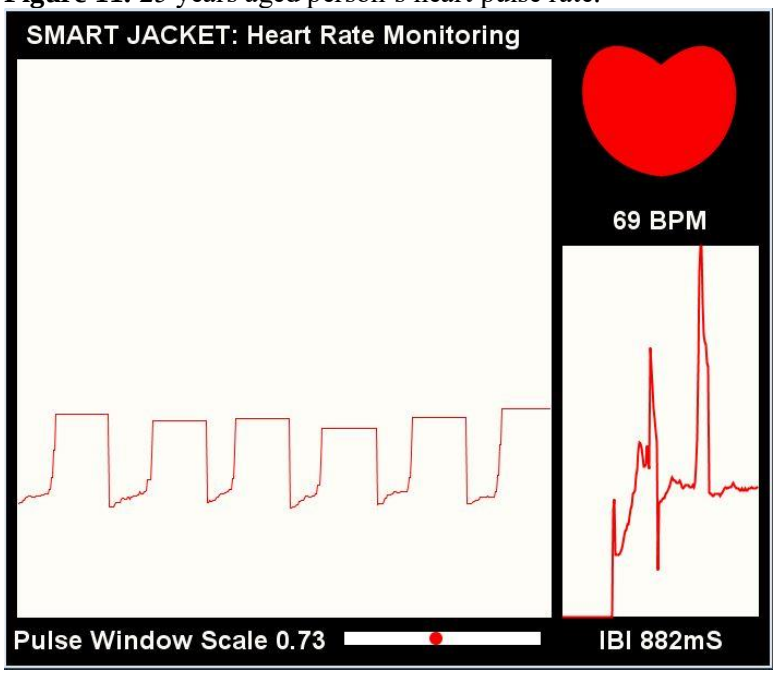

Figure 12. 20 years aged person's heart pulse rate.

The scope of circuit (Figure 13) was established in between 8-100m which works as a better alternative for our home appliances. As we are very friendly with textile, introducing technology in them can make as much better, the design of smart jacket has scope in three areas mainly.

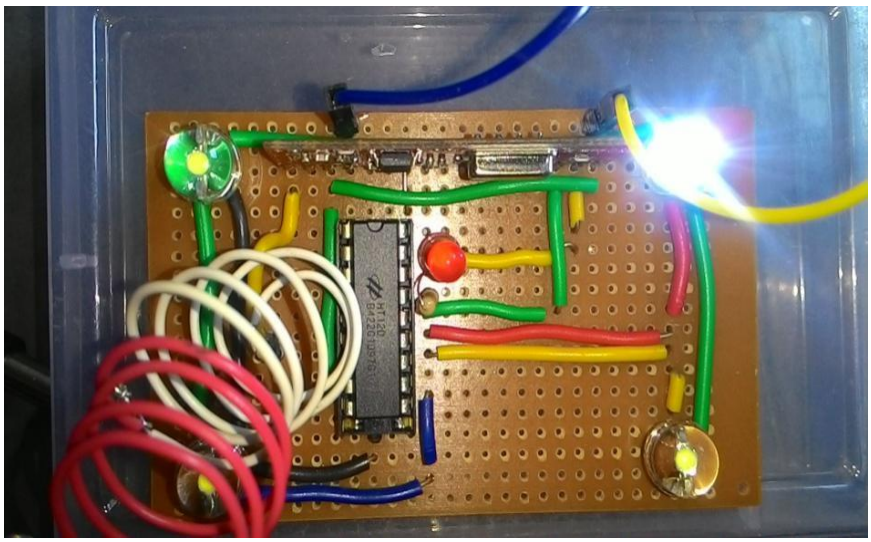

Figure 13. LED ON Condition at 80 meters range.

CONCLUSION AND FUTURE SCOPE

Heating/Cooling Effect

As every individual is busy in their own work, varying this smart textile could make much better during all climatic conditions. These can be majorly used for soldiers, as they tend to survive in extreme hot and cold conditions.

Heart Rate Monitoring

These smart jackets are more preferable to patients who have to keep track of blood pressure monitoring.

Device Control/Automation

Implementation of smart jackets in harsh climatic conditions can build new change. As the demand for technology is gradually increasing day-by-day, integration of electronics in textiles can bring a new change.

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