

Safety and Convenience Smart Jacket(SACO Jacket)

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Abstract—Travelling on road in countries like India can sometimes be very discomfoting, dreadful due to multiple factors like varying extreme weather conditions, road conditions etc. especially for women and children considering the increased crime rates against them. Also more importantly it can be often unsafe owing to the poorly maintained roads and the heavy traffics with a vast number of reckless drivers. And most of the times these accidents turns out to be a tragedy taking lives because of delayed arrival of medical assistance. And it's very unfortunate. Hence developing a system that can ensure good comfort and also safety by easily alerting the victim's friends or family and the authorities in case of occurrence of an accident right away enabling proper medical assistance at the right time felt very necessary. It's for serving that purpose the safety and convenience jacket is proposed. The jacket's heating and cooling mechanism based on peltier modules maintains the comfort level for the user respective to the external weather conditions. The thermo-regulatory system is an IoT based system. It can be controlled and monitored real-time using an Android app. Also the accident alert system employed inside the jacket offers safety to the rider. It can pinpoint the users' location and send it over to the assigned contacts/authorities whenever triggered. Also the jacket can act as a safety gadget for women when they are travelling alone or if they are someway subjected to harassment or abuse or end up in sketchy situations. This jacket can be manually triggered to alert family and friends and send SOS messages to necessary authorities along with the location. Also the buzzer attached to the system will go off alerting the people within a closer proximity. So this proposed system is a multi-utility gadget which can be very convenient and useful.

Index Terms—Peltier cooling, women safety, accident alert, smart wearable

I. INTRODUCTION

In the current global scenario, women are facing many problems like women harassment, molestation, eve-teasing, rape and kidnapping. Especially outside their homes while travelling, the rate of crimes against women increases at an alarming rate. Women are getting kidnapped at every 54 minutes, raped at every 49 minutes, 17 dowry deaths per day. As a result the proposed system introduces a safety jacket which would provide the user or the victim a panic button on its side to alert the registered contacts as well as the

nearby police station by giving an SOS message along with the tracked location with the help of GPS and GSM modules. Also, a buzzer is attached to the women safety system which when the panic switch is triggered will start to make a loud buzzing. This sound will attract the attention of the people in closer proximity hence providing immediate help.

Another important factor to be tackled while travelling on road in countries like India is the pathetic condition of the roads and the heavy traffics with a vast number of reckless drivers. The count of accident cases reported every year in India alone is around 4-5 lakhs. Also, most of the time these accidents turns out to be a tragedy taking lives because of delayed arrival of medical assistance. And it's very unfortunate. Hence developing a system that can ensure safety by alerting the victims friends or family and the authorities right away enabling proper medical assistance at the right time felt very necessary. The women safety system can also therefore be made to act as an accident alert system when necessary. Hence, it operates the same way as the women safety system does.

Unfavorable weather conditions can cause discomfort to the 2 wheeler riders. It can cause difficulties for them to travel and explore long distances under scorching heat and extreme cold conditions. Therefore an IoT based thermo regulatory system making use of peltier modules for heating and cooling is also incorporated into the jacket. It provides the user with the capability to regulate the temperature within the jacket as per his/her convenience. The temperature can be adjusted easily using the android app where the temperature change can also be monitored real time.

Our proposed systems outcome is to create a safety and convenience smart jacket for semi-automatic heating and cooling as well as for accident alert and women safety. So as a base to our work we did a long and thorough scrounging for similar products that are already available but we were unable to find a product very similar in operation and functionality to our proposed system available for commercial sale either in the online or the offline markets.

All the similar products that are already available in the commercial market are only capable of providing any one of the functionalities of our proposed system. For example there are different kinds of heating jackets available some of them rely on carbon nano-tubes for heating the jacket for regulating the body temperature of the user while some other heating jackets use coils of other metal alloys as heating element for heating up the jacket. But none of these jackets have any provision for cooling the jacket [9].

There are certain other jackets that are capable of imparting a cold sensation to the users body with the help of different mechanisms and materials such as incorporating fans into the jackets for air circulations and hence improve the rate of evaporation and impart a cooling effect to the user or use synthetic menthol gels, honeycomb fabric and other sweat absorbing fabrics which can cool the body naturally up-to a limit [10]. But none of these products are very effective and the users cannot rely on any one of these product for both heating and cooling purposes. The user will have to buy two different products for getting the complete thermo-regulatory effects of both heating and cooling which is inconvenient and more expensive.

Also none of these heating or cooling jackets that are available in the markets have got an integrated accident alert or women safety system. Again if the user wishes to have that feature also he/she will have to buy a whole another product to serve that purpose. there are several gadgets and products for the sole purpose of women safety or accident alert, they are available in different forms like watches, pendants, jackets, helmets or even pens. again they are separate gadgets or systems which are designed to perform only that specific task of accident alert or women safety.

II. EXISTING SYSTEMS

The existing systems of women safety system, accident alert and thermo regulatory heating and cooling system is analyzed and reviewed.

A. Women Safety System

The work [1] is an electronic jacket for women safety with wireless system to send an alert message along with the current location of the victim. They also have additional features of self defence with the help of shock circuit and a buzzer to alert the nearby people. In the literature survey, Pawar R, Kulabkar M, Pawar K, Tambe A, Khaimar P.S [2] has developed a smart shield for women safety. It has a number of sensors such as detecting the heartbeat of a person via health monitoring sensor and temperature sensor, in order to find the severity of the incident by measuring the heartbeat, pulse and so on. The GPS and GSM are integrated with device to send an alert notification to the emergency contacts. The work [3] is an AVR microcontroller based wearable jacket for women safety which is a combination of wearable jacket and mobile technology. This system helps to alert family members and people closest to the victim by using buzzer, GPS and GSM module. A women safety system [4] with GPS module that

tracks the latitude and longitude to trace an exact location of the victim and sends the pre-stored emergency messages including location to the registered contact numbers. The audio recording module starts recording the conversation. The camera captures the video for about 5 minutes and is been stored as evidences.

B. Accident Alert System

Accident detection using smart phones [5] detect the accident in place of automatic collision, such that it sends the accident notification to the nearby police station, to the relatives and medical authorities. The sensors in the smart phone identifies GPS location, speed and acoustic signature of the vehicle during an accident and sends this information. The work [6] is a microcontroller based road accident detection and communication system, infrared sensor is used to detect objects. In case of an accident, it determines the latitude and longitude of a position where an accident occurs through the GPS module and sends the information to the authorities through GSM. Moreover, Mohammed Baqer [7] presented a vehicle tracking system based on GPS and General Packet Radio Services (GPRS). The system used GPS to determine the position of the vehicle or fleet of vehicles. The position of the vehicle is regained using an embedded GPS sensor. Jose, Prasad and Sridhar [8] has developed an intelligent vehicle monitoring system using cloud computing and GPS. The system collects valuable information like driver conditions, fuel level and tire pressure. The build-in vehicle GPS used to transmit the vehicle position, speed in near-real-time via cellular or satellite communication to a centralized server maintained in the cloud network.

C. Thermoregulatory system

Hidayanti F, Wati EK and Anwar R [9] have developed a thermoregulatory heating jacket which can rise the temperature upto 53.1 degree Celsius used for providing comfort at very low temperatures using peltier modules utilizing seebeck effect. In the experimental set up a 6000mAh can provide power for peltier for 35 minutes. A thermoregulatory cooling jacket [10] was developed by Sivarenjini TM, Panbude A, Sathyamoorthy S, Kumar R, Maaza M, Jayabal K and Veluswamy P. using a flexible TEC module which is capable of achieving a temperature drop of 3 degree Celsius from a high ambient temperature of 35 degree Celsius with current of 0.2-0.4A and low heat transfer coefficient of 20W/m²K.

III. PROPOSED SYSTEM

The SACO jacket stands for Safety and Convenience Smart jacket. As the name suggests it is a device designed to ensure safety and comfort to the user while riding two wheelers.

The Safety and Convenience jacket is a thermoregulatory heating and cooling jacket with accident alert and women safety features Which acts as a safety device for the riders to pinpoint the location and to send an alert message along with the location with the help of a GPS and GSM module. Accident alert and women safety are two important features of the



Fig. 1. General block diagram of SACO Jacket

product. In case of any danger or physical abuse the women can hold on the trigger of the microcontroller to activate the women safety system. Accordingly it decides to send the information to the registered mobile numbers as well as to near by police station. The thermoregulation is carried out with help of a temperature sensor and peltier module. It can be controlled with the help of manual switch too.

IV. METHOD OF OPERATION

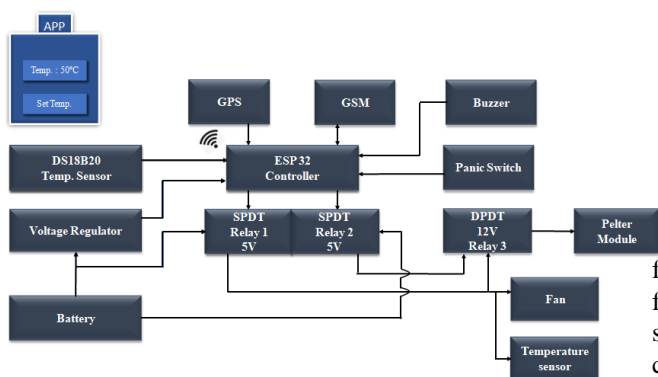


Fig. 2. Working block diagram of SACO Jacket

There are three major functions for the SACO jacket they are as follows;

- a) Thermo-regulation
- b) Accident Alert system
- c) Women Safety system

Based on these functions and the components they rely on for performing these functions the whole system inside the jacket is divided into two subsystems;

- a) Women safety and accident alert system
- b) thermo-regulatory system

Women safety and accident alert system makes use of the same components and hence is a single system. While the thermo-regulatory system which has a separate set of components except for the controller and power source makes up the second system. ESP32 WROOM microcontroller is being used as the brain for the entire system. Hence there is only one microcontroller for controlling the operations of both of the system.

The first system comprises of the micro controller to which a GPS and GSM modules along with a buzzer is connected. A switch is provided on the jacket. In case of an emergency like accident or other threats it can be triggered to send a SOS message to the pre-assigned contacts along with the location of the user. This can help in facilitating immediate medical assistance to road accident victims and also to prevent women abuse.

The second system makes use of peltier modules to heat and cool water or any other coolant. The coolant is circulated inside the jacket using mini water pump to provide necessary heating or cooling according to the need. The heating and cooling effects can be controlled using the DPDT switch provided on the jacket.

A. Women Safety and Accident alert system

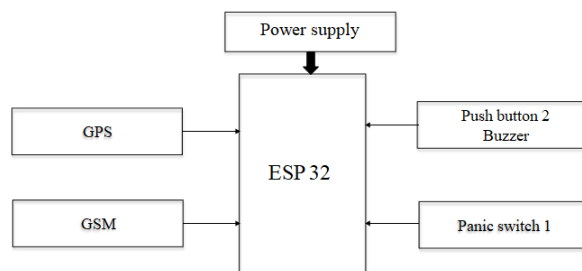


Fig. 3. Block diagram of Women Safety and Accident Alert system

Women safety and accident alert are two of the major features of SACO jacket. The same set of components are used for performing both these features hence they act as a single system that could be used in different situations. The central component of the system is the micro controller which is ESP32 WROOM. Attached to the micro-controller are NEO-7M GPS module, IOT-GA6 GSM module and a panic switch. Also a buzzer is connected along with this. A 12V 7Ah LiPo Battery is used as the primary energy source here for the prototype but a normal power bank for smart phones can be also used as a portable backup power source.

For the actual product the battery powering the two-wheeler of the rider can be used as primary energy source the power code form the jacket can be plugged into the USB charging port of the vehicle. The jacket can be plugged into the power bank when away from the vehicle. Whenever the women who is wearing the jacket feels that she is in danger or if the rider wearing the jacket meets with an accident then he or she can simply hold down the panic button provided on left hip side of the jacket. This triggers the micro-controller. As soon as the micro-controller gets activated it initiates the GPS module and grabs the location coordinates of the wearer. This tracked location of the user is then send over to the preassigned contact and the concerned authorities with the help of the GSM module. The micro-controller is pre-programmed to perform these tasks when triggered by the panic switch.

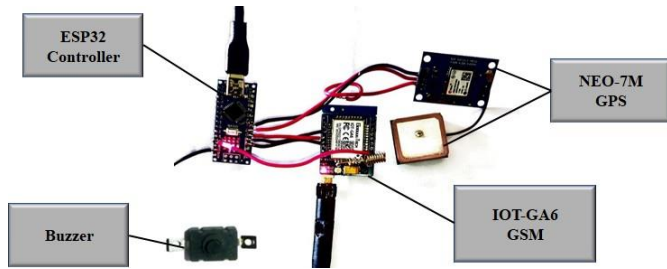


Fig. 4. ESP 32 Micro-controller Based Alert System and GPS Location Tagging System

B. Thermo regulatory system

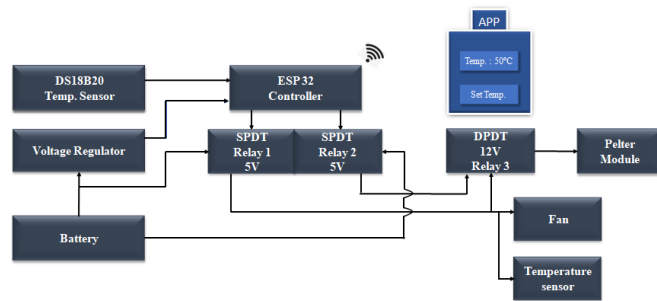


Fig. 5. Block diagram of Thermo regulatory system

The thermo regulatory system has a separate set of components except for the controller and power source. A peltier module is attached to a water cooling aluminium block and a heat sink and a high speed fan for heat dissipation. This acts as a thermo electric cooler or heater. This thermo electric cooler is then attached with a 2 meter tube connected with a self primming mini water pump for circulating the coolant. The tube is run across the front and back of the jacket in a zig zag pattern for effective spacing and thermo regulation.

A temperature sensor is attached to the peltier water cooling block and it measures the temperature and provides information to the ESP32 micro-controller. The microcontroller then send this data over to the cloud storage of the IoT based Android App called Blynk. So once the Blynk app is installed and set upped in the smart phone when opened the app UI will display the measured temperature. This will be happening real time. The temperature can be then controlled using the interface of the app according to the convenience of the user.

When the ESP32 module senses a temperature lower or greater than the ambient temperature which is 26 degree celsius, or if the temperature is tweaked manually via the Blynk app, the ESP module provides a signal to the relay which turns on the peltier module. Then it sends information accordingly to the 3 relays such that they normally turn on

the peltier or they reverse the polarity of the supply to the peltier so that the operation switches from cooling to heating. So these relays are simultaneously operated to switch between heating and cooling accordingly. The heated or cooled coolant is then circulated inside the jacket using the mini water pump. The heating and cooling can be controlled using the android app.

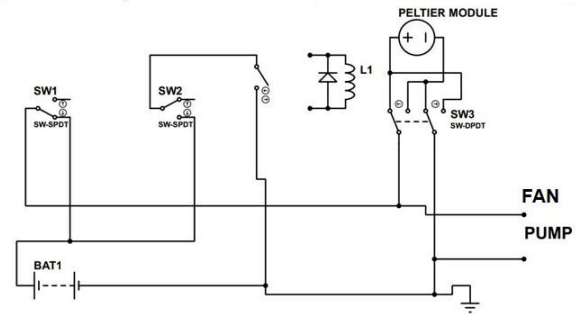


Fig. 6. Circuit diagram of Thermo-Regulatory System

V. DESIGN OF PIPE

The design of the pipe for the prototype of our proposed system was carried out with respect to the dimensions of a large sized jacket. The dimensions of the jacket is provided below. .So we need to find the heat dissipation and cooling capability in different folds of pipe in-order decide on the length of the pipe to be used. So first we took 1 meter pipe and it was placed in a zig zag manner on the back side and the chest of the jacket. then the pipe was circulated with the coolant and the temperature inside the jacket was measured. Size: LARGE

- Height: 71 cm
- Chest: 47cm
- Cross Sectional Area: 33.42m²

First the coolant was heated up 8 degrees from the room temperature and the temperature inside the jacket was measured along with the time taken top reach that temperature range. Then the temperature was reduced 8 degree Celsius and the temperature inside the jacket was measured along with the time taken for cooling.

It was observed that it took around 2 minutes for heating up the jacket to up to 5-8 deg Celsius and about 3-5 minutes to cool down the jacket temperature to up to 4-5 deg Celsius depending on the external conditions.

After experimenting this we calculated the area 1m of pipe was able to heat and cool. We find out that 1m pipe produces necessary heating/cooling for an area of 15m². So its assumed 2m pipe is necessary to produce the sufficient heating and cooling to an area of around 33m² in an ambient time of about 2-5 minutes.



Fig. 7. Dimensions of the jacket

Sl.no	Size of Jacket	Cross sectional area of jacket	Total length of pipe
1	S(43*63)cm	27.09m ²	1.67m
2	M(46*68)cm	31.28m ²	1.9m
3	L(47*71)cm	33.42m ²	2m
4	XL(48*73)cm	35.04m ²	2.2m
5	XXL(50*76)cm	38m ²	2.35m

Fig. 8. Design of Pipe

VI. ALGORITHM

- Step 1: Start
- Step 2: Initialization of women safety system which includes GPS and GSM module.
- Step 3: Women safety system is triggered with the help of switch and a buzzing sound is alerting the nearby people.
- Step 4: If the switch is ON, then it will send an alert message along with the current location using GPS and GSM module.
- Step 5: Initialisation of heating and cooling system
- Step 6: Temperature is read by the temperature sensor.
- Step 7: The data is stored in the cloud of the android app named Blynk App.
- Step 8: The data from the cloud is verified and the if condition is checked.
- Step 9.1: If the temperature is less than the set temperature, then the information is send to the relay and starts cooling by switching on the peltier module.
- Step 9.2: If the temperature is greater than the set temperature, then the information is send to the relay hence starts heating.
- step 10: Stop

VII. RESULT AND DISCUSSION

It is observed that the practically thermo regulatory system is capable of reducing the temperature upto 5 to 8C. It's observed that the heating of system to ambient level only takes around 2 minutes. While for downing to 5-8C takes up about 5 to 6 minutes depending on the external conditions and the coolant used. It was calculated and verified that 2 TEC modules were sufficient to produce the necessary heating and

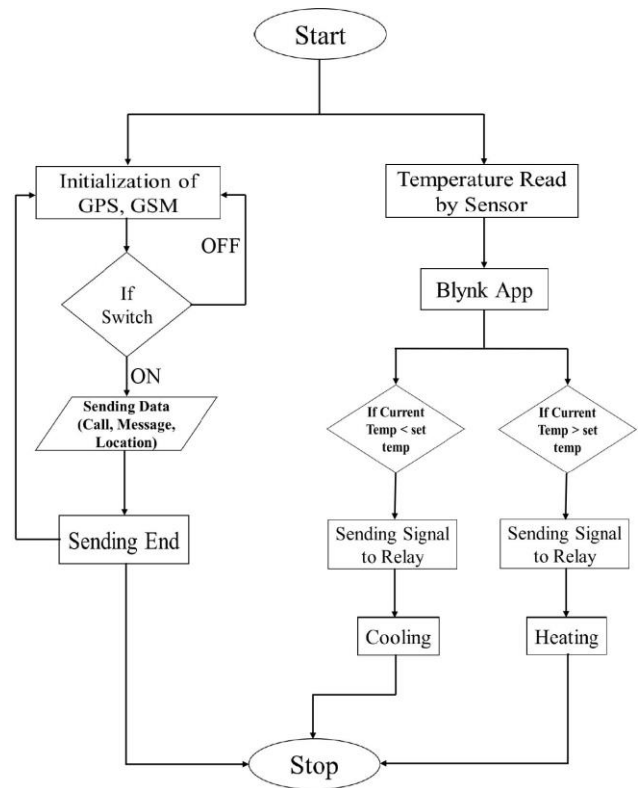


Fig. 9. Flow chart

cooling. The jacket was also capable of accurately pinpointing the location of the user along with text and call alerts.

An android app named Blynk app is developed in order to set up the thermo regulatory mechanism of heating and cooling. The real time temperature inside the jacket is monitored time to time. The hence collected data is stored in the data cloud. From the cloud the data is taken and hence is compared with the set temperature.

If the temperature is less than the set body temperature, then the app sends the information to the relay module to start heating by providing a signal to the peltier module. If the temperature is greater than the set body temperature then the relay module sends information to start cooling and the heat dissipation in the jacket is carried out with the help of a cooling fan. Thermo regulatory mechanism is a semi automatic device such that it can be operated either automatically or manually by the user itself, if the user feels discomfort.

The Blynk app can also provide a real time monitored temperature and the changes occurred due to heating or cooling is also plotted using the temperature variation curve. The curve indicates the rise in temperature during the heating using the peltier modules and it lowers the temperature when its being cooled.

Heating and cooling are the two essential needs of a thermo regulatory system. It is very helpful for the riders during the long drive irrespective of scorching heat and extreme cold conditions. The proposed system has become a need of the

hour.

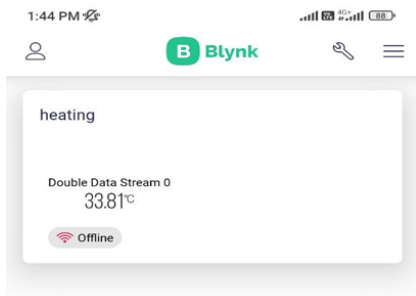


Fig. 10. Blynk App Interface



Fig. 11. Graph of Thermoregulation

VIII. HARDWARE MODEL

The developed hardware of the proposed system is shown in the figures 13- 16. The figure 13 shows the front view of the SACO Jacket. On the front side of the jacket there is a

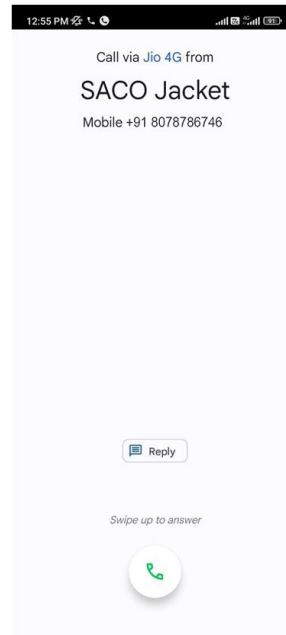


Fig. 12. Screenshot of Call alert

plug in port provided on the bottom right corner of the jacket below the pocket. Also the panic switch is provided under the hem of the jacket on the front side too. The figure 14 shows the rear side of the jacket. A small incision is made on the center-bottom portion of the jacket rear side and a high speed fan for heat dissipation is placed. It is attached to the heat-sink of the peltier module. The internals of the SACO Jacket is shown in the figures 15 and 16. The layout of the cooling and heating pipe along with the pumping mechanism and thermo-electric heating/cooling block is shown in figure 15. The last figure (fig 16) shows the electronic circuitry for controlling the entire system including Women Safety, Accident Alert and the Thermo-regulatory systems. The complete electronic circuitry is placed inside two different plastic pouches. One for placing the Women Safety and Accident Alert control system. The other one for the control circuits of the Thermo-regulatory system. Both these pouches are then stitched to the bottom right hand portion of the jacket inside.

IX. CONCLUSION

The SACO jacket developed is a product well suiting the safety needs and convenience of the people in a country like India. The thermo regulatory system employed inside the jacket is capable of increasing or decreasing the body temperature up to 5 to 8°C. Heating of the jacket can be specifically increased to upto 10°C in very cold conditions if it is necessary. The implementation of the IoT based Blynk app for the monitoring and control of the thermo regulatory system improves the convenience and makes it more easy for the product owner to use according to his/her needs. Also with the help of the Blynk app the temperature inside the jacket can be automatically maintained to a preset value which the user finds ambient for



Fig. 13. Front side of the jacket



Fig. 14. Rear side of the jacket



Fig. 15. Layout of Pipe

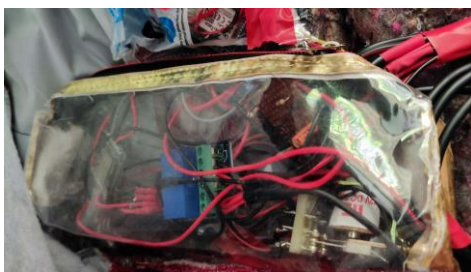


Fig. 16. Electronic Circuitry

his or her body. So each time the thermo regulatory system is turned on, the jacket automatically heats up the jacket to the preset value until the temperature is manually changed by the user.

The accident alert and women safety system incorporated into the system can give alert texts and emergency calls under life threatening situations or other critical situations of potential danger. And the whole alerting process can happen in no time as the user will only have to long press the panic switch which is embedded on the bottom left pocket of the jacket. This feature proves to be very useful owing to current social scenarios of the country. The number of women abuse cases and road accident cases are sky rocketing day by day.

Half of the pages all the newspapers printed in India are filled with these news alone. Total eradication of such grievous social issues is a very hard task to achieve with any kind of technology until we decide to change ourselves for the good.

But the advent of a product like this and its wide usage can prevent the occurrence of such events to a greater extent. Or even in worst cases even if some unfortunate situations of these sorts takes place it can be made sure that immediate assistance or medical support can be provided on the right time. Hence the product can reduce the rates of crime against women and the fatalities due to road accidents.

X. FUTURE SCOPE

The thermo regulatory system can be fully automated and be made to work by sensing the weather and automatically regulating the inside temperature with respect to the external temperature. The temperature of the air can be further lowered by employing advanced and compact heat rejection mechanism on the hot side of the peltier module and this could also help in developing even more compact systems and could be pursued as part of future studies.

Also many other women safety features like face id detection and incident capturing and live relaying can all be integrated into the women safety system as a part of future expansion. It is very much possible and it can make the system more effective.

As a part of future expansion of the system automatic accident detection using accelerometer and gyroscope also be integrated into the system making it capable of automatically detecting accidents and alerting the relatives and authorities without even requiring the accident victim to trigger it. So this will prove more useful if the rider goes unconscious as a result of the accident.

REFERENCES

- [1] Gadhave SN, Kale SD, Shinde SN, Bhosale AC. Electronic jacket for women safety. IRJET. 2017 May.
- [2] Pawar R, Kulabkar M, Pawar K, Tambe A, Khairnar PS. Smart Shield for Women Safety. International Research Journal of Engineering and Technology (IRJET) e-ISSN. 2018;5(4):56-2395.
- [3] Clement D, Trivedi K, Agarwal S, Singh S. AVR microcontroller based wearable jacket for women safety. IRJET, e-ISSN. 2016:2395-0056.
- [4] Paradkar A, Sharma D. All in one intelligent safety system for women security. International journal of computer applications. 2015 Nov;130(11):33-40.

- [5] White J, Thompson C, Turner H, Dougherty B, Schmidt DC. Wreck-watch: Automatic traffic accident detection and notification with smart-phones. *Mobile Networks and Applications*. 2011 Jun;16(3):285-303.
- [6] Prabha C, Sunitha R, Anitha R. Automatic vehicle accident detection and messaging system using GSM and GPS modem. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*. 2014 Jul;3(7):10723-7.
- [7] Kamel MB. Real-time GPS/GPRS based vehicle tracking system. *International Journal Of Engineering And Computer Science*. 2015 Aug;4(8):648-52.
- [8] Jose D, Prasad S, Sridhar VG. Intelligent vehicle monitoring using global positioning system and cloud computing. *Procedia Computer Science*. 2015 Jan 1;50:440-6.
- [9] Hidayanti F, Wati EK, Anwar R. Implementation of Peltier tiles for heating jacket. *Int J Manage Hum*. 2020;4(7):49-51.
- [10] Sivarenjini TM, Panbude A, Sathiyamoorthy S, Kumar R, Maaza M, Jayabal K, Veluswamy P. Design and Optimization of Flexible Thermoelectric Coolers for Wearable Applications. *ECS Journal of Solid State Science and Technology*. 2021 Aug 12;10(8):081006.