A

PROJECT REPORT

on

SMART WEARABLE DEVICE FOR WOMEN SAFETY USING IOT

Submitted in partial fulfilment for the Award of Degree of

BACHELOR OF ENGINEERING

IN

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CERTIFICATE

This is to certify that the project work entitled "**SMART WEARABLE DEVICE FOR WOMEN SAFETY USING IOT**" submitted by **V. HYNDAVI (160116737066)** and **N. SAI NIKHITA (160116737076)** in partial fulfilment of the requirements for the award of the degree of **BACHELOR OF ENGINEERING** in **INFORMATION TECHNOLOGY** to **CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)**, affiliated to **OSMANIA UNIVERSITY**, Hyderabad, is a record of bonafide work carried out by them under my supervision and guidance. The results embodied in this report have not been submitted to any other University or Institute for the award of any other Degree or Diploma.

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DECLARATION

We hereby declare that the research work entitled **"Smart Wearable Device For Women Safety Using IOT"** is original and bonafide work carried out by us as a part of fulfilment for Bachelor of Engineering in Information Technology, Chaitanya Bharathi Institute of Technology (A), affiliated to Osmania University, Gandipet, Hyderabad, under the guidance of **Mr. S. Rakesh**, Assistant Professor, Department of IT, CBIT, Hyderabad.

No part of this work is copied from books/journals and wherever a portion is taken, the same has been duly referred in the text. The report is based on the project work carried out entirely by us and not copied from any other source.

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ABSTRACT

There has been a significant increment in crimes against women in the previous decade. Now-a-days we often hear about molestation, eve-teasing and rape cases of women even in the public places of the society. The only thought haunting every girl is when they will be able to move freely on the streets even in odd hours without worrying about their security. Since we humans can't respond aptly in critical situations, there is a need for a device which informs our friends or relatives in time of need.

The main aim of the project is to build a smart device to automatically detect any emergency situation and send SMS with location of the person to the relatives or helpline number. This device contains various sensors like pressure sensor, temperature sensor and pulse-rate sensor to automatically detect if the person is in any danger and then uses a GPS module to access location of user instantly and GSM to send messages. The device also has a switch that is attached to any of the accessories so that the person can press it when there is an emergency.

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1. INTRODUCTION

1.1 OVERVIEW

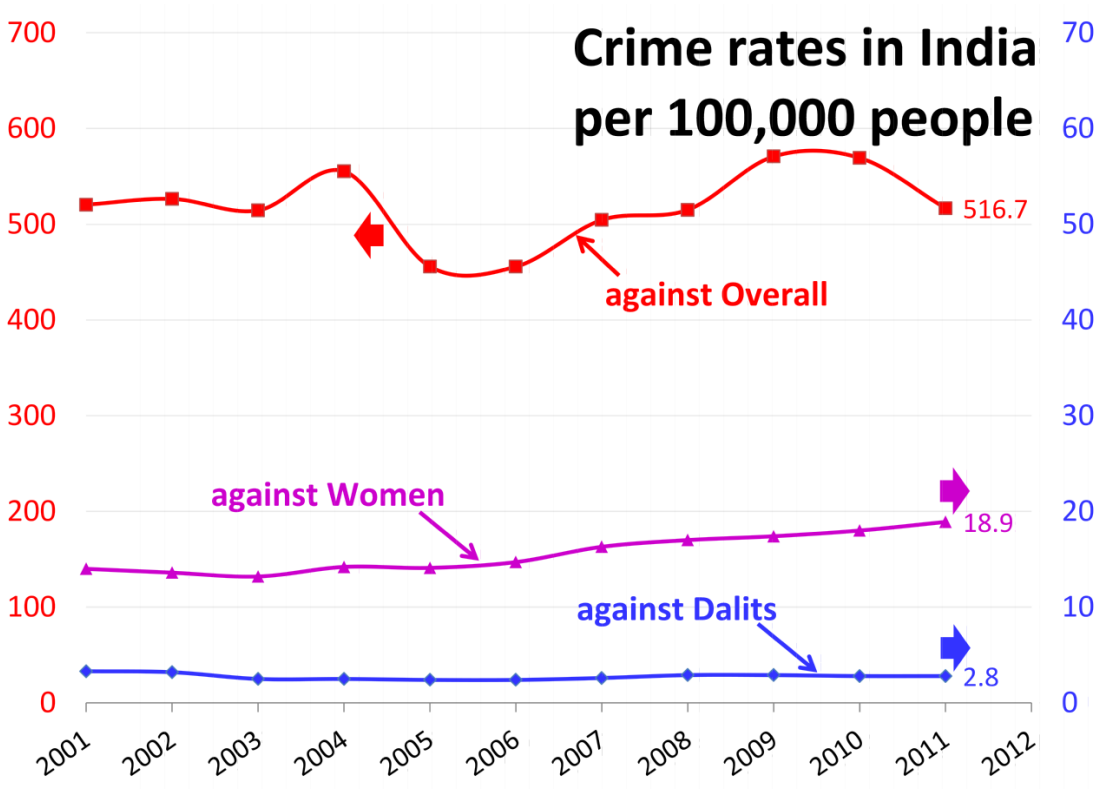
Women are the backbone of any economy primarily shaping the future of the country. She who earlier stayed at home to attend her domestic duties is now maintaining work and home simultaneously, participating in the process of economic development on an equal footing with men.

Women are the most integral part of any economy primarily responsible to shape the future of a country. Many crimes against them are not being reported because of the society's hypocritic point of view. Various types of humiliations and mistreatment is being faced by the victims who try to report their assaults from society. Only one of four cases lead to conviction trials in India. Proper precautions should be taken in order to build the best solution to this problem. So his paper proposes an IOT based smart wearable for the safety of women. The device is used to automatically detect such situations and inform the related persons. It not only helps women escape the critical situations but also ensures to provide justice to the women by helping them in times of need.

The Government of India, meeting a longstanding demand for gender parity in the workforce, has approved an amendment in The Factories Act 1948 to allow women employees to work in night shifts. The amendment suggests that night shift for women shall be allowed only if the employer ensures safety, adequate safeguards in the factory as regards occupational safety and health, equal opportunity for women workers, adequate protection of their dignity, honour and transportation from the factory premises to the nearest point of their residence are met.

Night Shifts have been in existence for a long time, however for India it was only recently through an amendment to the Factories Act 1948 that it was allowed under the law for women to work night shifts. Women are participating in almost all the spheres of economic activity. From village to city, we can see a number of women workers and entrepreneurs contributing towards the national income of the country. Garment units already employ 60% of the women workforce; and with growth in this industry the number will go up tremendously. So far, the IT sector were employing women for late-night work hours but had no legal obligation to provide the above safety measures.

Graph 1.1: Crime rates in India



The map(see Graph above) shows the comparative rate of violence against women in Indian states and union territories in 2012, based on crimes reported to the police. Crime rate data per 100,000 women in this map is the broadest definition of

crime against women under Indian law. It includes rape, sexual assault, insult to modesty, kidnapping, abduction, cruelty by intimate partner or relatives, trafficking, persecution for dowry, dowry deaths, indecency, and all other crimes listed in Indian Penal Code.

There is no denying the fact that women in India have made considerable progress in almost seven decades of Independence, but they still have to struggle against many handicaps and social evils in the male-dominated society. Many evil and masculine forces still prevail in the modern Indian society that resists the forward march of its women folk.

With the onset of IT&BT industry, women work in night shifts, it is the responsibility of the firm to provide office transportation to such employees. Corporates must play their part by ensuring they have effective policies to deal with sexual harassment at the workplace. They must also work on their organisational culture to prevent a hostile work environment for women. Now a days even though the companies provide the facilities for transportation, but the security of the women is not fully ensured as one of the incident occurred in the year 2007 at Pune where a girl working in the call centre was brutally raped by two of her cab drivers assigned by the company, not only this we have come across many of the same incidents in the recent times where the safety of the women cannot be fully ensured with the cab facilities provided by the companies.

Among the worst countries in crime, India has an abhorrent track record in all forms of sexual exploitation. In homes, on streets, in public transports and even offices. Indian women are in a constant state of vigilance, like a country on terrorist alert. There have been grotesque cases of rapes of toddlers, gang rape of eight years old and women trafficking. We have created a nation where women are learning to cope with existential anxiety and we should be ashamed.

Fig 1.1 Violence against Women

India is considered to be the world's most dangerous country for sexual violence against women. Rape is one of the most common crimes in India. Criminal Law (Amendment) Act, 2013 defines rape as penile and non-penile penetration in bodily orifices of a woman by a man, without the consent of the woman.According to the National Crime Records Bureau, one woman is raped every 20 minutes in India. Incidents of reported rape increased 3% from 2011 to 2012. Incidents of reported incest rape increased 46.8% from 268 cases in 2011 to 392 cases in 2012. Despite its prevalence, rape accounted for 10.9% of reported cases of violence against women in 2016.

Victims of rape are increasingly reporting their rapes and confronting the perpetrators. Women are becoming more independent and educated, which is increasing their likelihood to report their rape. Although rapes are becoming more frequently reported, many go unreported or have the complaint files withdrawn due to the perception of family honour being compromised. Women frequently do not receive justice for their rapes, because police often do not give a fair hearing, and/or medical evidence is often unrecorded which makes it easy for offenders to get away with their crimes under the current laws. Increased attention in the media and awareness among both Indians and the outside world is both bringing attention to the issue of rape in India

and helping empower women to report the crime. After international news reported the gang rape of a 23-year-old student on a moving bus that occurred in Delhi, in December 2012, Delhi experienced a significant increase in reported rapes. The number of reported rapes nearly doubled from 143 reported in January–March 2012 to 359 during the three months after the rape(see Table 1.1). After the Delhi rape case, Indian media has committed to report each and every rape case.

Table 1.1 :Statistics of rape in India

Year	Reported rape
2008	**21,467**
2009	**21,397**
2010	**22,172**
2011	**24,206**
2012	**24,923**
2013	**34,707**
2014	**36,735**
2015	**34,651**

A lot of NGOs, rehabilitation centres and helpline numbers have been made operational in the past years but they are all cures to the harassment that has already

happened and not the ‘preventions’ that we need. There are certain pre-existing apps that do send a message to the saved contacts but none of them is effective and quick enough and according to a survey, the existing technology doesn’t make most women feel safe. A major change in the basic structure and a few add-ons to these is a necessity. In a lot of cases, it is observed that women do not file a complaint against the accused because of various reasons like not knowing the correct authority to report it to or feeling ashamed/guilty about the incident.

The only solution to the problem can be taken in such a way that women should be assigned with a safety gadget that is portable and ensures her safety. Our project focuses on providing a Smart gadget based on IoT solutions that not only helps to woman escape the critical situations but also ensures to provide justice to the women by helping them in times of need.

Fig 1.2 Image depicting to stop violence against women

Swami Vivekananda, one of the greatest sons of India, quoted that, “There is no chance for the welfare of the world unless the condition of women is improved. It is not possible for a bird to fly on only one wing.” Therefore, the inclusion of “Women Empowerment’ as one of the prime goals in the eight Millennium Development Goals underscores the relevance of this fact. Thus, in order to achieve the status of a developed country, India needs to transform its women force into an effective human resource and this is possible only through the empowerment of women.

1.2 MOTIVATION

In the present scenario women are competing with men in every prospect of society. Women contribute fifty percent to the development of our nation. But the women have fear of getting harassed and killed. All these types of women harassment cases are increasing day by day. So, it is very important to ensure the safety of women. Our proposed model aims to provide a required safety to women so that they can work late nights.

1.3 PROBLEM STATEMENT

The present era is with equal rights, where both men and women are taking equal responsibility in their respective works. They are assigned works in both the even and odd shift. Every single day women and young girls from all walks of life are being assaulted, molested, and raped. At any emergency situation people get panicked and, in that situation, they may not be able to operate their smartphone applications, and cannot immediately defend the attacker and protect themselves.

Hence there is a need to design a prototype which comes to help instantly in dangerous times and the modal should be working as a safeguard in times of need. The proposed system can be useful for women and children for security purposes. It consists of a wearable safety device having sensors and an emergency button which

when activated sends an alert message with location information to the victim's family and nearby police station.

1.4 OBJECTIVE

The main objective of the project is to develop a smart wearable which comes handy in times of need for women. The smart wearable need to be sophisticated enough to detect the alert mechanism in the right time whenever the women is in harm's way. When the alert mechanism is triggered corresponding relatives should the alert message

1.5 APPLICATIONS

- Provide parents with a sense of security for their child in today's time.
- Can be used for the safety of physically challenged & elderly aged people.
- Useful for soldiers to report any activity.
- Ensures women's safety.
- Can be used as a legal evidence of crime with exact location information for prosecution

1.6 FEATURES

- Small and easy to use
- Real Time Notification
- 24*7 alerts from anywhere

1.7 ORGANIZATION OF THE REPORT

Section 1 deals with the Introduction of the Project and the problem statement of the Project.

Section 2 discusses about the literature survey of this project which includes some of the previous research papers.

Section 3 deals with the Methodology and Design. Detailed Analysis on used Algorithms is also given.

Section 4 deals with the implementation of the proposed system.

Section 5 gives the results of the project, the way the proposed algorithm is working.

Section 6 discusses the conclusion and the further work. Limitations and Possible extensions are also discussed.

2. EXISTING SYSTEM

In the existing system there is no such monitoring system for women. However, there are some places which are prone to molestation where CCTV cameras are fitted and the recording is stored to the cloud. This system is not useful by any means to prevent the situation. It can only be used to act after everything has happened.

The only way for them to ask for help is to use their mobile phone to send a message to their friends and family. In the heat of the moment most of the women find it difficult to get a hold of their mobile phone. Even if they do, it is difficult to send a message quickly before anything brutal happens. It is also very unreliable.

It should create many problems for them and the no safety mechanism to protect the girls from the misbehaviour activities. In addition, in the existing system there is no alert mechanism for the girl's safety, it should be done by manually only.

The disadvantages of existing systems are as follows:

- Not very reliable
- Need manual effort
- Expensive

2.1. LITERATURE SURVEY

Our idea of the proposed system is based on the base paper of Naeemul Islam , Md. Anisuzzaman , Sikder Sunbeam Islam , Mohammed Rabiul Hossain , Abu Jafar Mohammad Obaidullah "Design and Implementation of Women Auspice System by Utilizing GPS and GSM" [1] which is employed using PIC16F876A microcontroller and a SIM808 module, which has GPS, GSM and GPRS support which are used to notify the friends and family when the emergency button is pressed. Advantages are

Useful for all types of crimes, Simple and cost effective. Disadvantages are Manual process ,Size of device.

S. A. More, R. D. Borate, S. T. Dardige, S. S. Salekar, Prof. D. S. Gogawale "Smart Band for Women Security Based on Internet of Things (IOT)" [2] discusses using temperature sensors and pulse rate sensors to automatically detect a chance of a possible situation and notify family and friends using a mobile application.

Mohamad Zikriya, Parmeshwar M G, Shanmukayya R Math, Shraddha Tankasali, Dr. Jayashree D Mallapur "Smart Gadget for Women Safety using IoT (Internet of Things)" [3] discusses the usage of image processing to detect any possibility of a danger and proposes various solutions to protect herself.

With reference to S. Ruiz, L. Negredo, A. Ruiz, C. García-Moreno, Ó. Herrero, M. Yela, et al., "Violencia de género" [4], battered intervention programs were opened for psycho-educational intervention of men that used the violence toward their partner or ex-partner. This was proposed in Spain, Costa Rica and Chile.

With reference to Remya George, AnjalyCherian.V, Annet Antony, Harsha Sebestian, Mishal Antony, Rosemary Babu.T "An Intelligent Security System for Violence against Women in Public Places ". [5], a facial expression analysing system was developed to report the threat based on facial expressions of danger. The camera captured images of the people and instantaneously the expressions of the people captured in those images were analysed. On detection of the expressions which showed fear, a threat report was filed. This system was proposed to be installed in railway stations, bus stations, shopping centres etc.

With reference to B.Vijayalakshmi, Renuka.S, Pooja Chennur, Sharangowda.Patil "Self defence system for women safety with location Tracking and SMS alerting through GSM network". [6], a self defence system was developed with GPRS (General Packet Radio Service) location tracking and Short Message Service (SMS) alerting through GSM networks. In this system the SMS contained information only about the victim location and the body posture of the victim. These messages will be sent to the predefined emergency numbers. In case if the caretaker wants to know the present location of the user, he/she can do so by sending a SMS to the SIM(Subscriber Identity Module) number of the lady which contains a secret password.

"Women safety device and application" [7]. In this paper an ARM controller and Android application are used in which both the device and the smartphone are synchronized using Bluetooth, hence both can be triggered independently. It can record audio for further investigation and can give an alert call and message to the preset contacts with the instant location every 2 minutes and can be tracked live using the application. Hidden camera detectors are also a distinct feature used which ensures privacy.

"A mobile-based women safety application (I safe Apps)" [8]. In this paper, a mobile-based application (I safe apps) is developed with Android support to know whether a woman is safe. It gives the location of the woman in danger by giving fake phone calls, video forwarding, location and first-aid information.

"Advanced Security system for women" [9]. The paper proposes an automated highly reliable women security device which consists of advanced sensors embedded in a wearable dress. It consists of advanced sensors and ATMEGA8 microcontroller with Arduino tool which keep the user under observation at all the time. It monitors the heartbeat rate, temperature and vibration in the body through sensors to check for uneasy situations.

In [10], Woman safety, the system has different sensors like heartbeat sensor, temperature sensor, accelerometer sensor for detecting the heartbeat, temperature and sudden change in motion of the user. GPS and GSM which will help to detect the location of the device and to send an alert message to guardians, relatives and police stations.

2.2. DISADVANTAGES OF EXISTING SYSTEM

- All the existing systems must be connected to the GPRS service to work properly, hence cannot be used during emergency if there is no internet connectivity.
- There is no hidden camera detector which is portable to ensure our privacy.
- Monitoring was tedious.
- Mischance in arriving rate.
- The whole process is manual and needs to be automated

3. SYSTEM DESIGN

Now-a-days women security is the main concern in the society. So, there is a need to build a system that can respond faster and provide security to the women in problem. Our proposed system hands over a wearable to the woman which contains a pressure, heartbeat sensor along with Arduino, GSM and GPS to detect a possible molestation and notify her friends and family through a message containing the location of the victim. We also provide a button on the wearable to manually be able to send a notification if the victim could react.

3.1 BLOCK DIAGRAM

The block diagram of the system we have proposed (see Fig.3.1.) shows all the components required for the device. To automatically detect any atrocity, we are using three sensors i.e. pressure, temperature, pulse-rate sensors. The pressure sensor is used to detect if any pressure is being applied on the woman beyond an acceptable limit. The temperature sensor is used to detect any deviation in the temperature. The pulse-rate sensor is used to detect abnormalities in the pulse-rate of the woman. The reading from these three sensors are combinedly used to detect any critical situation. The device also provides a push button for the woman to press when she feels unsafe. When any of the two above mentioned events occurs, the buzzer is activated to alert the people around her that the woman is in a dangerous situation and then the location of the woman is detected using the GPS module and GSM is used to send the message to the relatives.

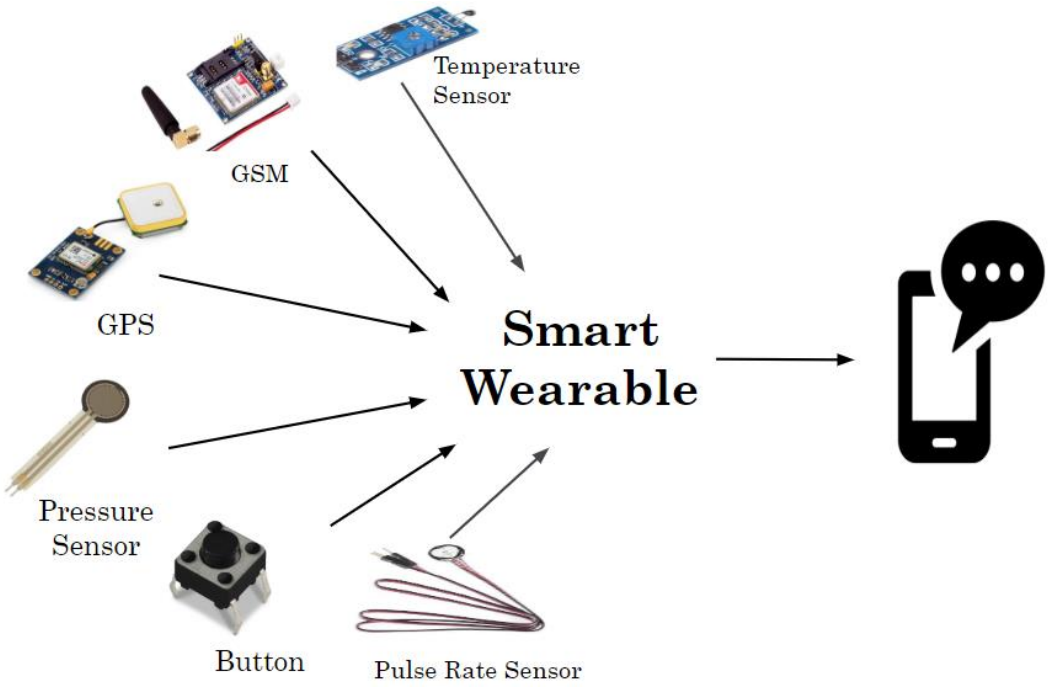


Fig 3.1 Block diagram of proposed model

3.2 COMPONENTS USED

The model consists of the following units which monitor the situation and act accordingly

A. GSM Module (SIM900)

B. Arduino UNO

C. GPS Module

D. BLE Button

E. Pressure sensor

F. Pulse rate sensor

G. Temperature sensor

H. Buzzer

I. Power Supply

3.2.1 GSM Module (SIM900):

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA).

GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band. GSM is used to transfer the signal from smart band to smart phone and also used to send emergency messages to family members, friends and nearby police stations.

The SIM800A Quad-Band GSM/GPRS Module(see Fig. 3.2) with RS232 Interface is a complete Quad-band GSM/GPRS solution in an LGA(Land grid array) type which can be embedded in the customer applications. SIM800A support Quad-band 850/900/1800/1900 MHz, it can transmit Voice, SMS and data information with low power consumption.

With a tiny size of 100 x 53 x 15 mm, it can fit into slim and compact demands of custom design. Featuring and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

The SIM800A modem has a SIM800A GSM chip and RS232 interface while enables easy connection with the computer or laptop using the USB to the Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800A modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manager of the USB to Serial Adapter.

Then you can open Putty or any other terminal software and open a connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your micro-controller you can start sending the AT commands. When you send AT commands for example “AT\r” you should receive a reply from the SIM800A modem saying “OK” or other response depending on the command sent.

Fig 3.2 GSM Module

3.2.2 Arduino UNO:

Arduino(see Fig.3.3)is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything

needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Original Arduino Uno Rev3 board is the first in a series of USB Arduino boards and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Fig 3.3 Arduino UNO

3.2.3 Push Button:

The pushbutton(see Fig. 3.4) is a component that connects two points in a circuit when you press it. We connect three wires to the Arduino board. The first goes from one leg of the pushbutton through a pull-up resistor (here 2.2 KOhms) to the 5-volt supply. The second goes from the corresponding leg of the pushbutton to ground. The third connects to a digital i/o pin (here pin 7) which reads the button's state.

When the pushbutton is open (not pressed) there is no connection between the two legs of the pushbutton, so the pin is connected to 5 volts (through the pull-up resistor) and we read a HIGH. When the button is closed (pressed), it makes a connection between its two legs, connecting the pin to ground, so that we read a LOW. (The pin is still connected to 5 volts, but the resistor in-between them means that the pin is "closer" to ground.)

Fig 3.4 Push Button

3.2.4 Pressure Sensor:

Pressure sensor(see Fig 3.5) is used to check for any situation. When the threshold of the pressure sensor crosses, the device will be activated automatically. This is a force sensitive resistor with a round, 0.5″ diameter, sensing area. This FSR will vary its resistance depending on how much pressure is being applied to the sensing area.

The harder the force, the lower the resistance. When no pressure is being applied to the FSR its resistance will be larger than 1MΩ. This FSR can sense applied force anywhere in the range of 100g-10kg.

Two pins extend from the bottom of the sensor with 0.1″ pitch making it bread friendly. There is a peel-and-stick rubber backing on the other side of the sensing area to mount the FSR. Just Connect a resistor to form a voltage divider and measure the voltage at the junction to find the force applied.

These sensors are simple to set up and great for sensing pressure, but they aren't incredibly accurate. Use them to sense if it's being squeezed, but you may not want to use it as a scale. This sensor can be easily interfaced with Microcontrollers, Arduino Boards, Raspberry Pi, etc. using an Analog to Digital Converter (ADC).

Fig 3.5 Pressure sensor

3.2.5 GPS Module:

The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no subscription fees or setup charges

GPS module(see Fig. 3.6) is used to track the current location of the victim with the help of latitude and longitude of the receiver. This is a complete GPS module that

is based on the Ublox NEO-6M. This unit uses the latest technology from Ublox to give the best possible positioning information and includes a larger built-in 25 x 25mm active GPS antenna with a UART TTL socket. A battery is also included so that you can obtain a GPS lock faster. This is an updated GPS module that can be used with ardupilot mega v2. This GPS module gives the best possible position information, allowing for better performance with your Ardupilot or other Multirotor control platform.

The Ublox NEO-6M GPS engine on this board is a quite good one, with a high precision binary output. It has also high sensitivity for indoor applications. UBLOX NEO-6M GPS Module has a battery for power backup and EEPROM for storing configuration settings. The antenna is connected to the module through a ufl cable which allows for flexibility in mounting the GPS such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications.

The Ublox GPS module has serial TTL output, it has four pins: TX, RX, VCC, and GND.

Fig. 3.6 GPS module

3.2.6 Temperature Sensor:

NTC Thermistor temperature(see Fig. 3.7) sensor module is low cost, small size module. It is very sensitive to ambient temperature. It is generally used to detect the temperature of the surrounding environment. Through potentiometer adjustment, it is possible to change the temperature detection threshold. DO output can be directly connected to the microcontroller to detect high and low, by detecting temperature changes in the environment. The temperature detection range of the module is between 20 and 80 degrees Celsius. This module can be replaced with a line temperature sensor for controlling the water temperature, water tank, etc. Generally the 4 wire method of thermistor measurement is the most accurate, because there is effectively no current flowing in either of the measurement cable wires and therefore no added resistance due to the cable wires.

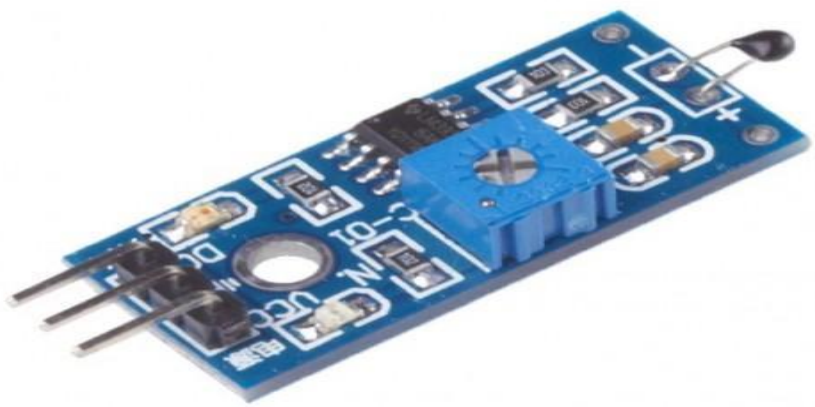


Fig. 3.7 NTC Thermistor Temperature Sensor Module

3.2.7 Pulse Rate Sensor:

Pulse Sensor(see Fig. 3.8) is a low cost, very small size plug-and-play heart rate sensor for Arduino and Arduino compatible boards. It can be used by students, artists,

athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects.

Pulse Sensor Amped adds amplification and noise cancellation circuitry to the hardware. It's noticeably faster and easier to get reliable pulse readings. Pulse Sensor works with either a 3V or 5V Arduino.

A Color-Coded Cable, with a standard male header connectors. Plug it straight into an Arduino or a Breadboard. No soldering is required. An Ear Clip, perfectly sized to the sensor. It can be hot-glued or epoxied to the back of the sensor to get reading from an ear lobe. Parts to make a handy Velcro finger strap. This is another great way to get heart-rate data

Fig. 3.8 Pulse Sensor

3.2.8 Buzzer:

This(see Fig 3.9) is Small PCB Mountable 5V Passive Buzzer. It is great to add Audio Alert to your electronic designs. It operates on 5V supply, uses a coil element to generate an audible tone. An Active Buzzer Alarm Module for Arduino is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Just

like what you are viewing now, it is a 3.3V-5V DC Electronic Part Active Buzzer Module. Using top quality material, it is durable in use.

An active buzzer rings out as long as it is electrified. Compared with a passive buzzer, it is a bit expensive but easier to control. Typical uses of buzzers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Fig. 3.9 Buzzer

3.2.9 Power supply:

A 12 V rechargeable Li-ion battery (see Fig. 3.10) is used to provide the power supply to the controller which in turn feeds the required power to all the sensors and modules connected to it.

Fig. 3.10 Power Supply

4. IMPLEMENTATION

The overall design of the prototype includes a smart wearable which consists of an Arduino, GSM module, GPS module, BLE button and sensors like pressure and pulse rate sensors**.**

The whole design is based on the idea that the BLE button when pressed gives the indication to the Arduino that a signal should be sent to the emergency contacts in the form of a message. When the button is pressed the coordinates, which are the exact longitude and longitudes are obtained using the GPS module which are converted to a google URL and then the GSM module comes in to send the messages to the concerned contacts.

As we can observe that this whole process takes place when the victim manually presses the button. But there might be cases where the victim is not in a position to press the button, so we are automating the system by introducing sensors which don't require manual intervention.

The sensors which we are used to automate the messages are pulse rate and pressure sensors. Any case of excessive touch and pressure on the victim leads to indicate that there is an emergency condition and then automatically GPS and GSM modules come into help to send the messages to the emergency contacts.

In this way the smart wearable can be worked in both ways manually and automatically. The pressure ,temperature and pulse rate sensor values are recorded every 10 sec and sudden change in these values resulting in abnormality of the previously recorded values indicates the emergency situation.

The process flow can be divided into three mechanisms :

4.1. FLOWCHARTS

4.1.1 Manual mechanism

Manual mechanism (see Fig.4.1) is the process flow which occurs when the women are in a situation to respond. It contains a button which can be pressed by the woman when she feels unsafe. When the button is pressed, the buzzer is activated to make a loud noise to alert the people around who can help her. Then the alert mechanism is triggered.

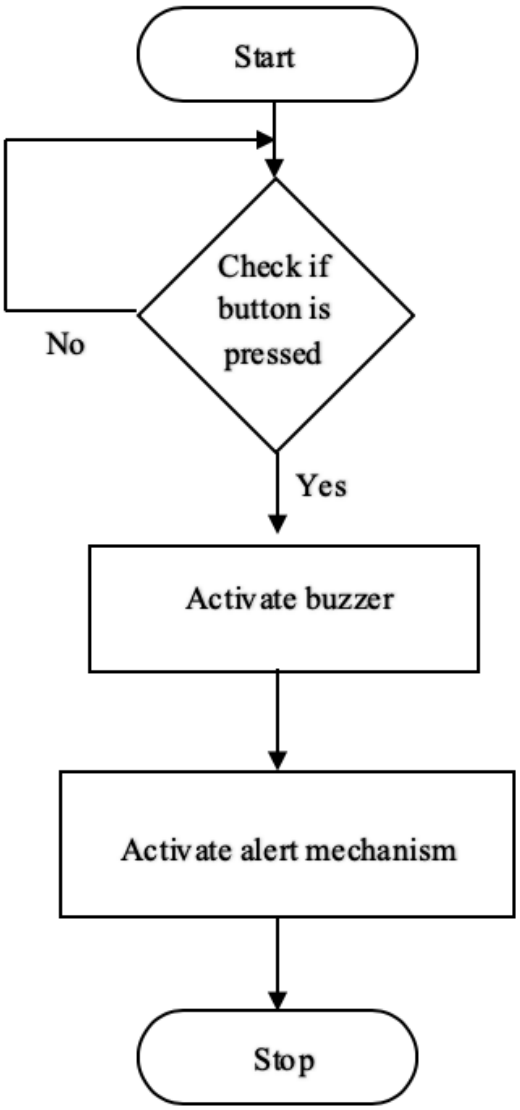


Fig.4.1 Flow chart of manual mechanism

4.1.2. Automated mechanism

In most of the situations, the woman may not be able to react and use the manual mechanism. So, we automate the mechanism using pressure, temperature and pulse-rate sensor (see Fig. 4.2). We use a conjunction of the readings of these sensors to avoid false positives. When any of the two sensors detect an abnormality, the alert mechanism is activated

The pressure sensor is a force sensing resistor sensor (FSR). With a small increase in force the resistance decreases exponentially. The resistance value is converted to analog voltage which ranges between 0-5V.

Table 4.1: Analog voltage output based on force applied on pressure sensor

Force (N)	FSR Resistance	Voltage
None	Infinite	0V
0.2N	30Kohm	1.3V
1N	6Kohm	3.1V
10N	1Kohm	4.5V
100N	250Kohm	4.9V

We followed a trial and error method to find the thresholds of the sensors after taking the normal and abnormal values for all the three sensors. Whenever the sensors readings cross the thresholds values then they become HIGH. The voltage output of pressure sensor for various types of activities such as a normal touch, pushing etc. were observed during this process. For a force which may be considered dangerous, about 4V analog output was shown which is around 5N force(see Table 4.1).

The temperature sensor is used to measure the temperature of the surroundings. As a person comes closer into the personal space of the victim, the temperature surrounding her increases. So, we have integrated a temperature sensor in such a way that it goes high when there is a sudden increase in the temperature around the woman. The pulse-rate sensor goes high when the heart rate crosses 90bpm.

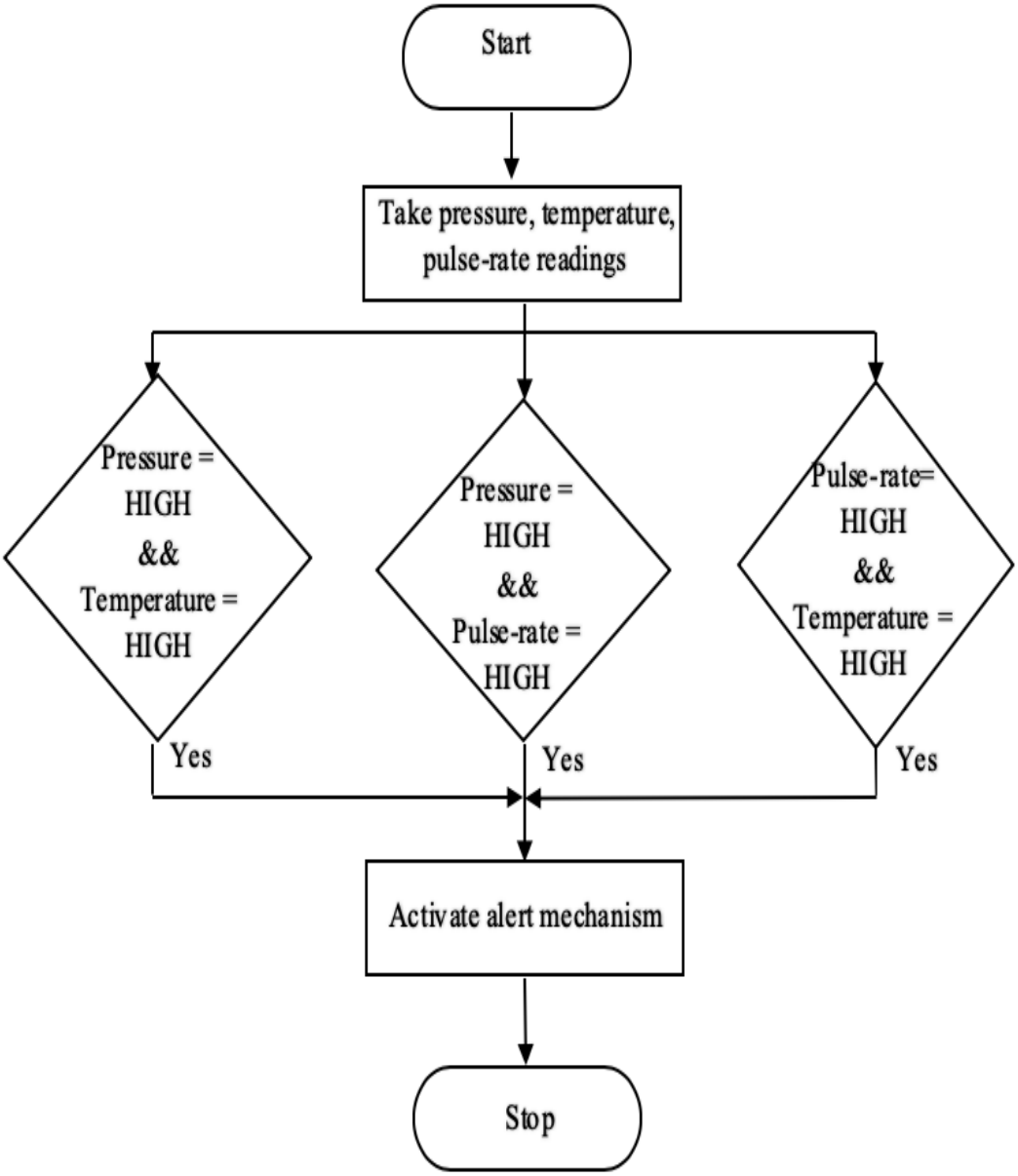


Fig.4.2 Flow chart of automated mechanism

4.1.3. Alert mechanism

Alert mechanism is triggered through one of the above mechanisms during a hazardous event. When the alert mechanism is triggered, GPS and GSM are used to send the message containing the location of the victim to relatives and officials. The location is sent as a Google Maps link for easy access.

The system architecture of the alert mechanism is shown in Fig. 4.3. The location coordinates are received from the GPS module whenever the alert mechanism is triggered. The GPS gets the location coordinates from the satellite. As these coordinates are difficult to interpret, we are converting the location coordinates into a google maps link for easy access. After the coordinates being received a google link is formed which contains the victim's location. This link is sent to the registered numbers with the help of GSM.

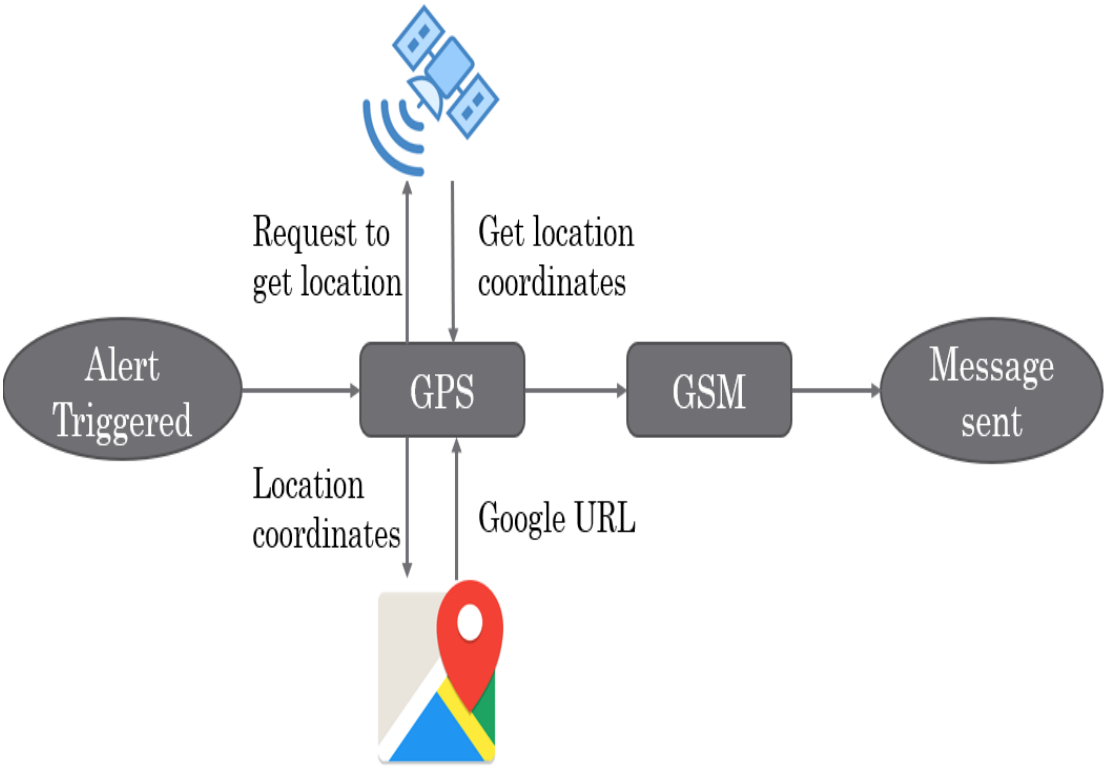


Fig 4.3 System architecture of alert mechanism

4.2 SYSTEM FEATURES

4.2.1 Functional Requirement.

- System should monitor the user location periodically.
- System should properly interact with the smart band.

4.2.2 Hardware Interface.

- Smart band is the one acting as the hardware interface as it consists of all the sensors required.

4.3 MODULES USED

4.3.1 Software Serial Library

The Arduino hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the Atmega chip to receive serial communication even while working on other tasks, as long as there room in the 64 byte serial buffer.

The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial"). It is possible to have multiple software serial ports with speeds up to 115200 bps. A parameter enables inverted signalling for devices which require that protocol.

To use this library:

```
#include <SoftwareSerial.h>
```

Limitations:

The library has the following known limitations:

- If using multiple software serial ports, only one can receive data at a time.
- Not all pins on the Mega and Mega 2560 support change interrupts, so only the following can be used for RX: 10, 11, 12, 13, 14, 15, 50, 51, 52, 53, A8 (62), A9 (63), A10 (64), A11 (65), A12 (66), A13 (67), A14 (68), A15 (69).
- Not all pins on the Leonardo and Micro support change interrupts, so only the following can be used for RX: 8, 9, 10, 11, 14 (MISO), 15 (SCK), 16 (MOSI).
- On Arduino or Genuino 101 the current maximum RX speed is 57600bps
- On Arduino or Genuino 101 RX doesn't work on Pin 13

Functions:

1) **SoftwareSerial(rxPin, txPin, inverse_logic)**

SoftwareSerial is used to create an instance of a SoftwareSerial object, whose name you need to provide as in the example below. The inverse_logic argument is optional and defaults to false. See below for more details about what it does. Multiple SoftwareSerial objects may be created, however only one can be active at a given moment. You need to call SoftwareSerial.begin() to enable communication.

Parameters:

rxPin: the pin on which to receive serial data

txPin: the pin on which to transmit serial data

inverse_logic: is used to invert the sense of incoming bits (the default is normal logic). If set, SoftwareSerial treats a LOW (0 volts on the pin, normally) on the Rx pin as a 1-bit (the idle state) and a HIGH (5 volts on the pin, normally) as a 0-bit. It also affects the way that it writes to the Tx pin. Default value is false.

Warning: You should not connect devices which output serial data outside the range that the Arduino can handle, normally 0V to 5V, for a board running at 5V, and 0V to 3.3V for a board running at 3.3V.

Example:

```
#include <SoftwareSerial.h>

const byte rxPin = 2;

const byte txPin = 3;

// set up a new serial object

SoftwareSerial mySerial (rxPin, txPin);

}
```

2) SoftwareSerial: begin(speed)

Sets the speed (baud rate) for the serial communication. Supported baud rates are 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 31250, 38400, 57600, and 115200.

Parameters

speed: the baud rate (*long*)

Returns

none

Example

```
// include the SoftwareSerial library so you can

use its functions:

#include <SoftwareSerial.h>

#define rxPin 10

#define txPin 11

// set up a new serial port
```

```
SoftwareSerial mySerial =  SoftwareSerial(rxPin, txPin);


void setup()  {
  // define pin modes for tx, rx:
  pinMode(rxPin, INPUT);
  pinMode(txPin, OUTPUT);
  // set the data rate for the SoftwareSerial port
  mySerial.begin(9600);
}void loop() {
  // ...
}
```

3) SoftwareSerial: read

Return a character that was received on the RX pin of the software serial port.

Parameters

none

Returns

the character read, or -1 if none is available

Example

```
SoftwareSerial mySerial(10,11);
void setup()
{
  mySerial.begin(9600);
}
void loop()
{
```

```
  char c = mySerial.read();
}
```

4) SoftwareSerial: write(data)

Prints data to the transmit pin of the software serial port as raw bytes.

Parameters

Serial: serial port object.

val: a value to send as a single byte.

str: a string to send as a series of bytes.

buf: an array to send as a series of bytes.

len: the number of bytes to be sent from the array.

Returns

byte

write() will return the number of bytes written, though reading that number is optional

Example

```
SoftwareSerial mySerial(10, 11);
void setup()
{
  mySerial.begin(9600);
}
void loop()
{
  mySerial.write(45); // send a byte with the value 45
  int bytesSent = mySerial.write("hello"); //send the
string "hello" and return the length of the string.
}
```

4.3.2 PulseSensorPlayground.h

This is an open source library which uses interrupts to calculate BPM(Beats Per Minute).

#define USE_ARDUINO_INTERRUPTS true

Functions Used:

pulseSensor.analogInput(PulsePin)

pulseSensor.getBeatsPerMinute()

4.3.3 GSM Commands

The AT+CMGF command sets the GSM modem in SMS Text Mode or SMS PDU Mode. In Text Mode, SMS messages are represented as readable text.

In PDU Mode, all SMS messages are represented as binary strings encoded in hexadecimal characters like 31020B911326880736F40000A900.

Although Text Mode is easier to use, PDU Mode is more consistent on different GSM Modems**.**

The AT+CMGF command sets the GSM modem in SMS Text Mode or SMS PDU Mode.

AT+CMGF=<mode>

The AT+CMGS command sends an SMS message to a GSM phone.

AT+CMGS=<number><message><CTRL-Z>

Command	Positive Response
AT+CMGF=<mode><CR>	OK

Parameters

<mode>: 0 = PDU Mode, 1 = Text Mode

<CR> = ASCII character 13

Example

Set the GSM modem to Text Mode SMS and send a message to GSM number +31628870634.

AT+CMGF=1

OK

AT+CMGS="+31628870634"

> This is the text message.→

+CMGS: 198

OK

5. RESULTS

The components and modules used for building the module have been shown in figure 5.1 below, the three sensors namely pressure, temperature and pulse rate sensors for the automatic mechanism are shown on the top of the model along with the other hardware required like GPS, GSM, buzzer along with the Arduino are present inside the model(see Fig 5.2). When the victim is in danger and pushes the button then an alert message is sent to the mobile of the pre-set mobile numbers(see Fig.5.4). The automatic mechanism can be triggered in any one of the three scenarios such as pressure and temperature sensors become HIGH or temperature and pulse-rate sensor become HIGH or pulse-rate and pressure sensor become HIGH.

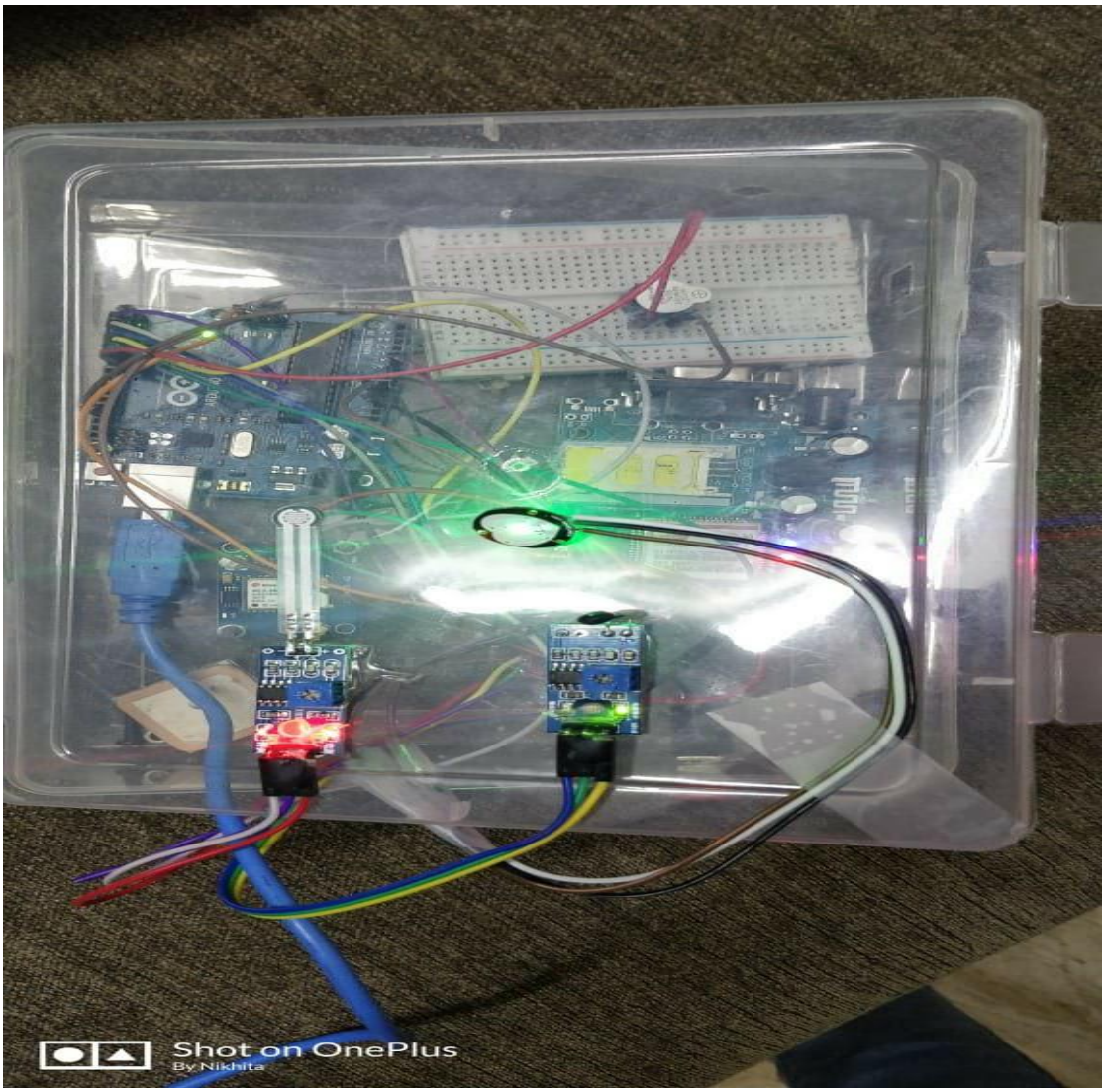


Fig.5.1 Prototype

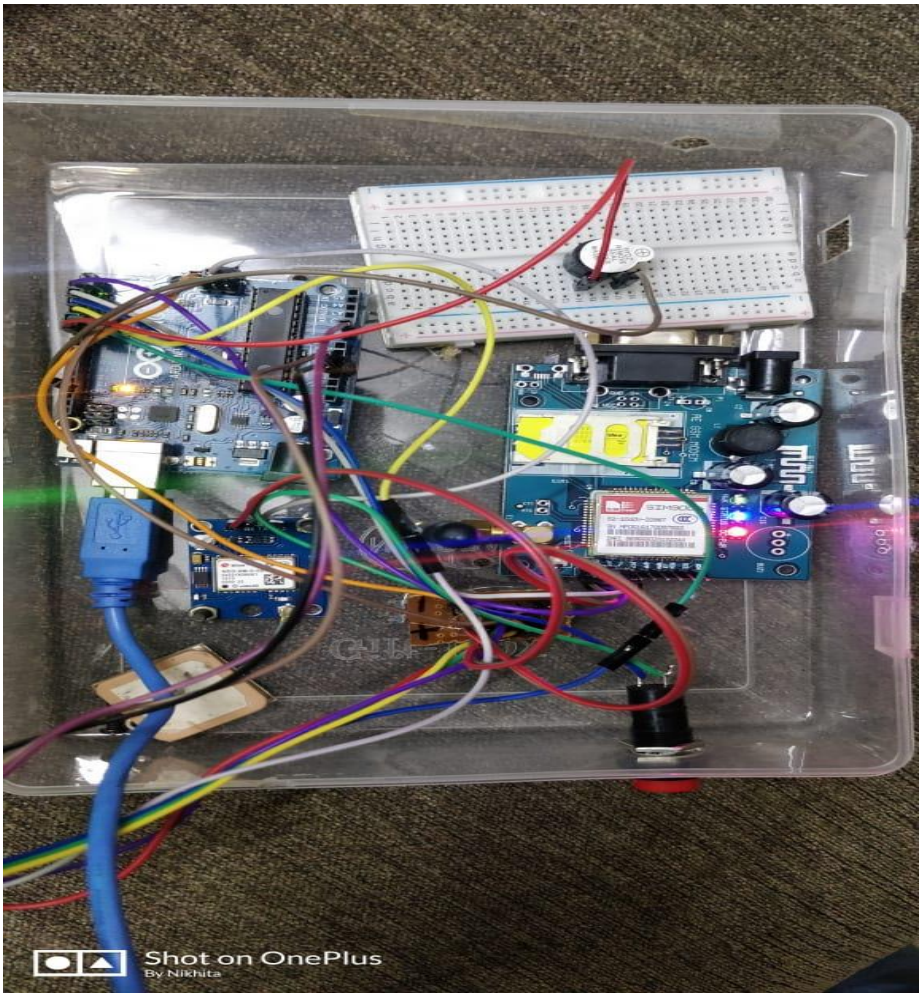


Fig. 5.2 Internal Image of the Prototype

The major advantage of the proposed system is that it is adaptable i.e. in a situation where it is humanly possible to reach the device, it allows activating the alert mechanism through a simple button and for situations where it is not possible to react it still detects the danger using the sensor. The proposed system is also lightweight, cost-efficient and easy to carry. It is easy to understand and use. It doesn't require any internet connection. The only requirement is that the area has mobile signals for the sim card.

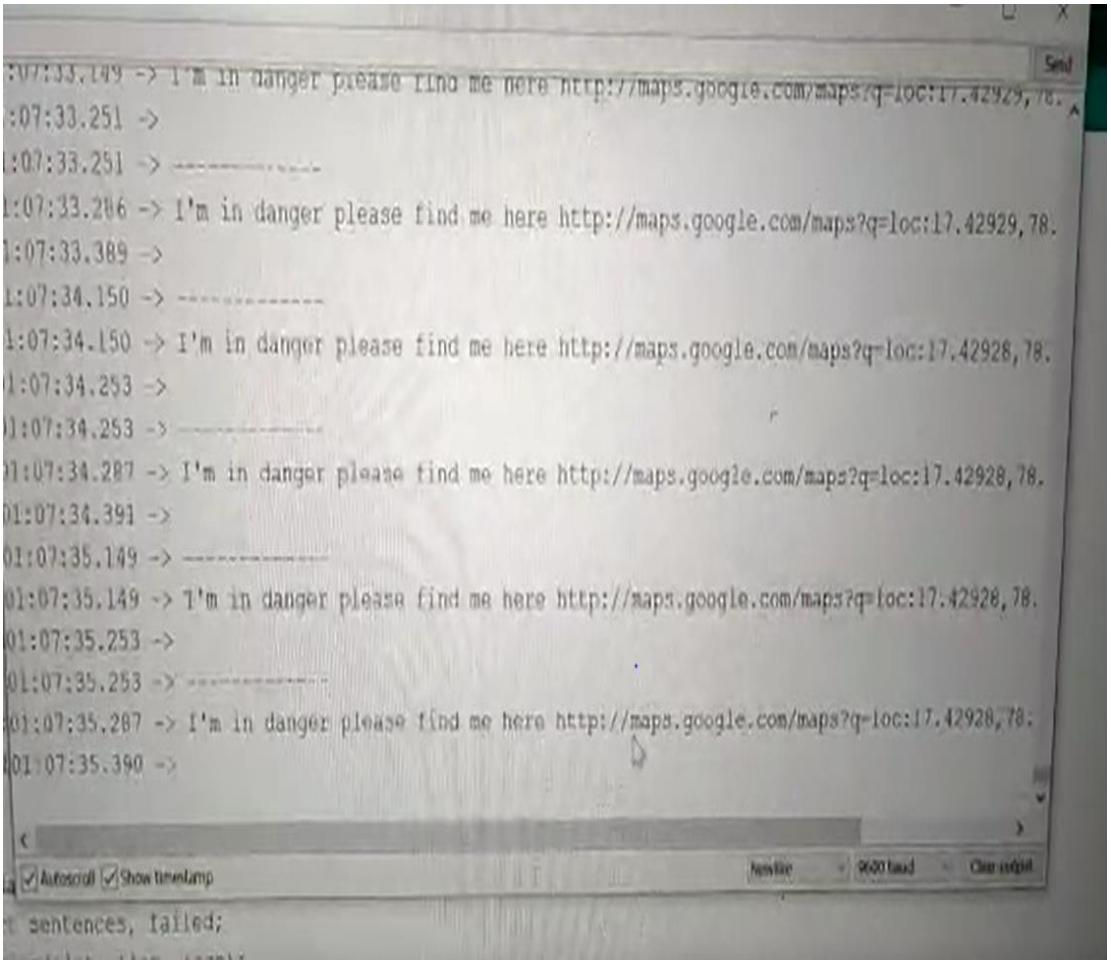


Fig 5.3 Arduino output Image

The above Fig.5.3 depicts the output from the Arduino whenever the manual or the automatic mechanisms are activated. The message is sent to the mobile numbers of the relatives which are pre-recorded. The image below(see Fig 5.4) shows the message received by the relative from the prototype whenever the alert mechanism is triggered. The link consists of the coordinates of the victim's location. On pressing the link the Google Maps are opened and the directions to the victims locations are shown in the Map Interface. The related person can now follow the directions and help the victim.

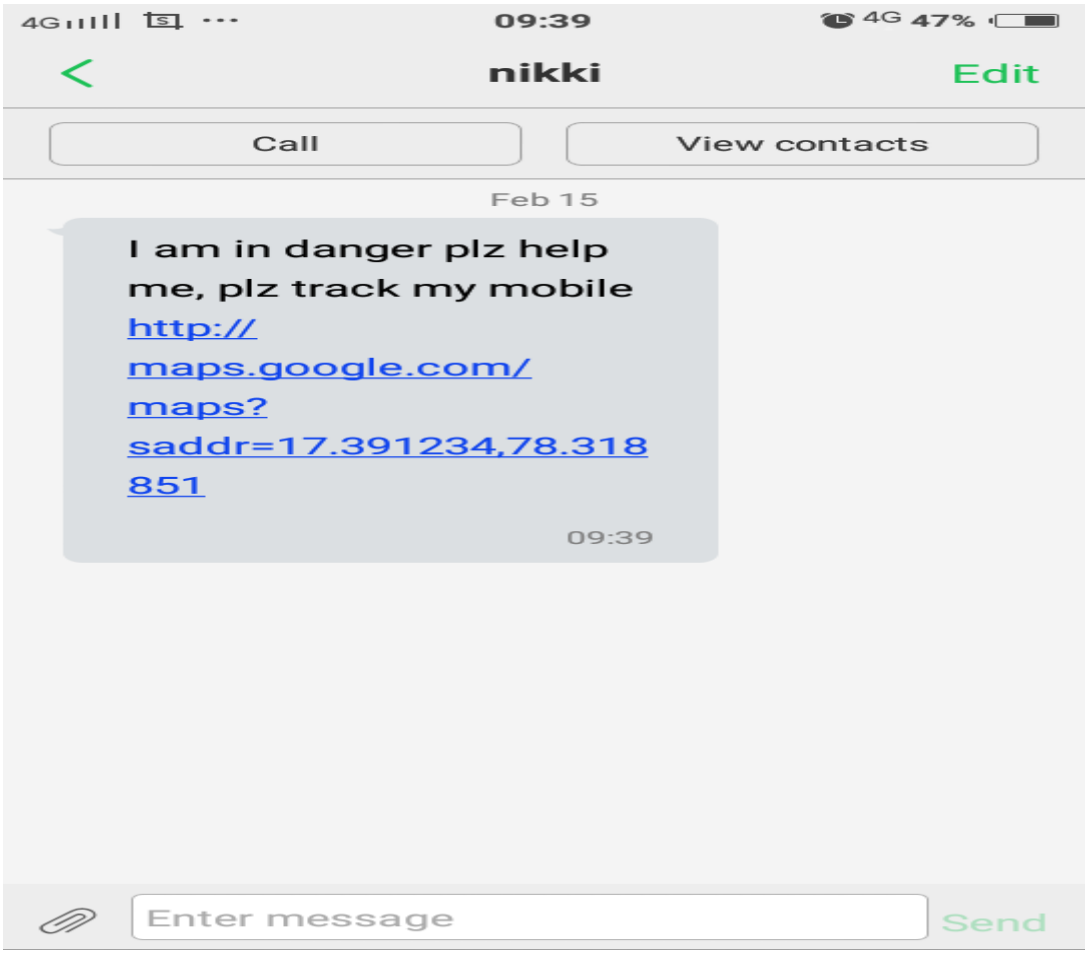


Fig.5.4 Alert Message

On pressing the link shown in the above image google maps interface is opened and directions to the victim's location are shown(see Fig 5.5)

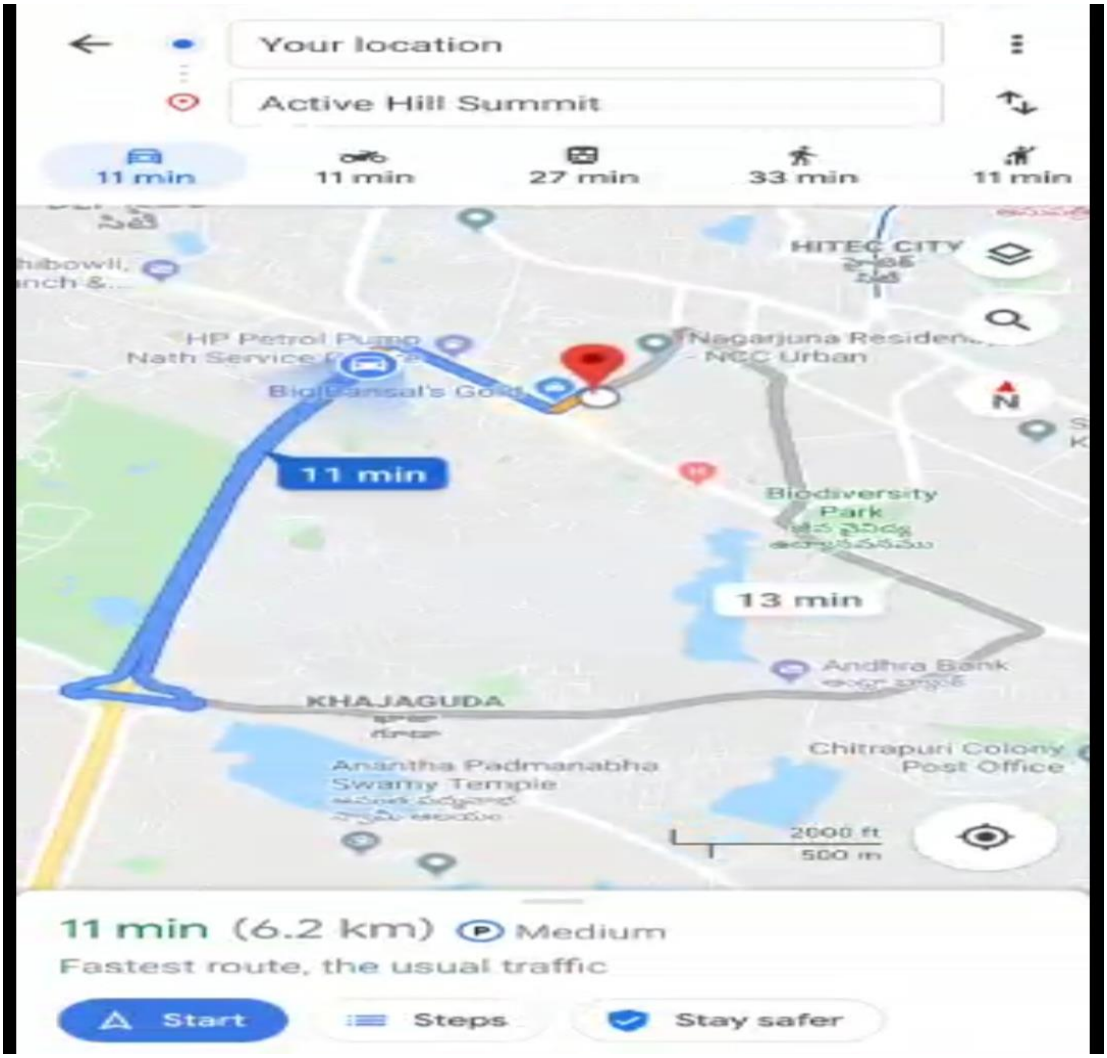


Fig.5.5 Map Interface Depicting directions

6. CONCLUSION AND FUTURE WORK

The main purpose of building a woman safety device to act as a rescue and prevent any harm at the time of hazard especially for women. Through the proposed system we developed a prototype of a smart device for women's safety which automates the emergency alert system by using Pressure sensor, Pulse-rate sensor and Temperature sensor to detect a possible atrocity automatically using outlier detection. This system detects and sends the alerts for the dear ones with the location coordinates of the women without the requirement of her interaction in critical times. It sends an emergency message automatically to the relatives and nearby police station.

The prototype which we developed is suitable to carry in any type of bags such as handbags and laptops. Carrying the prototype in these bags is suggested because even the person who is trying to harm may not notice the device inside the bag. Through the process of customization, this prototype can be modified to wearable like smartwatches, bracelets, necklace etc. The main advantage of our proposed system is that both automatic and manual mechanisms are implemented. It is also cost-efficient and easy to use. The proposed system can be further developed with capabilities like recording audio, video of the culprit when the alert mechanism is activated which can be produced as a piece of evidence in the court.

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