Smart Wearable Device for Women Safety Using IoT

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Abstract— **The crimes against women have been rising significantly and often hear about molestation, eve-teasing and rape cases in the public places of the society. The security of women is the most important concern these days and to build a safety device to act as a rescue and to prevent from harm at the time of hazard is highly necessary especially for women. In this paper, 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 is proposed. 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.**

Keywords— *Pressure sensor, Temperature sensor, Pulse-rate sensor, GSM, GPS, Internet of Things (IoT), Smart Device, Women Safety.*

I. INTRODUCTION

Women are the most integral part of any economy primarily responsible to shape the future of the country. Many crimes against them are not being reported because of society's hypocritic point of view. Various types of humiliations and mistreatment are being faced by the victims who try to report their assaults from society. Only one of four cases lead to conviction trails in India.

Proper precautions should be taken to to build the best solution to this problem. This 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 critical situations but also ensures to provide justice to the women by helping them in times of need.

II. RELATED WORK

The research of S. A. More [1] 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. [2] discusses the usage of image processing to detect any possibility of danger and proposes various solutions to protect herself. In [3] the authors developed a device which employed 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. In [4] a system based on the facial features is developed. If the facial expression is a threat-based expression then a report is filed. About [5], GSM and GPS are used to build a safe device. In this system, the message is sent to pre-stored mobile numbers which consist of the body posture of the victim along with her location. In [6] independent triggering of android application and arm device takes place with the help of synchronized Bluetooth connection. The audio and video that have been recorded are sent to the phone numbers which are pre-set in the application along with the location in the form of a call and also a message to alert them. In [7], an android app is developed which gives the location of the woman in danger by giving fake phone calls, video forwarding, location and first-aid information. In [8], body vibrations, heart rate and body temperature are sensed using sensors by the help of a reliable security device which consists of ATMEGA8 controller with Arduino tool and advanced sensors. In [9], three sensors namely heartbeat, temperature and accelerometer are used. These sensors are used to detect if there are any anomalies and a message to alert the dear ones is sent using GPS and GSM module.

III. EXISTING SYSTEM

In the existing system, there is no way to monitor the crimes occurring against women. However, there are some places where CCTV cameras are fitted, and the recording is stored. They are used only 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 that crucial moment, for most of the women, it is 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.

The disadvantages of existing systems are as follows:

- Not very reliable
- Need manual effort
- Expensive

IV.   PROPOSED SYSTEM

. Our proposed system is a wearable for women which contains pressure, temperature and pulse-rate sensors along

A. Block Diagram

The block diagram of the system in Fig.1 shows all the components required for the device. To automatically detect any atrocity, three sensors i.e. pressure, temperature, pulse rate sensors are used. The pressure sensor is used to detect if any pressure is being applied to 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 is 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 event 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.
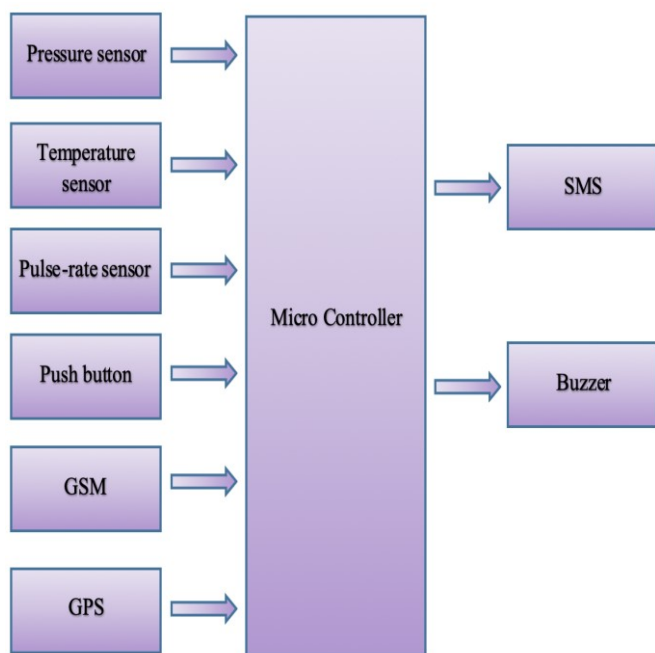

Fig. 1. Block diagram of proposed system.

B. Components

The prototype uses the following components

1)   Pressure Sensor: This is a force sensitive resistor (see Fig. 2.) with a round, 0.5″ diameter, sensing area. Depending on how much pressure is applied, the force sensitive resistor will vary according. Resistance varies inversely with the force applied.

2)   Pulse-rate Sensor: Pulse Sensor (see Fig. 3.) is very small sized, low cost, a plug and sense heart rate sensor. This

with GSM and GPS to detect a possible atrocity and notify her friends and family through a message containing her location. Also provide a button on the wearable to manually be able to send a notification if the victim could react. sensor is compatible with Arduino. It helps in getting reliable pulse readings fast. Pulse-rate Sensor is compatible with a 5V or 3V Arduino.
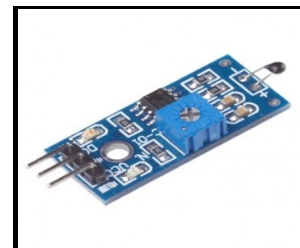

Fig. 2. Pressure sensor   Fig. 3. Temperature sensor

3)   Temperature Sensor: NTC Thermistor temperature sensor module (see Fig. 4.) is small sized, low cost sensor which is very sensitive to ambient temperature. This sensor helps in sensing the temperature of surrounding environment. The detection range of temperature is between 20 -80 degree Celsius.

4)   Push Button: The mechanism of the push button is that two points are touched when the button is pressed which activates the alert mechanism (see Fig. 5.)

Fig. 4. Pulserate sensor.   Fig. 5. Push button

5)   GPS-GSM module: The location of the person in real-time is obtained using SIM808 module (see Fig. 6.) Both GPS and GSM are implemented as a two-way function in this module. Quad-Band is supported for GSM . Satellite navigation is supported with the help of GPS technology. A cheaper solution of two-way communication is achieved using a GSM modem compared with the two-way GPS communication satellite.

6)   Buzzer: It is Small PCB Mountable 5V Passive Buzzer (see Fig. 7.). It is used to add Audio Alert to electronic designs. An audible tone is generated using the coil element and works on 5v supply.

Fig. 6.GPS-GSM module   Fig. 7. Buzzer

7)   Microcontroller: For communicating different sensors, switches, modules, the Arduino Uno (see Fig. 8) microcontroller is used. It works as a decision-making controller by obtaining various signals from the different sensors and triggering output sensors appropriately.

8)   Power supply: A 12 V rechargeable Li-ion battery (see Fig. 9) 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. 8. Arduino Uno.   Fig. 9. 12V Battery

V.   METHODOLOGY

The process flow can be divided into three mechanisms

A. Manual mechanism

Manual mechanism (see Fig. 10.) 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.
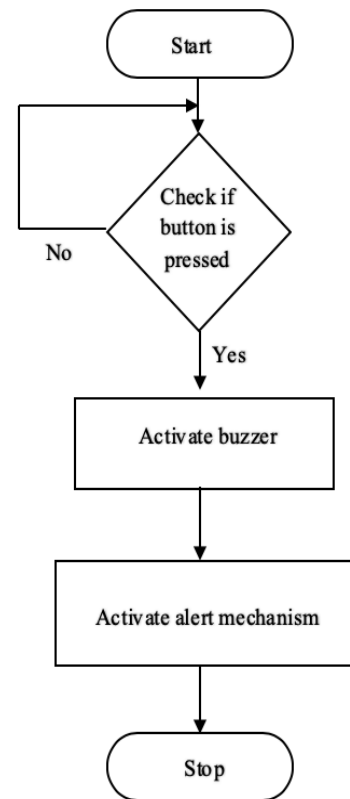

Fig. 10. Flow chart of manual mechanism

B. Automated mechanism

In most of the situations, the woman may not be able to react and use the manual mechanism. So, automate the mechanism using pressure, temperature and pulse-rate sensor (see Fig. 11.) and 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 I.   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

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.

The temperature sensor is used to measure the temperature of the surroundings. As a person comes closer to the personal space of the victim, the temperature surrounding her increases. So, a temperature sensor is integrated 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.
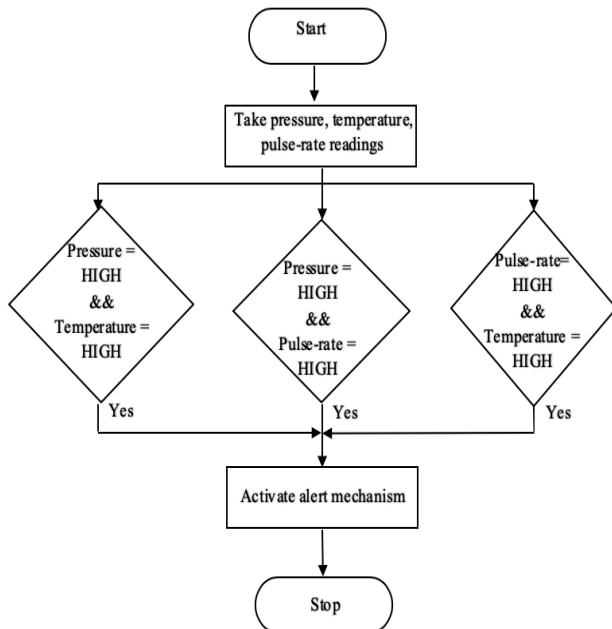

Fig. 11. Flow chart of automated mechanism

C. Alert mechanism

The 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. 12. 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, the location coordinates is converted 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.
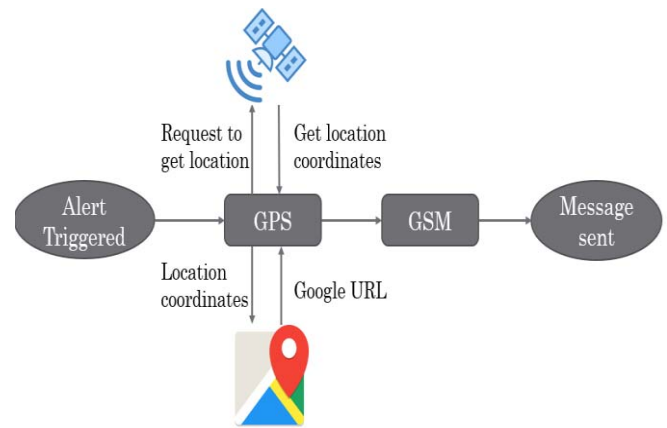

Fig. 12. System Architecture of Alert mechanism

VI. RESULTS

The components and modules used for building the module have been shown in figure 13 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. 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. 13). 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.

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.
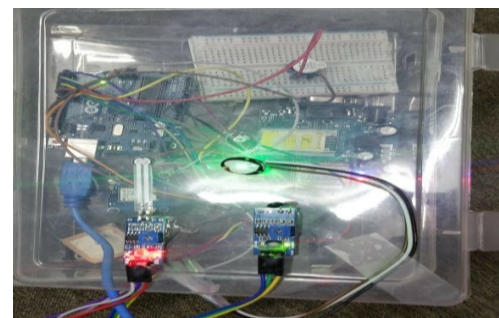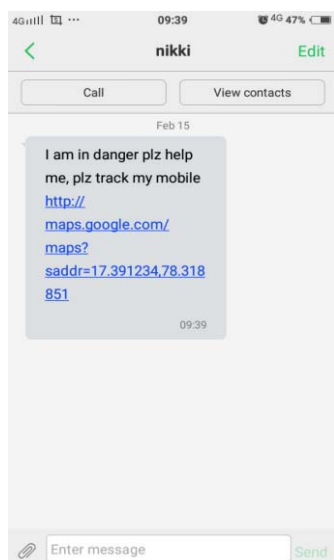

Fig. 13. Prototype

Fig. 14. Message sent to user

VII. CONCLUSION AND FUTURE SCOPE

The main purport 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 a smart device for women's safety which automates the emergency alert system is designed. 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 is suitable to carry in any type of bags such as handbags and laptop. 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 mechanism is 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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