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Women Safety and Health Monitoring System

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Abstract: *Women safety is a very big issue even in this modern world running with advanced technologies. After a history of times, women got a freedom of equality at the workplace, asset rights, family law, and education. Even Feminist Movement, claimed during 20th Century, Women are not safe anywhere and violence against women and girl child's happening everywhere during the lonely travelling on roads, picnic spots, work and deserted places. Though we have many armies and super forces to protect everybody, the day to day crime rate against women has not been reduced. There are several safety devices available to protect the women during the violence, but need more human intervention such as entering the data, or shaking the device roughly. We propose a solution for a secure and peaceful environment for women with handbag safety hand-held devices with the aim to provide false proof women safety devices by overcoming the disadvantages in existing system. When we are talking more about Women empowerment, Women achievements it is also very important to think about women safety since a huge numbers (848) of women's are Indian Women Are Harassed, Raped, Killed Every Day. The proposed work aims at IoT based women safety device by hardware controller attached to the handbag, android application and Bluetooth connectivity in Smartphone. By pressing the controller button, the device alerts the first holder, relatives stored in the database and police when a woman is not safe. The main advantage of the work is, the device works without internet connectivity. Additional features such as protecting the valuable things to be stolen by thieves in crowded places or buses by a separate alarming system, heartbeat sensor setup to monitor heart rate, fingerprint scanner for effecting accessing of the devices and also the mobile android application provide the victim's location to reach the women and safeguard the women from any harassment at the right time. The main thought of this paper is that it will not only protect the women from physical harassment during odd hours but also safe the women health when it is found abnormal, as a single device comparatively.*

Keywords: Heartbeat Monitoring sensor, Alert sound, Automatic call, Location tracking, Women safety, Smart device

I. INTRODUCTION

Women safety is always considered to be a substantial issue in India even equipped with modern and advanced technologies. Women empowerment has been emphasized for past decades not sensed the crimes against women as a series issue. India is known for promising superpower, a financial hub, matured powerful women freedom fighters and also postulated for a precarious place for women. Though various security gadgets are available for women safety more human intervention is required to activate the device by pressing the buttons, rash shaking of the device, pressing the buzzers etc while or after sensing the woman was in danger. If a woman forgets to do any of these jobs to activate the device, the system will not work and the woman cannot be saved and the purpose of the device fails. In a developing country like India, the crime against women is higher than its human population. The crimes against woman are listed as harassment, rape cases, burglary case, murder case, violence so on. It uses modern technology to automatically detect if a woman is in danger and can send alerts to nearby contacts or authorities without needing manual activation. Additionally, the system tracks vital health signs like heart rate and body temperature, ensuring timely medical assistance if needed. This project addresses two major issues—safety and health—by offering a smart, efficient tool to empower women in today's world.

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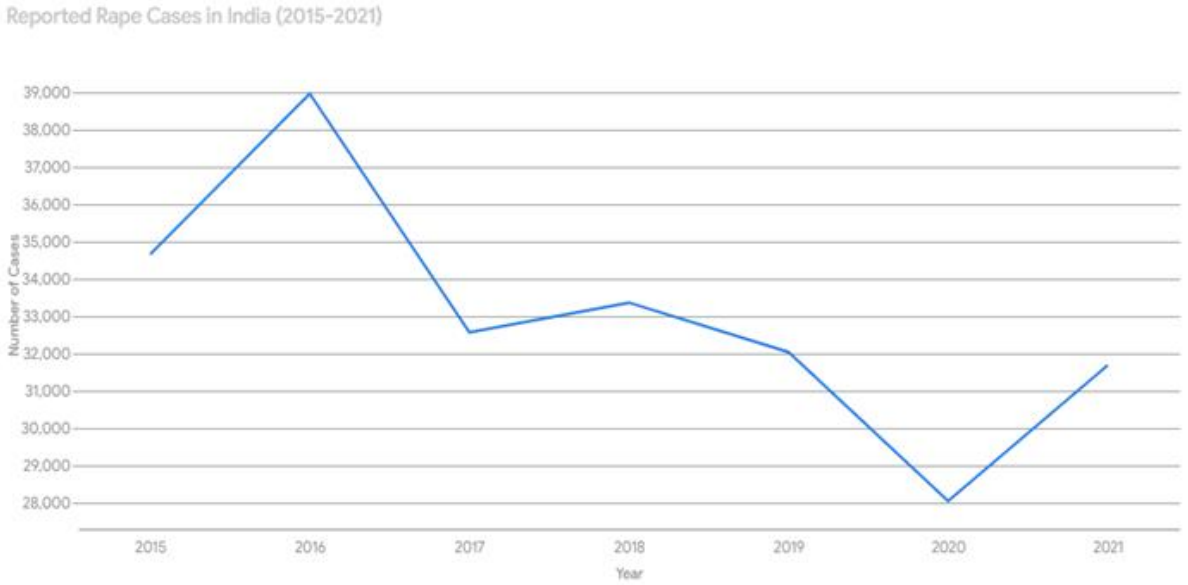

Figure 1.1: Reported Rape Cases in India (2015-2021) (Source: National Crime Records Bureau)

According to Georgetown University's Institute for Women, Peace and Security, India is ranked 133 out of 167, report of the year 2019. NCRB Data (2019-2021): The NCRB reports show a consistent increase in reported crimes against women. In 2021, over 4 lakh cases were reported, with a significant proportion being domestic violence cases.

National Family Health Survey (NFHS-5): The NFHS-5 (2019-2021) revealed that 30% of women aged 18-49 have experienced spousal violence.

Global Gender Gap Report: India's ranking in the World Economic Forum's Global Gender Gap Report has fluctuated but remains low, indicating significant gender disparities in various areas, including economic participation, health, and political empowerment. Child marriage is the crime frequently happening in India and also estimated around sixtythree millions women are missing due to sex-selective abortion and twenty one millions of unwanted girls, disfavoured by the parents. In the year 2016, India is reported with 38,947 rape cases and the attacks happens when they women travelling alone in remote areas when find no one to help or assist. After Nirbhaya Delhi case, the whole nation triggered to safeguard the women in India who faces crimes, social challenges and violence using the technology. This paper suggested intelligence security systems and health monitoring with IoT technology to accost necessities and demands during crime against women. The prognosis of such an incident is not feasible hence to reduce the possibility of harassment by using helpful tools equipped to safely escape from violent situations. This reduces risk and brings assistance whilst needed.

Features included in the proposed work for the support women safety are as follows:

1. Sending messages from the device to registered mobile numbers and nearest police station from the victim's mobile phone.
2. Spot the current location of the victim using Google map usage.
3. Monitors the heartbeat and in-case of any medical emergency messages will be sent to the contacts registered.

However, it's important to note that this is just one aspect of addressing the broader issue of violence against women. While technology can play a valuable role, it's crucial to address the root causes through social, legal, and cultural reforms. This includes promoting gender equality, challenging harmful stereotypes, and strengthening support systems for survivors of violence.

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II. LITERATURE SURVEY

Title	Author	Methodology	Microcontroller Used	Sensors Used
A Smart Safety Device for Women Security Based on IoT	K. Anusha, et al.	Employs an Arduino board with GPS and GSM modules to track location and send alerts to predefined contacts in case of distress. Includes a panic button and fall detection mechanism.	Arduino UNO board	GPS, GSM, fall detection
Design and Development of Women Safety Device with Health Monitoring System	M. Monisha, et al.	Utilizes a microcontroller, heart rate sensor, GPS module, and GSM module to monitor the user's health and location. Sends alerts to emergency contacts and authorities if abnormalities are detected.	Atmega328p Microcontroller	Heart rate sensor, GPS, GSM
Smart Watch Based Women Safety Device	A. Deepa, et al.	Integrates sensors (heart rate, accelerometer) into a smartwatch form factor for discreet monitoring and safety. Features emergency SOS activation, location tracking, and health data recording.	Raspberry pi	Heart rate, accelerometer
IoT Based Women Safety Device with Self Defence Mechanism	P. Sathya, et al.	Combines a wearable device with pepper spray activation for self-defence. Includes GPS tracking, audio recording, and alert transmission via GSM.	ESP32 microcontroller	GPS, audio sensor, GSM
A Real-Time Women Safety System Using GSM and GPS Technology	S. Priya, et al.	Focuses on real-time location tracking and alert generation using GPS and GSM. Employs a dedicated mobile application for monitoring and receiving alerts.	ARDUINO UNO	GPS, GSM

III. PROPOSED METHOD

The proposed method for the microcontroller-based system is to use an ATmega328p microcontroller to manage data from various sensors and modules, including the LCD board, GPS/GSM modem, Wi-Fi module (ESP8266), pulse sensor, temperature sensor, and more. This data is processed locally by the microcontroller to monitor key parameters, respond to sensor inputs, and control system functions such as activating the buzzer.

The Women Safety and Health Monitoring System is thoughtfully designed to provide real-time protection and health tracking for women, particularly in emergency situations. At its core is the ATmega328P microcontroller, which orchestrates all the system's functions by processing input from sensors and communicating with external devices. The system is powered by a stable power supply that keeps the components operating seamlessly.

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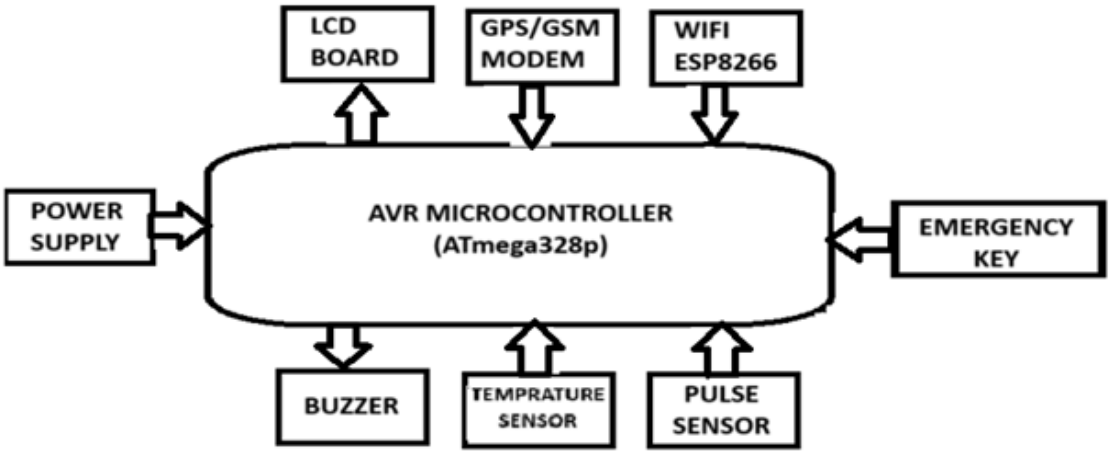

Figure 2.1 Block diagram

A standout feature is the GPS/GSM module, which not only tracks the user's location but also enables the system to send emergency alerts through SMS to a set of trusted contacts when the user is in danger. This can be life-saving, as it provides real-time location data to loved ones or authorities. Alongside this, the Wi-Fi ESP8266 module allows the system to connect to the internet, facilitating remote monitoring through a mobile app or a web server. This way, caregivers or emergency responders can keep track of the user's health and location remotely, offering an extra layer of security.

Health monitoring is another crucial aspect of the system. It uses a pulse sensor to keep an eye on the user's heart rate and a temperature sensor to measure body temperature. These sensors continuously feed data to the microcontroller, and if abnormal readings are detected—such as an unusually high heart rate or fever—the system can automatically notify emergency contacts, ensuring that health issues are addressed promptly.

In addition to these automatic features, there's an emergency key that the user can press if they feel threatened or unwell. Once activated, it triggers an SOS alert, complete with the user's current location, allowing for immediate action. To further ensure the user's safety, a buzzer sounds an alarm during emergencies, potentially drawing the attention of people nearby or scaring off potential threats.

For ease of use, the system includes an LCD screen, which displays key information such as the user's heart rate, temperature, and system status, providing clear, real-time updates. This can be especially useful for the user or a bystander to quickly understand the situation. Together, these components create a comprehensive solution that not only helps ensure a user's safety in dangerous situations but also keeps an eye on their health.

IV. HARDWARE COMPONENTS

1. Atmega328p Microcontroller:

The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

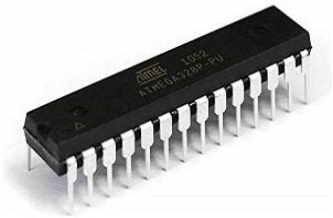

Figure 3.1 Atmega328p microcontroller (Source: ielectrony.com)

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The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz.

2. GSM Module:

A GSM module is a device that allows electronic devices to communicate with each other over the GSM network. GSM is a standard for digital cellular communications, which means that it provides a platform for mobile devices to communicate with each other wirelessly. The GSM module is a specialized device that enables a device to send and receive data over the GSM network.

Parameter	Value
CPU type	8-bit AVR
Maximum CPU speed	20 MHz
Performance	20 MIPS at 20 MHz[2]
Flash memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Package pin count	28 or 32
Capacitive touch sensing channels	16
Maximum I/O pins	23
External interrupts	3
USB interface	No

Table 3.1 Parameters and values of Atmega328p (Source: WIKIPEDIA)

The GSM network is an essential component of modern communication systems. It is a standard used by mobile devices to communicate with each other wirelessly. The GSM network provides a reliable and secure platform for communication, which makes it a preferred choice for many applications.

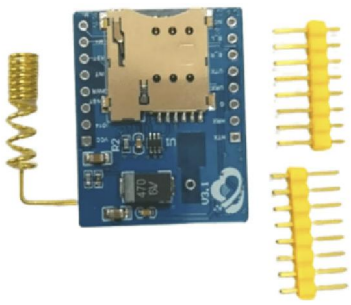

Figure 3.2 GSM Module (Source: indiamart.com)

Features	Specifications
Operating frequency	GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz
Operating Voltage rating	3.2V – 4.8V dc
Output pin voltage	5V dc
Output pin current	25mA
Communication mode	UART interface, configured for full-duplex asynchronous mode
Baud rate	Supports auto bauding, 9.6kb/s used.

Table 3.2 Specifications Of GSM Module (Source: ResearchGate)

3. Wifi Module:

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications. It employs a 32-bit RISC CPU based on the Tensilica

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Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.
ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.
To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

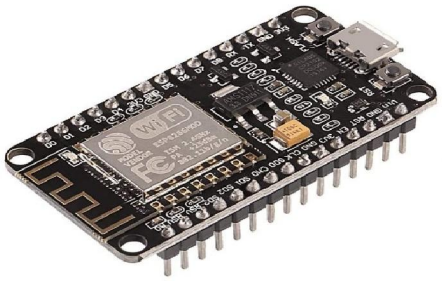

Figure 3.3 Wifi Module (Source: srkelectronics.in)

ESP8266	DESCRIPTION
Core	1
Arquitecture	32 bits
Clock	Xtensa LX106 80-160MHz
WiFi	IEEE802.11 b/g/n support for WPA and WPA2
Bluetooth	No
RAM	160KB - 64KB Instruction - 96KB Data
Flash	Extern QSPI - 512KB A 4MB
GPIO	16
DAC	0
ADC	1
Interfaces	SPI-I2C-UART-I2S

Table 3.3 Specifications of Wifi Module (Source: https://www.nabto.com/)

4. Pulse Sensor:
An **IR pulse sensor** is a biomedical device used to measure heart rate by detecting blood volume changes in the fingertip or earlobe. It uses an infrared light-emitting diode (LED) and a photodetector to sense the variation in light absorption as blood pulses through the skin. The sensor converts these changes into electrical signals.

Operating Temperature	-40°C to +80°C
Input Voltage (VCC)	3V to 5.5V
Output Voltage	0.3V to VCC
Supply Current	3mA to 4mA
Dimensions (L x W)	15.8mm

Figure 3.4 Pulse Sensor (Source: 5.imimg.com)

5. Temperature Sensor:
The **DS18B20** is a digital temperature sensor that provides accurate temperature readings over a range of -55°C to +125°C. It communicates using the **1-Wire** protocol, meaning it requires only one data line (and ground) to transmit data, making it ideal for use with microcontrollers. The sensor offers a resolution of 9 to 12 bits and can operate on external power or be powered through the data line (parasite power). It is widely used in weather stations, thermostats, and other temperature monitoring systems due to its precision and ease of integration.
This device is available in an 8-pin TDFN package and operates over the 0°C to +50°C temperature range..

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Figure 3.5 Temperature Sensor (Source: amazon.com)

Parameters	Specifications
Temperature Range	-55°C to 125°C
Accuracy	±0.5%
Humidity Range	Not Applicable
Sampling interval	0.75s
Body Size	910 mm long, 4 mm dia. cylindrical
Operating DC Voltage	3 V -5.5 V

Table 3.5 Specifications Of DSb18B20 (Source: https://www.mikroe.com/)

6. GPS Module :

The GY-GPS6MV2 GPS module is a compact and reliable component used to provide real-time location data in electronics projects. It uses the NEO-6M GPS chip from u-blox and comes with a built-in ceramic antenna, which helps it receive signals from GPS satellites even in areas with weak coverage. This module is ideal for tracking applications as it can provide accurate information such as latitude, longitude, altitude, speed, and time. It operates on a voltage range of 3.3V to 5V, making it compatible with popular microcontrollers like Arduino and ESP32.

Hardware	NEO 6M GPS Module
Update Rate	1 – 5 Hz
Sensitivity	-161dBm
UART Baud rate	9600
Operating Voltage	3 – 5 V
Function	Location Tracking

Fig 3.6 GPS Module

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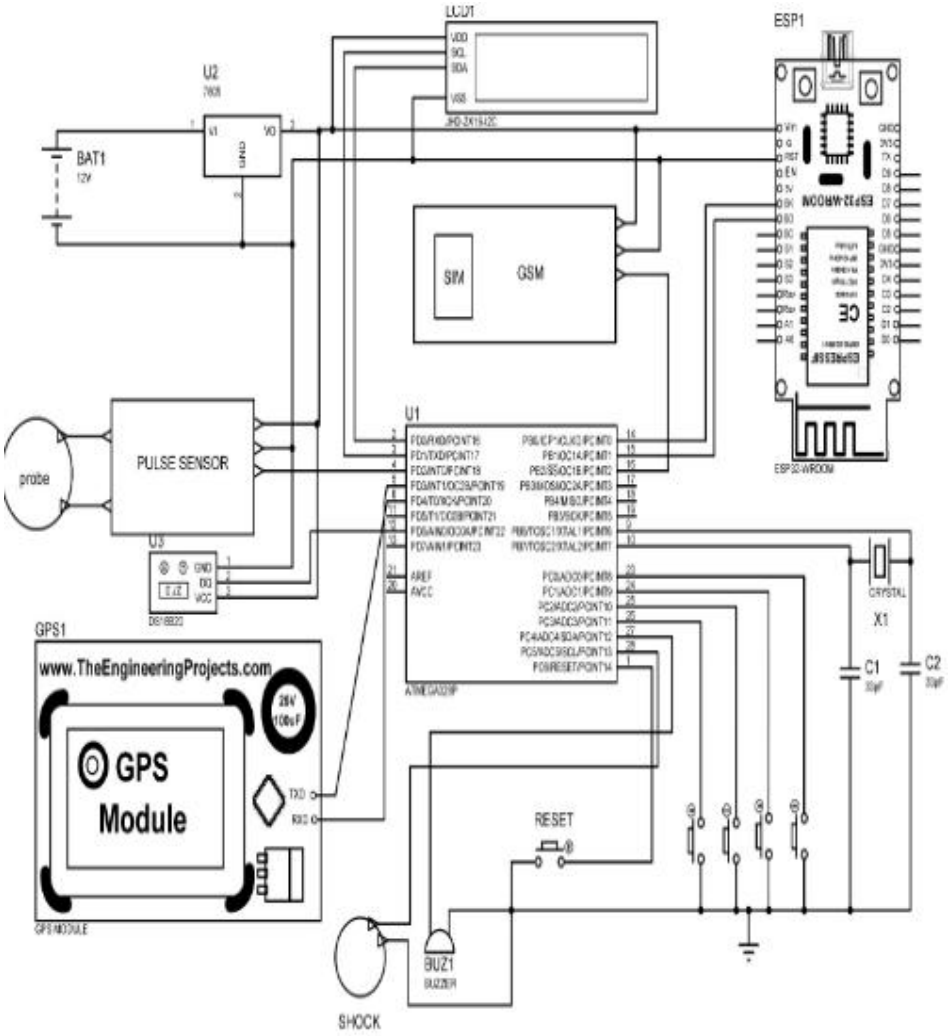
V. Circuit Diagram



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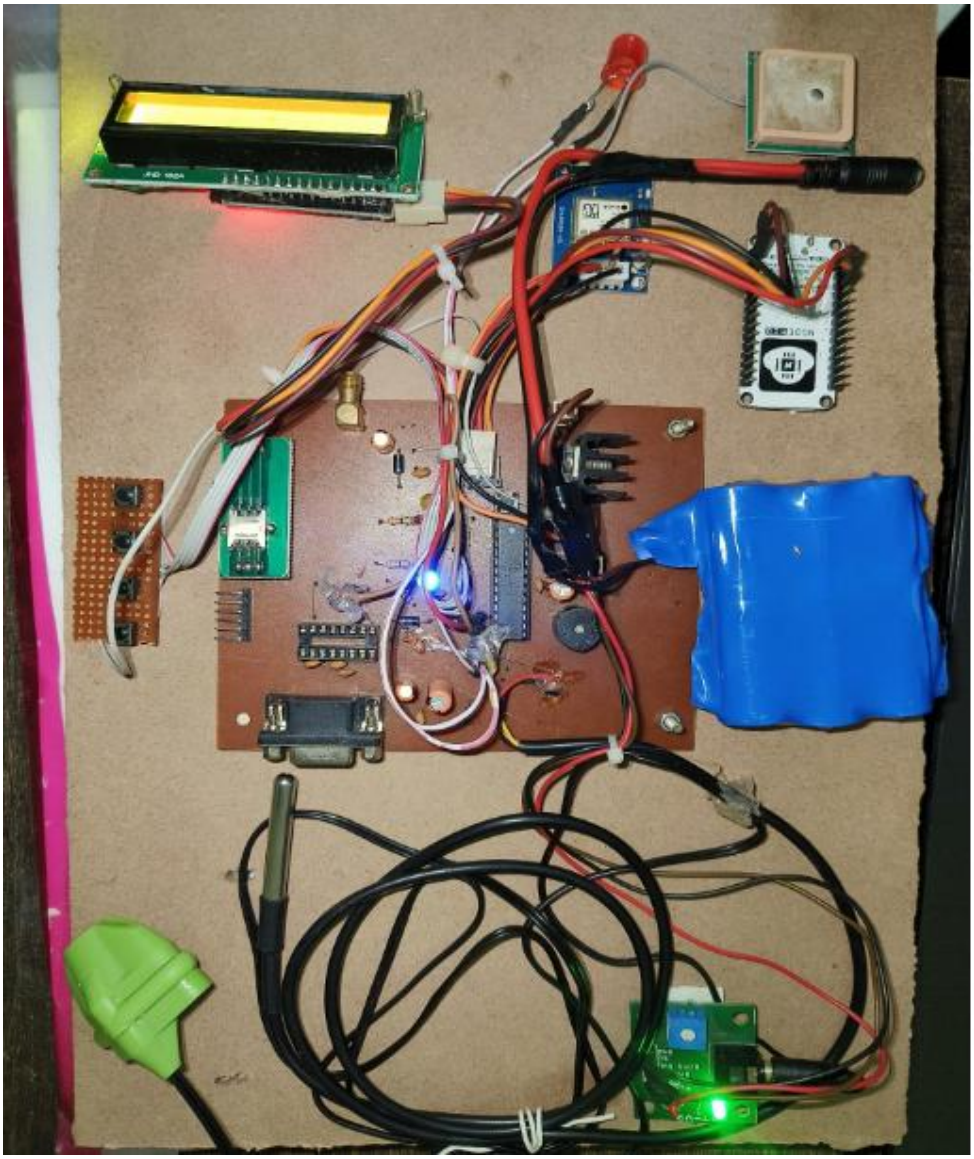
VI. RESULT



VII. SOFTWARE COMPONENTS

1. Arduino IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information.

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2. Proteus 8 professional:

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

3. ThingSpeak cloud:

ThingSpeak is an open-source software written in Ruby which allows users to communicate with internet enabled devices. It facilitates data access, retrieval and logging of data by providing an API to both the devices and social network websites. ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications.

ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks,allowing ThingSpeak users to analyze and visualize uploaded data using MATLAB without requiring the purchase of a MATLAB license from MathWorks.

VIII. METHODOLOGY

1. Hardware Development:

The first step is to create the physical device for the Women Safety and Health Monitoring System. This will involve designing and building:

Wearable Device: A small, comfortable gadget that can be worn by the user to continuously track health and location.

Health Monitoring Sensors: These will keep an eye on important health indicators like heart rate, body temperature, and stress levels.

GPS Module: For real-time tracking of the user's location, especially useful in emergencies.

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Communication Modules: These will ensure that all the data (health and location) is sent securely and reliably to the cloud or a mobile app.

The device should be lightweight and comfortable for daily wear. The sensors need to provide accurate, real-time information, while the communication modules should guarantee that the data is transmitted quickly and securely when needed.

2. Algorithm:

Several smart algorithms will make this system work effectively:

Health Monitoring Algorithm: This will continuously analyse the health data from the sensors, such as heart rate and body temperature, and alert the user or emergency contacts if something seems wrong.

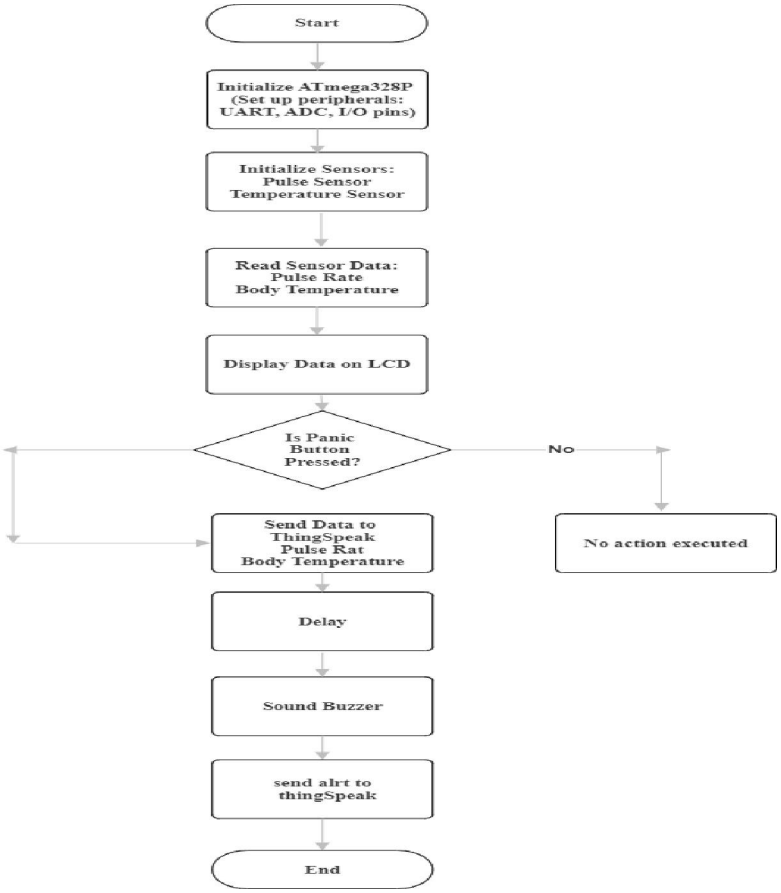
Emergency Detection Algorithm: This will detect if the user is in distress, either through abnormal health readings or by pressing an emergency button on the device. It will automatically trigger an alert when something seems off.

Location Tracking Algorithm: This will keep track of the user's location using GPS, allowing emergency responders or loved ones to know where the user is during a crisis.

Safety Alert Algorithm: If an emergency is detected, this system will send an alert to the user's emergency contacts, including their current location and health status.

User Privacy and Security: This ensures that only authorized people can access the data, protecting the user's personal health and location information.

IX. FLOWCHART:



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X. APPLICATIONS:

Personal Safety: This device helps women stay safe by sending alerts to family or friends in case of danger. If they feel unsafe or face an emergency, a simple button press or automatic health alert sends their location to their trusted contacts for immediate help.

Health Monitoring: The system keeps an eye on important health stats like heart rate and body temperature throughout the day. If it detects anything unusual, it can warn the user or notify someone they trust, helping them stay on top of their health.

Travel Safety: Women traveling alone or in new places can rely on the system for added security. With real-time location sharing and health monitoring, they can explore confidently, knowing that someone they trust is always just a notification away if they need assistance.

Workplace Safety: Women working in isolated or risky environments can wear this device during their shifts. If they feel unsafe or experience a health emergency, the system can quickly notify their supervisors or emergency contacts, providing their exact location.

GPS Tracking: It can track the real-time location of the user and share it with family or emergency contacts, ensuring quick response in case of danger.

Campus Safety Alerts: For female students, the system can be connected with campus security systems, sending immediate distress signals in case of emergencies like stalking, assault, or any unsafe situations.

XI. CONCLUSION

The proposed women safety and health monitoring system aims to prove an exhaustive security for women in this 21st technology century. The main aim of the research is to reach the rural areas and the women can benefit from the device at a lower price and come out without any fear. The alarm sounds make the women safe during the travel and also alerts the near-ones about grotesque. The considerable features like sending messages, dial a phone call, sharing the location and alarm sound alerts the relatives and near-ones and help to trace the victims location. If required the location of the victim can be snapped and shared as a group message. In addition to the hardware design, an android app is developed to provide additional safety features like sending group text messages, recorded audio and safe nearby location share audio recording.

The research paper presents the prototype of a smart women safety and health monitoring device and performance metrics have to be considered for further analysis to prove its efficiency. In the future, the device may be added with features like greater processing speed, additional health monitoring features and burglar sound during emergencies.

XII. ACKNOWLEDGMENT

We would like to express my heartfelt thanks to my respected mentor and guide, Prof. G. V. Madhikar, Assistant Professor in the Department of Electronics and Telecommunication Engineering at Sinhgad College of Engineering, Vadgaon (BK), Pune-41. Throughout our journey, his technical advice has been incredibly helpful, and his constant encouragement has given me the strength to keep going, even during challenging times. He always offered constructive criticism, which helped me improve and grow. His guidance has truly inspired me to work harder and aim for greater success. We are deeply grateful for all the support and knowledge he has shared with me.

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