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An IoT Approach for Providing Safety to Women

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Abstract: As is well known, one of the biggest challenges in today's world is the security issues surrounding women's protection. Even yet, we are taking a number of steps to ensure that, in contrast to the prior system, there are no additional obstacles to security. Despite the government's efforts to raise awareness and implement literacy programs for women's protection, the current state of affairs remains unaffected. The sensitivity of the conditions is also carried forward by a variety of gadgets, but wearing and maintaining them is a very time-consuming operation. Therefore, in this process, we are attempting to integrate all those devices—whether they are similar to blood pressure or heart rate monitors and SPO_2, or perhaps they are related to clothing—into a single device that makes keeping it less stressful and aids in the proper manner as many devices may. Since the output is generated from a single source, the process uses a variety of sensors and Arduino kits to integrate into a single platform and operate with more accuracy. The primary goal of designing such a gadget is to take into account the safety precautions for women and to lessen any negative effects. Additionally, the gadget is wearable, making it impossible for anyone to identify it as such. In the future, the mobile application and other requirements can be modified to manage or run it in other ways. Due to the fact that the most recent technological parameter incorporates devices with high precision, it is embedded with Arduino and associated sensors.

Keywords: *Internet of Things (IoT), Literacy, Safety, Monitoring, Arduino, Cloud*

1. INTRODUCTION

The fundamental objective of this system is to establish a security system that is solely geared on the provision of safety and protection to women, with the goal of ensuring that they never experience a sense of helplessness in the face of such societal difficulties. It is possible to create a sophisticated system that makes use of technological devices such as receivers for the global positioning system (GPS), sensors for measuring body temperature, sensors for the global system for mobile communications (GSM), and pulse rate sensors in order to determine the location of a person and their current state of health in order to provide appropriate responses. The current circumstances of women who are in situations that are deemed to be severely abusive can be properly determined with the help of a number of sensors that can be applied. In circumstances such as these, a person's heartbeat is often faster. This factor, in conjunction with other sensors, such as motion sensors, allows for the identification of the woman's irregular motion when she is being abused. The decision-making process is aided by this information. When compared to the many different security options that are already available to women, such as a separate device, the concept that led to the development of a smart device specifically for women is that it is more convenient for them to use. Clothing, belts that are bulky, and mobile applications that are infamously out of date and abstract are all examples of this.

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2. LITERATURE SURVEY

Sathyasri et. al. states that today in the current global scenario, women are facing many problems like women harassment. We propose to have a device which is the integration of multiple devices, hardware comprises of a wearable “Smart band” that endlessly communicates with sensible phone that has access to the web. This paper covers descriptive details about the design and implementation of "Smart band". The device consists of a trigger, microcontroller(ATmega2560), GSM module

(SIM900), GPS module(Neo-6M),IoT module(ESP-12E),Neuro Stimulator, Buzzer and Vibrating Sensor. In this project, when a woman senses danger she has to hold ON the trigger of the device. Once the device is activated, it tracks the current location using GPS(Global Positioning System) and sends emergency message using GSM(Global System for Mobile communication) to the registered mobile number and near by police station. IoT module is used to track the location continuously and update into the webpage. Neuro Stimulator will produce non-lethal electric shock in emergency situations to detect the attacker, buzzer is used as an alarm to alert the nearby people so that they may understand that someone is in need and vibrating sensor will send the last location in case if the device gets defected. The main advantage of this project is that this device can be carried everywhere since it is small. [1]

Budebhai et. al. proposed that "IoT Based Child And Woman Safety" can be used to locating missing or lost children and also tracking the child movements outside from the home. The system can also be used to locate women who are in danger. We have combined GPS with one of the basic service of a smart phone which is GSM more specifically SMS in one system. Our proposed model contains various sensors which measure different parameters on a regular basis. In case of emergency a message will be sent to parents and/or police, by either pressing the panic button or pronouncing the keyword. The complete system is implemented using Raspberry Pi 3 Model B. Python programming is used interface all the sensors and other hardware. This device is wearable (like a wrist watch), and so it is easy to carry. [2]

Harikiran et. al. states that the current global scenario, the prime question in every girl's mind, considering the ever rising increase of issues on women harassment in recent past is mostly about her safety and security. 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. This paper suggests a new perspective to use technology for women safety. "848 Indian Women Are Harassed, Raped, Killed Every Day!!" That's a way beyond HUGE number! We propose an idea which changes the way everyone thinks about women safety. A day when media broadcasts more of women's achievements rather than harassment, it's a feat achieved! Since we (humans) can't respond aptly in critical situations, the need for a device which automatically senses and rescues the victim is the venture of our idea in this paper. We propose to have a device which is the integration of multiple devices, hardware comprises of a wearable "Smart band" which continuously communicates with Smart phone that has. The internet of things, or IoT, is a system of interrelated computational access to the internet. The application is programmed and loaded with all the required data which includes Human behavior and reactions to different situations like anger, fear and anxiety. This generates a signal which is transmitted to the smart phone. The software or application has access to GPS and Messaging services which is pre-programmed in such a way that whenever it receives emergency signal, it can send help request along with the location co-ordinates to the nearest Police station, relatives and the people in the near radius who have application. This action enables help instantaneously from the Police as well as Public in the near radius who can reach the victim with great accuracy.[3]

3. PROPOSED WORK

The main intension is to provide a security on the provision of safety and protection to women, with the goal of ensuring that they never experience a sense of helplessness in the face of such societal difficulties. It is possible to create a system that uses of devices such as arduino and gsm module. The proposed system presents an IoT-based women safety monitoring and emergency alert system designed to provide immediate assistance during critical or threatening situations. The system continuously monitors vital physiological parameters such as pulse rate (heart rate) and blood oxygen saturation (SpO_2), which are strong indicators of physical stress, panic, or medical distress commonly experienced during unsafe conditions. Biomedical sensors are used to measure the heart rate and SpO_2 values of the user in real time. An input from the sensors will be sent to the ESP32 microcontroller (Arduino-based) which continuously analyzing the incoming data with the preloaded threshold values representing abnormal or emergency conditions. When both the value reaching to the threshold the signal or sms is sent with current location of the victim, which help the receiver to reached out the location before any unfortunate thing happen. When the measured heart rate or SpO_2 value exceeds or falls below the specified threshold limits, the system automatically identifies the situation as an emergency. Upon detection, the ESP32 triggers an alert mechanism using a GSM module, which sends an SMS notification to pre-registered emergency contact numbers such as family members, guardians, or local authorities. The alert message includes the current geographical location of the woman, obtained through location tracking (GPS or network-based location), along with an emergency warning. This ensures that the concerned persons can quickly locate and assist the individual. The system operates without requiring manual intervention, thereby providing immediate support even if the victim is unable to actively request help. By integrating IoT technology, real-time health

monitoring, wireless communication, and location tracking, the proposed system offers a reliable and efficient solution to enhance women's safety. The use of compact and low-power devices such as the ESP32 Arduino and GSM module makes the system portable, cost-effective, and suitable for continuous real-world deployment. Receivers for the global positioning system (GPS), sensors for measuring body temperature, sensors for the global system for mobile communications (GSM), and pulse rate sensors in order to determine the location of a person and their current state of health in order to provide appropriate responses. The current circumstances of women who are in situations that are deemed to be severely abusive can be properly determined with the help of a number of sensors that can be applied. In circumstances such as these, a person's heartbeat is often faster. This factor, in conjunction with other sensors, such as motion sensors, allows for the identification of the woman's irregular motion when she is being abused. The decision-making process is aided by this information. When compared to the many different security options that are already available to women, such as a separate device, the concept that led to the development of a smart device specifically for women is that it is more convenient for them to use.

To ensure that women never feel helpless in the face of such societal challenges, the primary objective of this system is to build a security system that is completely focused on the provision of safety and protection to women. This is done with the intention of ensuring that women never feel like they are powerless. The creation of a sophisticated system that makes use of technological equipment such as an Arduino and a GSM module is something that is not impossible to accomplish. An Internet of Things (IoT)-based women's safety monitoring and emergency alert system is presented in the proposed system. This system is intended to provide prompt assistance in the event of severe or potentially dangerous circumstances. Vital physiological characteristics, such as pulse rate (heart rate) and blood oxygen saturation (SpO2), are continuously monitored by the system. These measurements are strong markers of physical stress, panic, or medical distress, which are typically experienced during risky settings.

4. WORKING FLOW OF THE PROPOSED SYSTEM

- The system is powered ON and initializes all connected hardware components, including the pulse rate and SpO_2 sensor, ESP32 Arduino, GSM module, and location tracking module.
- The ESP32 continuously collects real-time heart rate and SpO_2 values from the biomedical sensors.
- The acquired sensor data is processed and compared with predefined threshold values stored in the microcontroller memory.
- If the heart rate and SpO_2 values are within the normal range, the system continues monitoring without triggering any alert.
- When the heart rate exceeds the maximum threshold or the SpO_2 value falls below the minimum threshold, the system detects a potential emergency condition.
- Upon emergency detection, the ESP32 activates the GSM module.
- The system fetches the current location of the user using GPS or network-based location services.
- An SMS alert is automatically sent to pre-registered emergency contact numbers. The message includes:
  - Emergency notification
  - Current heart rate and SpO_2 values
  - Live location link of the user
- After sending the alert, the system continues monitoring the sensor values to check for further abnormal conditions.
- The system remains active until it is manually powered OFF or reset.

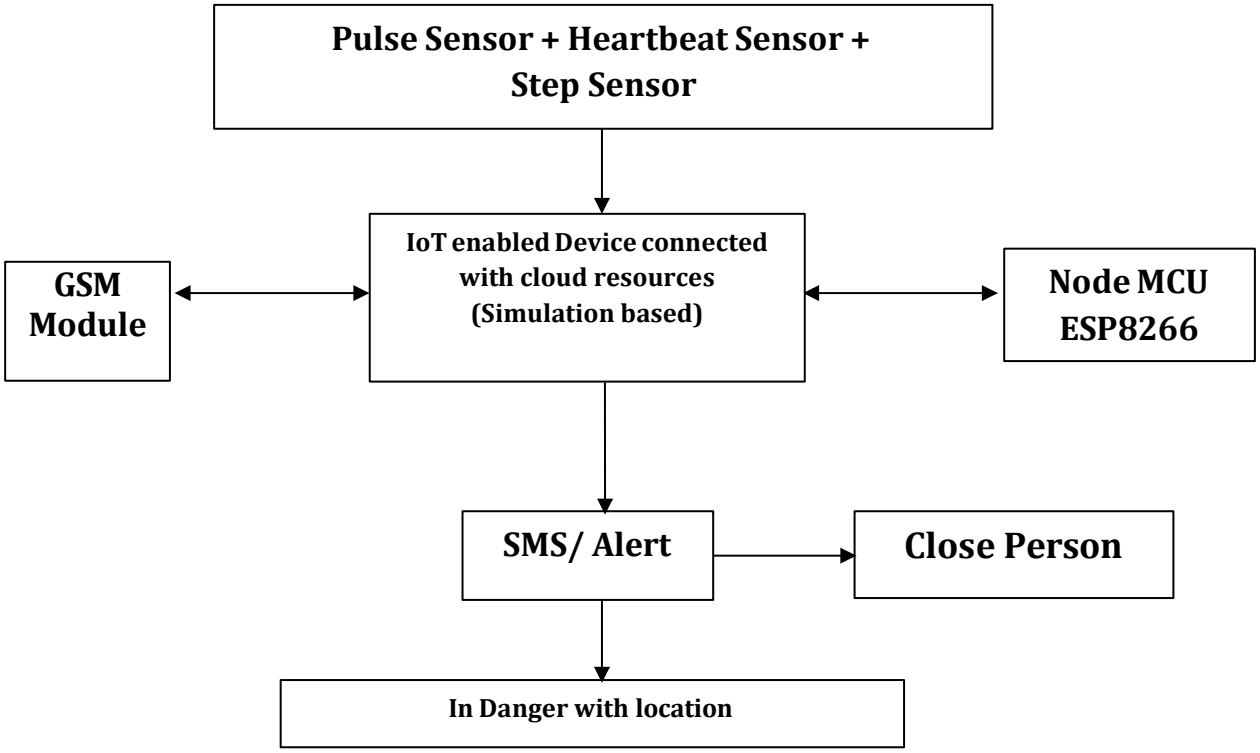

Figure 1. Structural flow of the system

5. ALGORITHM FOR WOMEN SAFETY MONITORING SYSTEM

Step 1: Start the system

Step 2: Initialize ESP32, sensors, GSM module, and location services

Step 3: Set threshold values for heart rate and SpO_2

Step 4: Read heart rate and SpO_2 sensor data

Step 5: Compare sensor values with threshold limits

- If (`Heart Rate > HR_threshold`) **OR** (`SpO2 < SpO2_threshold`) → Go to Step 6
- Else → Go to Step 4

Step 6: Activate emergency mode

Step 7: Acquire current location coordinates

Step 8: Send SMS alert via GSM module to stored contact numbers

Step 9: Log alert status (optional)

Step 10: Continue monitoring or wait for system reset

Step 11: Stop

6. RESULT

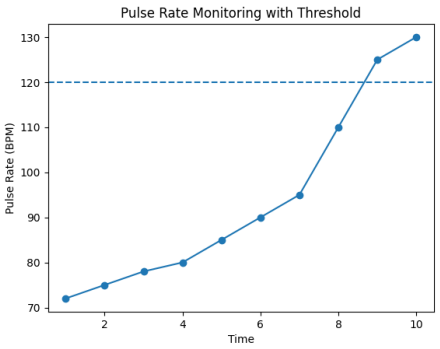

Fig. 2 Pulse rate normal and threshold value

Fig. 3 SPO_2 value normal and threshold value

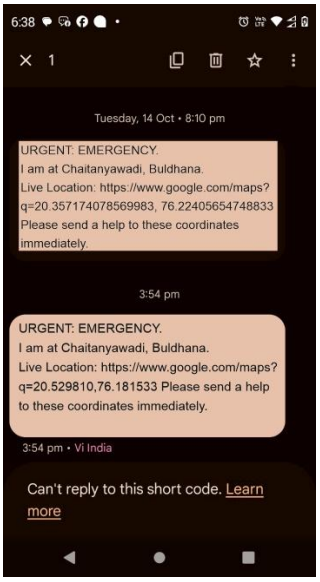

Fig. 4 SMs template for alerting the receiver

7. PREVIOUS SYSTEM

Many system was designed to solve the problems those are as follows:

- SHE (Society Harnessing Equipment): It is a garment embedded with an electronic device. This garment has an electric circuit that can generate 3800kV which can help the victim to escape. In case of multiple attacks it can send around 80 electric shocks [3].
- ILA security: The co-founders of this system, have designed three personal alarms that can shock and disorient potential attackers and hence safegaurd the victim from perilous situations.
- AESHS (Advanced Electronics System for Human Safety): It is a device that helps track the location of the victim when attacked using GPS facility.
- VithU app: This is an emergency app initiated by a popular Indian crime television series "Gumrah" aired on Channel [V]. When the power button of the Smartphone is pressed twice consecutively, it begins sending alert messages with a link of the location of the user every two minutes to the contacts.
- Smart Belt: This system is designed with a portable device which resembles a normal belt. It consists of Arduino Board, screaming alarm and pressure sensors. When the threshold of the pressure sensor crosses, the device will be activated automatically. The screaming alarm unit will be activated and send sirens asking help [4]

The main drawback of these applications and services is that the initial action has to be triggered by the victim which often in situation like these doesn't happen. So the emphasis is to build a solution that works autonomously in situations encountered.

8. CHALLENGES AND THE PATH FORWARD

- **Technical Reliability and Accuracy:**
  - Ensuring sensors (e.g., GPS, accelerometers, gyroscopes, biometric) provide consistent, accurate

data in varied environments (dense urban areas, rural zones, indoor/outdoor). False positives (unnecessary alerts) and false negatives (failure to alert in a real emergency) are critical issues.

- Battery life limitations for wearable or portable devices. A device that runs out of power quickly is ineffective.
- Connectivity issues in areas with poor network coverage (cellular, Wi-Fi, LoRaWAN). An emergency device is useless without reliable communication.
- Data latency. Delays in transmitting distress signals can be critical in time- sensitive situations.

- **Privacy and Security Concerns:**
  - Protecting sensitive personal data (location history, activity patterns) from breaches and misuse. This is paramount for trust and adoption.
  - Preventing unauthorized access to the device or its data by potential perpetrators.
  - Ensuring the privacy of the user even when the device is active (e.g., preventing constant tracking unless an emergency is declared).
- **Usability and Accessibility:**
  - Designing a device that is discreet, easy to activate under duress, and comfortable to wear or carry without drawing unwanted attention.
  - Ensuring accessibility for users with varying technological literacy, physical abilities, or language barriers.
  - Creating intuitive user interfaces for companion apps (for setting up contacts, monitoring, etc.).
- **Social and Ethical Considerations:**
  - Avoiding the creation of a "panic culture" or fostering excessive reliance on technology over community-based safety measures.
  - Addressing potential biases in algorithms if AI is used for threat detection (e.g., misinterpreting normal behavior as a threat).
  - Ensuring equitable access and affordability, preventing the solution from becoming a privilege rather than a universal safety tool.
  - Establishing clear protocols for emergency responders and ensuring their effective integration into the system (e.g., verifying alerts, response times).
- **Cost and Scalability:**
  - Keeping the manufacturing and subscription costs low enough to be affordable for a broad demographic, while ensuring quality and functionality.
  - Scaling production and deployment to reach a wide user base, including infrastructure for maintenance and support.

9. CONCLUSION

The reason that the system that has been developed is able to effectively satisfy the growing worry over the protection of women is because it provides a solution that is not only dependable and compact, but also technologically advanced. This is the reason why the system has been able to effectively satisfy the growing concern. Traditional safety devices, which are frequently bulky, difficult to maintain, or stressful to use, are addressed by the system, which solves the constraints of these devices. The system also addresses the fact that these devices are frequently burdensome. In order to accomplish this objective, all of these measurement devices, such as sensors for heart rate and SpO2, are consolidated into a single wearable device. The deployment of a platform that is based on Arduino guarantees the capture of exact data, the processing of data in real time, and the seamless integration of a range of components, which eventually results in an improvement in the system's overall efficiency and dependability.

A hidden operation is being demonstrated by the equipment that is currently being displayed, which stands in contrast to the standard safety protocols that are currently being demonstrated. This makes it more difficult for other people to recognize it as a safety measure, which in turn enhances its practical importance in scenarios that occur in the real world. Consequently, it is one of the most important things that can be done. Due to the fact that it blends cognitive decision-making with physiological monitoring, the system is able to execute a speedy response during times of crisis. Because of this, it is able to adapt to situations that are always shifting. As a consequence of the installation of the system, the risk of undesired outcomes and potential dangers can be reduced to a lesser extent. Additionally, because the device is wearable, it is possible to provide continuous monitoring without interfering with the activities that the user generally engages in. This gives the user the ability to continue with their normal activities.

In conclusion, this system is an illustration of a practical method that may be applied to significantly enhance the protection afforded to women by making efficient use of embedded

technology and the Internet of Things (IoT). There is the possibility that the solution that has been provided could be improved further in order to bring about improvements in terms of accessibility, scalability, and user engagement. The reason for this is that there is opportunity for future upgrades, such as the incorporation of mobile applications and improved control methods. For example, there is room for future improvements. By combining high-precision sensors and intelligent integrated architecture, the system, in general, makes a significant contribution to the development of contemporary safety solutions. Its primary objective is to offer women with immediate aid and protection. Consequently, this is carried out in order to meet the core aim of the system.

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