Design and Development of an IoT-Based Nirbhaya Smart Safety Watch for Women Safety

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Abstract— Women safety has become a major concern due to the increasing number of harassment and emergency situations faced by women in daily life. Traditional safety measures are often insufficient to provide immediate assistance during critical situations. This paper presents the design and development of an IoT-based Nirbhaya Smart Safety Watch that enables quick emergency response and real-time location tracking. The proposed system integrates an ESP32 microcontroller with GPS and GSM modules to transmit the user's location and emergency alerts to pre-registered contacts with a single press of an SOS button. Additional features such as an alert buzzer and compact wearable design enhance usability and effectiveness. The system aims to provide a reliable, portable, and cost-effective solution for women safety. The proposed design focuses on rapid response, ease of use, and continuous monitoring, making it suitable for real-time safety applications.

I.INTRODUCTION

Women safety is a critical social issue that requires immediate technological solutions to prevent crimes and provide rapid assistance during emergencies. Despite the availability of mobile applications and helpline services, accessing these solutions during panic situations is often difficult. Wearable safety devices provide a more reliable and quicker response compared to smartphone-based systems.

With advancements in Internet of Things (IoT) and embedded systems, smart wearable devices can be developed to continuously monitor user safety and transmit real-time information during emergencies. The proposed Nirbhaya Smart Safety Watch is designed to provide an instant alert mechanism by sending the user's live location to trusted contacts using GSM communication. The system addresses these limitations by integrating GPS and GSM modules with a user-friendly SOS mechanism.

ensures ease of use, minimal user interaction, and fast response time.

This paper focuses on the design and conceptual implementation of a smart safety watch that can be used as a preventive and responsive solution for women safety. The proposed system aims to enhance personal security using modern communication technologies while maintaining affordability and portability.

II. LITERATURE SURVEY

Several research works have been proposed to improve women safety using wearable and IoT-based systems. Existing systems mainly focus on mobile applications and GPS-based tracking solutions.

In [1], the authors proposed an IoT-based women safety system using a panic button that sends emergency alerts through GSM communication. Although effective, the system lacks portability and continuous monitoring features. In [2], a smart wearable device integrated with GPS and accelerometer sensors was developed to detect abnormal movements and transmit alerts. However, the system increases complexity and power consumption.

Another approach discussed in [3] introduced a smartphone-based safety application that shares live location during emergencies. The major limitation of this approach is the dependency on user interaction and smartphone availability. In [4], a wristband-based safety system was designed using wireless communication to send alerts to emergency contacts, but it lacked real-time tracking accuracy.

From the literature, it is observed that there is a need for a compact, reliable, and easy-to-use wearable safety device that provides instant alerts and accurate location tracking. The proposed Nirbhaya Smart Safety Watch

III. PROPOSED SOLUTION:

The system consists of a GPS module to obtain real-time location coordinates and a GSM module to transmit alert messages to pre-registered emergency contacts. An SOS button is provided to allow the user to manually trigger an

emergency alert during critical situations. A buzzer is included to generate an audible alert and attract nearby attention.

The compact and wearable nature of the device ensures continuous availability and ease of use. The proposed system is designed to operate with minimal user interaction while ensuring fast and reliable communication during emergencies.

IV. System architecture

The system architecture of the proposed safety watch includes input, processing, and communication units. When the user presses the SOS button, the ESP32 activates the GPS module to fetch the current location. The obtained latitude and longitude values are then processed and sent to the GSM module.

The GSM module transmits an emergency message containing the user's location to pre-defined contacts such as family members or authorities. Simultaneously, the buzzer is activated to alert nearby individuals. The overall system architecture ensures a quick response and efficient emergency communication.

V. METHODOLOGY

The methodology of the proposed Nirbhaya Smart Safety Watch focuses on providing a simple and efficient emergency alert mechanism. The system operates in a sequence of steps to ensure quick response during critical situations.

Initially, the device remains in an idle state while continuously monitoring the SOS button. When the user presses the SOS button, the ESP32 microcontroller is activated and initiates communication with the GPS module. The GPS module retrieves the current geographical location of the user in terms of latitude and longitude.

- Independent of smartphone usage

VIII. APPLICATIONS

The proposed system can be used in various real-life scenarios, including:

- Women personal safety
- Safety for children and elderly people
- Emergency alert system for travelers
- Campus and workplace safety
- Real-time tracking during emergencies.

XI.CONCLUSION

This paper presented the design and conceptual development of an IoT-based Nirbhaya Smart Safety Watch aimed at enhancing personal safety, especially for women during emergency situations. With the increasing concerns regarding women security, there is a strong need for compact, reliable, and easy-to-use safety solutions. The proposed system addresses this requirement by integrating essential embedded and communication technologies into a wearable form factor.

The system is designed to operate with minimal user interaction, where a single SOS button press is sufficient to activate the emergency mechanism. Upon activation, the ESP32 microcontroller

Once the location data is obtained, the ESP32 processes the information and forwards it to the GSM module. The GSM module sends an emergency alert message containing the user's location to pre-registered contact numbers. Simultaneously, the buzzer is activated to alert nearby people. This methodology ensures minimal delay and reliable emergency communication.

VI. FLOW OF OPERATION

The operational flow of the proposed system is designed to be simple and user-friendly. The following steps describe the working flow of the system:
Power supply is provided to the system.

- The ESP32 initializes all connected modules.
- The system waits for SOS button activation.
- When the SOS button is pressed, the GPS module captures the current location.
- The ESP32 processes the location data.
- The GSM module sends an alert message with location details.
- The buzzer is activated for local alert.
- This flow ensures rapid response and continuous reliability during emergency situations.

VI. ADVANTAGES

The proposed Nirbhaya Smart Safety Watch offers several advantages:

- Compact and wearable design
- Quick emergency response
- Real-time location tracking
- Easy operation with single button activation
- Cost-effective implementation

coordinates with the GPS module to acquire the real-time geographical location of the user. This location information is then transmitted through the GSM module to pre-registered emergency contacts, ensuring timely communication during critical situations. Additionally, the buzzer alert provides immediate local awareness by attracting attention from nearby individuals.

The proposed solution is independent of smartphones, making it suitable for users who may not have access to mobile devices during emergencies. The compact and wearable design allows continuous usage without discomfort, thereby improving reliability and accessibility. The system is also cost-effective, making it feasible for large-scale deployment in real-world applications.

Overall, the Nirbhaya Smart Safety Watch demonstrates how IoT and embedded systems can be effectively utilized to provide a practical and efficient safety solution. The proposed system has the potential to significantly reduce response time and improve emergency handling. In future work, the system can be enhanced by integrating additional sensors such as heart rate monitoring, fall detection, and geo-fencing, along with cloud connectivity and mobile application support to further strengthen personal safety and monitoring capabilities.

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