AI-DRIVEN SECURITY: REAL TIME WOMEN'S PROTECTION VIA IoT-BASED GUARDIAN DEVICE

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ABSTRACT: Women plays a key role in every family. Despite their contribution towards world they face many threats like public transport vulnerability, human trafficking, acid attacks, domestic violence, harassment etc., during covid-19 made them vulnerable to many cyber bullying attacks and there are many attacks they are going through. Harassment effects women's physical, mental and emotional well-being. Though a lot of existing solutions are there but not quite effective, they are of high costs and are considered for taking more response time and less battery life. In this research paper we are proposing an idea to reduce the response time where we have voice recognition system that takes the input commands from user we considered Elec house voice recognition system, when she have time in that distress situation else there we are also providing the panic buttons when the request is received firstly we start playing the buzzer/alarm sound in device through buzzer we inserted in it and also send messages and make calls to all their contact list using GSM module and trace their live location through GPS Module and also send it to all the nearby emergency services. When considering different existing solutions this device takes less response time.s

Keywords: *Women Safety, Voice Recognition System, Panic Buttons, Emergency Alerts, GPS Tracking, GSM Module*

I. INTRODUCTION

The convergence of Internet of Things (IoT), Artificial Intelligence (AI), and wearable devices is shaping the future of technology, making it more intelligent, efficient, and user-centric. [1]IoT connects devices, enabling them to share data seamlessly over the internet, while AI analyzes this data to provide actionable insights. Wearable devices, equipped with sensors, serve as a bridge between users and these technologies, collecting real-time data on health, fitness, and environment. Together, these innovations create a connected ecosystem that enhances daily life, improves decision-making, and enables personalized experiences.

IoT and AI Integration drives the evolution of wearables, empowering them to perform advanced tasks beyond simple tracking. [4]For instance, AI-powered wearables can predict health anomalies by analyzing patterns in heart rate or blood oxygen levels. IoT ensures these devices are connected to cloud platforms or other systems, enabling real-time data sharing with healthcare providers or fitness apps. [5] This integration fosters smarter healthcare, remote patient monitoring, and proactive fitness management, paving the way for improved health outcomes and lifestyle changes.
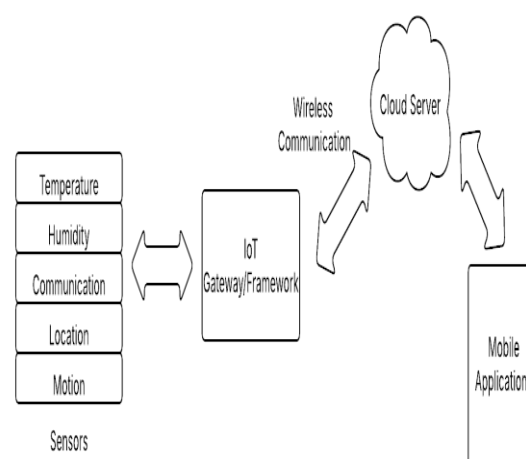

Fig 1: System Architecture

The benefits of combining these technologies extend to multiple domains. Wearables with AI and IoT capabilities offer predictive maintenance in industrial settings, real-time monitoring for athletes, and enhanced productivity in workplaces.[9] For example, a wearable smart glass can guide technicians through repairs by overlaying instructions via augmented reality. Similarly, IoT-enabled smartwatches with AI-driven alerts can notify users about unusual health patterns, such as an irregular heartbeat, prompting timely medical intervention.

While this integration promises significant advantages, it also presents challenges like data privacy, security, and battery efficiency. The vast amount of sensitive data collected by wearables must be safeguarded against breaches, requiring robust encryption and compliance with data protection laws. Additionally, maintaining user comfort and device longevity remains critical for widespread adoption. Despite these hurdles, the synergistic potential of IoT, AI, and wearables continues to drive innovation, offering a glimpse into a future where technology is seamlessly woven into the fabric of daily life.

A. PROBLEM STATEMENT:

Women face various threats like harassment, domestic violence, acid attacks, public transport safety issues, and even human trafficking. These threats affect their physical, mental, and emotional well-being. The COVID-19 pandemic made things worse, with more cases of cyberbullying and online harassment. Although there are some safety devices available, many of them are expensive, take too long to respond, and have short battery life.There is a need for a safety device that works faster, is more affordable, and is easier to use. The primary problem identified is the increasing prevalence of threats to women's safety, such as harassment, assault, and other forms of violence, with limited tools available to provide immediate assistance. In many cases, victims are unable to communicate their distress or location effectively, leading to delays in help. 28,211 harassment cases were recorded in India, in the year 2023.805 million harassment cases were reported all over the world in the year 2023.Furthermore, many safety devices are either too expensive or lack essential features like real-time tracking or instant alerts to multiple contacts.

B. RESEARCH GAPS:

I. Most devices use the manual activation of the user to press a button or activate a feature. However, in critical situations, users may not be able to do so, and the alerts will then be delayed.

II. Due to the use of low cost hardware,the battery life of the device is less efficient.

III. The limitation of storing only one contact is identified as significant gap as it restricts the device ability to notify multiple contacts during emergency.

IV. In all the existing devices there is only one method of communicating the emergency situation.

V. Some of the devices are not user-friendly which is inconvenient to carry.

VI. Some Device require technical knowledge to activate during emergency situation.

II. LITERATURE REVIEW

Dr. Pallavi Devendra Deshpande et.al,2024 : This paper proposed a system with the integration of Arduino and GPS Tracking Technology. It is used to provide a real-time position monitoring and distress signal activation with portable and wearable designs

C K Gomathy et.al,2023 : In this paper, a women's safety product system is typically designed which includes sensors like voice recognition, GSM, and GPS, along with audio and video recorders. These sensors are connected to a central controller that collects data, compares it to standards, and transmits results to authorities. IoT technology enhances the system's efficiency, simplicity, and compactness.

Dr. Chanda V Reddy.et.al,2023 : This paper proposes a women's safety system that provides self-defence and also consist of a device with salient features. it is used to provide Audio recording of incidences Emergency Preparedness, Wearable Designs

Bhasutkar Mahesh et.al,2023 : The system operates by sending live location and notifications to family members in emergency situations, thus facilitating prompt assistance. It also captures and sends live images, which is visual evidence of the situation.

Sharad Saxena et.al,2023 : The proposed Women Safety Gadget (WSG) aims to design a wearable safety device model based on Internet-of-Things (IoT) and Cloud Technology. It is designed in three layers, which updates information in the cloud database.it is used Real-time Location Alerts,

Integrated Defence Mechanism: Pepper spray system deters attackers immediately.

Hrucha Wankhade et.al,2022 : The safety device mentioned in this paper will generate an emergency alarm and send a message to the user's friend, family or to the police. This will also help women or concerned during her trouble and keep others alert. By this process location tracking becomes easy.

Bhargav D V et.al, 2022: This paper focusses on proposed systems: A.Safelet:- Safelet works through a Bluetooth 'low energy' association and is actuated by all this while tapping on the two buttons as an afterthought. B. Sound Grenade:-This device was designed in the U.S.A and is very well appraised for it utility among people. This can be very useful, especially for women, kids, and Senior

Citizens. They are used for Quick Emergency Response, Discreet Design looks like a bracelet.

T.P. Suma et.al, 2021 : The device specified in this paper uses IoT technology to detect screaming sounds and capture video evidence in cases of emergencies. It gives real-time alerts to the authorities and family members, thus providing timely aid. Improving women's safety and security.

Manikumar et al.,2021 : This paper gives information about the survey they conducted for the existing women safety devices their advantages and the limitations existed. They mainly mentioned about the traces of the culprits are not being found, limited power, self-defense tricks like shock generators etc.. When rectified these and made improvements could lead in a better way for women protection using these wearable devices

S.NO	YEAR	AUTHORS	ARTICLE TITLE	KEY FINDINGS
1	2024	Dr.Pallavi Devendra Deshpande et.al	Women safety device with GPS tracking and alerts using Arduino	Portable and Wearable Design, Alert Settings, Multi-Language Support, Buzzer or Speaker: Triggers alarm sound
2	2023	CK Gomathy et.al	A review on women safety device - stree	Less power consumption, Simplicity of use
3	2023	DR. Chanda V Reddy et.al	Literature survey on women safety device	Audio recording of incidences Emergency Preparedness, Wearable Designs
4	2023	Bhasutkar Mahesh et.al	IOT based smart wearable device for women safety	Real-time monitoring, Automated alerts
5	2023	Sharad Saxena et.al	IoT-Based Women Safety Gadgets (WSG): Vision, Architecture, and Design, Trends	Real-time Location Alerts, Integrated Defense Mechanism: Pepper spray System deters attackers immediately.
6	2022	Hrucha Wankhade et.al	Women's safety device with GPS tracking and alert	Improved, Convenient
7	2022	Bhargav D V et.al	Market analysis of women's safety devices	Quick Emergency Response, Discreet Design looks like a bracelet
8	2021	T.P. Suma et.al	IoT- based women safety device with screaming Detection and video capturing	Improved Safety, Real-time Response
9	2021	ManiKumar M. et.al	Guardian device for women	Neuro-Stimulator for Self-Defense, Spy-Cameras could capture the images of the attacker
10	2019	Swathi S et.al	Women Safety Device Using Panic Button	Panic Button: Pressing the button sends an alert to emergency contacts.
11	2019	Wasim Akram et.al	Design of a Smart Safety Device for Women using IoT	Biometric Authentication (Fingerprint Scanner),Multiple Communication Channels (GSM Module)

III. METHODOLOGY

A) OBJECTIVES:

The main objective of Guardian Device for Women Safety Using Iot With AI is to develop a wearable device which can be used to enhace the women's safety.

The main features of this device are to provide real-time location tracking and instant alerts to predefined contacts during emergency situations.

The alarm generation reduces the response time and helps the victim to get out of the threat. Voice recognition module reduces the manual hands-on activation of the wearable safety device.

Loud Audible buzzer sounds will cause nearby crowd to react quickly and take immediate actions against the attackers. The Guardian Device For Women Safety device provides reliable functionality.

Ensure compatibility with various communication networks for reliable functionality. To Design a compact, user-friendly, and discreet wearable device. To Improve accessibility and usability for women of all age groups and professions. Fostera sense of security and independence through advanced safety technology.

B) ALGORITHMS USED:

The algorithms used in a wearable women's safety IoT device with AI include:

1) **Dynamic Time Warping (DTW)** : It is a **voice recognition algorithm**.It is used to compare a recorded voice input with predefined templates to identify spoken commands. It works by aligning the temporal patterns of the input speech with the stored reference, even if there are variations in speed or pronunciation. For instance, if "Help" is spoken slowly or quickly, DTW stretches or compresses segments of the input to match the reference pattern effectively. This flexibility makes DTW suitable for systems with limited vocabulary, like IoT-based safety devices. However, DTW is less effective in handling complex, large-scale voice datasets or noisy environments.

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reference, even if there are variations in speed or pronunciation. For instance, if "Help" is spoken slowly or quickly, DTW stretches or compresses segments of the input to match the reference pattern effectively. This flexibility makes DTW suitable for systems with limited vocabulary, like IoT-based safety devices. However, DTW is less effective in handling complex, large-scale voice datasets or noisy environments.

3) **Kalman Filter:** The Kalman Filter is a **GPS location tracking algorithm** by combining noisy measurements with predictions based on the system's motion model. It predicts the state of the tracked object and updates this prediction when new GPS data is available, giving more weight to the more reliable source.
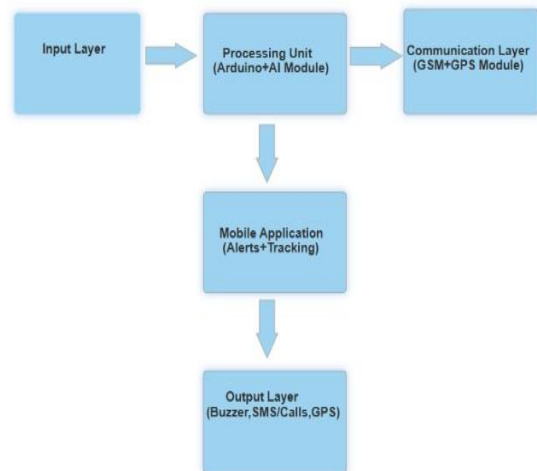
C) PROCESS FLOW:

Fig 2: Process Flow

Step 1: Hardware Setup and Component Integration

The first step in implementing the system is gathering and connecting all necessary hardware components. The core components include an Arduino microcontroller, a voice recognition module (such as the Elechouse Voice Recognition Module V3), a GPS module (e.g., NEO-6M), a GSM module (such as the SIM800L or SIM900 for sending SMS and making calls), a buzzer for alerts, and a suitable power supply (such as a rechargeable battery).

Step 2: Voice Recognition Module Configuration

In this step, the voice recognition module is configured to detect specific voice commands that will trigger the emergency responses. Using the training software provided with the module,

commands such as "Help" or "Emergency" are recorded.

Step 3: System Integration and Testing

Once the individual modules are programmed and tested, the next step is to integrate all components and conduct system-wide testing.

This involves connecting the voice recognition module, GPS module, GSM module, and buzzer to the Arduino.

The system is then tested by simulating an emergency.

Step 4: Power and Enclosure Design

The next step focuses on ensuring the system is portable and can run for extended periods. The device is powered by a rechargeable battery or power bank, and the power consumption of each component is optimized to extend battery life.

Step 5: Final Testing and Deployment

In the final step, the device undergoes comprehensive real-world testing to ensure that it works reliably in various emergency scenarios.

This includes testing the voice recognition module in noisy environments, verifying the accuracy of the GPS module for location tracking, and checking the GSM module's ability to send SMS and make calls in areas with varying network strength.

IV. RESULTS & DISCUSSION

This research paper includes to enhance personal safety in emergency situations. The device allows users to input commands through either voice recognition or a panic button. Once activated, it generates alarms to alert those nearby, while simultaneously sending the user's live location to predefined emergency contacts.

Additionally, the device automatically places calls to both emergency services and predefined contacts, ensuring immediate assistance. By integrating these features into a compact, user-friendly wearable, the device offers an efficient and reliable way to quickly respond to emergencies and ensure safety.
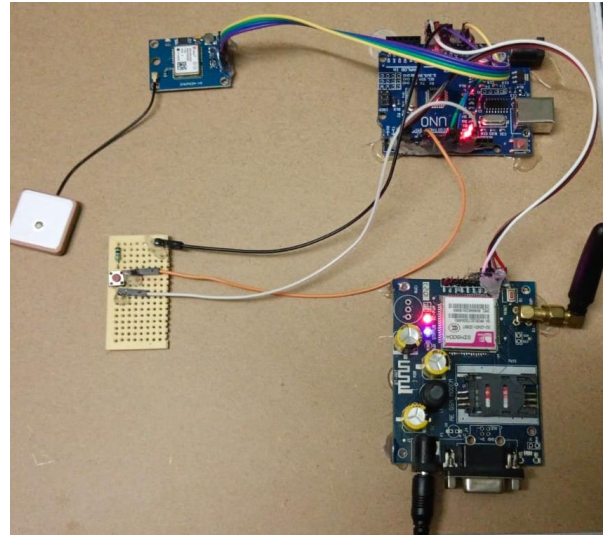

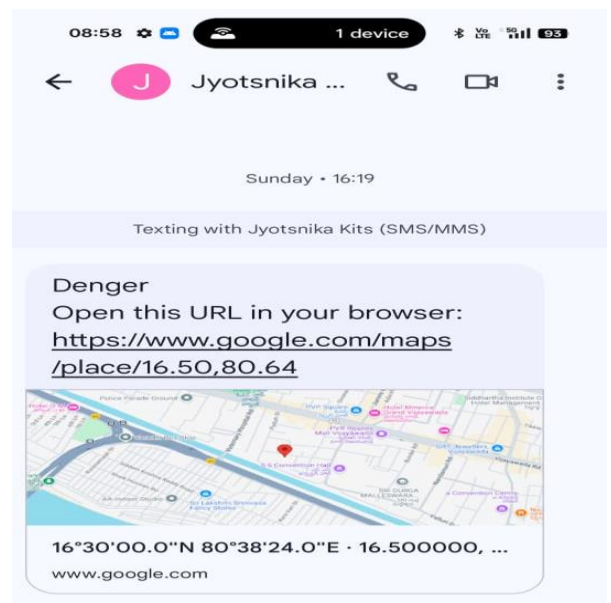Fig 3 : Hardware setup for Guardian Device

Fig 3: A wearable IoT-based safety device that sends the user's real-time location via SMS to emergency contacts

V. CONCLUSION

In conclusion, this IoT-based women's safety device represents a key step forward in technology to enhance personal security. By integrating GPS tracking, AI-driven voice recognition, and real-time alert systems, the device ensures rapid response during emergencies, providing peace of mind and empowerment for women. Its ability to produce an audible alarm, send accurate live location details, and alert pre-defined contact list and emergency services demonstrates a approach to addressing safety concerns. This innovative solution highlights the potential of IoT and AI in creating smarter, more secure environments for women, welcoming a safer environment.

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