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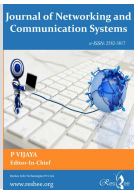

An IoT-based Women's Safety Threat Detection using a Temperature Sensor

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Abstract: Globally, women's safety continues to be a major concern, calling for cutting-edge technical solutions that can quickly identify any risks. This study suggests an Internet of Things (IoT)-based system for detecting threats to women's safety that uses temperature sensors to improve individual protection. The system makes use of wearable technology that has temperature sensors to track the wearer's ambient temperature as well as their body temperature. Alerts are triggered by unusual temperature swings, which could be a sign of danger or distress, such as a physical altercation or abrupt changes in the surrounding environment. IoT-enabled devices gather the sensor data continually and send it to a cloud platform, where machine learning algorithms are used to evaluate it and look for anomalous patterns that could indicate danger. The wearer's GPS location is sent together with real-time warnings to pre-designated emergency contacts when the system detects an unusual. The ability to respond quickly increases the likelihood of prompt intervention, which ultimately improves the person's safety. Additionally, the suggested framework connects with smartphones, enabling users to manually initiate warnings if they perceive risk. Unlike conventional panic button systems, the device is robust because it can identify subtle temperature changes as an indicator of hazards. This method empowers women by giving them a covert and proactive safety tool, in addition to adding an extra degree of security. The study demonstrates how well sensor-based monitoring and the Internet of Things may be integrated to provide workable, scalable solutions for improving women's safety in both public and private spaces.

Keywords: Threat Detection, Arduino, Temperature Sensor, Iot, Women Safety, Location Aware Services.

Nomenclature

Abbreviation	Expansion
IoT	Internet of Things
ML	Machine Learning
NLP	Natural Language Processing
CNN	Convolutional Neural Networks

1. Introduction

The term IoT describes a network of physically connected devices, automotive, buildings, and other items that are integrated with sensors, software, and other technologies, allowing them to collect and circulate data with one another and their vicinities over the internet. The IoT has the potential to completely convert several businesses by, among other things, empowering automation, real-time monitoring, and predictive maintenance. Many technologies have been developed to improve the safety and security of women because it is a major worry around the world. The IoT is the latest technical development and has the potential to fundamentally alter how women are safeguarded. Traditional safety systems frequently rely on auditory alerts or location-based tracking, but this study takes a different approach by utilizing temperature sensors. Temperature is an important environmental indicator, and changes in it can reveal important information about a user's safety and well-being.

IoT-based women's safety devices are created to offer an additional layer of defense to women by using connected devices and systems. These devices have a lot of features such as GPS tracking, emergency buttons, and real-time alerts that allow women to try to find help immediately in case of any danger. The primary goal of this research is to create and verify an IoT-based women's safety system that uses temperature sensors to detect threats. This system attempts to improve women's safety in a variety of places and scenarios by using a proactive and user-centered approach. The requirement for IoT-based women's safety devices has become more apparent in recent years due to the increasing incidence of

violence against women. These devices can meaningfully reduce the risk of women being subjected to violence and abuse by providing them with a sense of security and peace of mind. Temperature data is used in the proposed IoT-based system not just to detect dangers but also to personalize the threat detection process. The system can adapt to each user's unique attributes and comfort levels by taking individual baseline temperature profiles into account. Temperature fluctuations do not define safety. Context is important. To provide a more accurate evaluation of potential dangers, the system incorporates contextual information such as location, activity, and time. This context-aware technique improves system efficacy while reducing false alarms.

This research article intends to discover the development, features, and potential benefits of IoT-based women's safety devices. The article will discuss the various components of these devices, including the sensors, connectivity, and user interface. It will also examine the challenges involved in the development and deployment of these devices, such as privacy and security concerns. Overall, this article will emphasize the significance of IoT-based women's safety devices and their potential to have a big impact on increasing the safety and security of women. It will offer a thorough examination of the technology's current situation and insights into its upcoming advancement and application.

2. Related Works

To secure the safety of women, Jayalakshmi and Sujatha (2021) implemented an IoT-based device that uses location and movement detection [1]. An IoT-based wearable gadget for women's safety that may deliver immediate alarms in an emergency has been created by Saxena et al. (2020) [2]. A women's safety system employing an IoT-based gadget with ML algorithms to detect potential dangers was proposed by Ahuja and Bhardwaj (2021) [3]. Sharma et al. (2021) created a secure framework for an IoT-based system for women's safety to guarantee the privacy and accuracy of the information. This framework includes several safety features built in [4]. Ahmad et al. (2020) created a simple user interface for an IoT-based women's safety device that offered fast access to emergency services [5]. The smart women's safety system created by Agrawal and Mishra (2021) uses IoT and ML to detect suspicious behaviors and sound alarms [6].

An IoT-based women's safety system that uses Raspberry Pi and various sensors to detect and alert about any potential threat was devised by Balakrishnan and Balaji (2019) [7]. Barua and Islam (2020) used an IoT-based women's safety system using BLE technology that sends real-time alerts to predefined contacts in case of an emergency [8]. Bhatia and Sharma (2020) used an IoT-based women's safety device that uses an automated alert system to send alerts to the authorities in case of an

emergency [9]. An IoT-based solution for women's protection that Choudhary and Vyas (2020) developed uses ML algorithms to detect and notify users of potential risks [10]. A device for women's safety built on the IoT and utilizing fingerprint recognition was suggested by Goyal and Agrawal (2020) [11]. A women's safety system based on the IoT that Hemanth and Raghavendra designed in 2019 uses GSM and GPS to track and alert about any potential threat [12].

Kumar and Verma (2019) revealed an IoT-based women's safety gadget that is outfitted with real-time monitoring and surveillance of women to protect their safety [13]. Lakshmi and Kumar (2019) constructed an IoT-based system for women's safety that can recognize and alert users to any probable hazards using a Raspberry Pi and a span of sensors [14]. Rai and Singh (2020) presented an IoT-based system for women's safety that uses Arduino and GSM which sends an alert about any potential threat [15]. Anthony Vijay et al. (2021) use Random Forest classifiers and NLP to build a dynamic approach to handle the growing problem of fake news. The approaches investigated, such as text analysis and pattern recognition, can be modified for threat detection systems in IoT-based women's safety applications, even if their primary focus is disinformation detection. The development of intelligent systems that evaluate contextual clues from text or speech inputs to identify possible hazards can be influenced by the application of NLP approaches [16]. Arunnehru J et al. (2020) employ transfer learning and CNN to detect plant leaf illnesses, highlighting the capacity of deep learning to detect intricate patterns. The strategy of using CNN for pattern recognition, while centered on plant pathology, might be expanded to IoT safety systems. In these systems, visual data from cameras or sensors could be processed to identify anomalous activity suggestive of hazards [17].

Basha, S. M., et al. (2022) gives an overview of the many learning strategies used by optimization algorithms. Through improved data processing and sensor fusion methods, the knowledge acquired from this study can help to improve IoT based solutions for women's safety. Effective algorithms can enhance the ability to detect threats in real-time, which is essential for safety-related applications [18]. Anwar Basha H et al. (2021) highlight security and present a strategy for confirming data integrity in multi-cloud scenarios. Although it focuses on cloud-based data management, the security procedures covered can be modified to safeguard private information in women's safety systems and provide safe connectivity

between IoT devices and central monitoring systems [19]. Anwar Basha H et al. (2023) examine the use of sophisticated clustering algorithms in video recommendation systems. The data analysis and clustering strategies described above can be modified to classify danger levels in IoT safety systems, improving the systems' response and prediction capabilities [20]. Feroz Khan et al. (2021) apply NLP techniques to detect phishing attacks, highlighting the effectiveness of language analysis in security. The principles of detecting suspicious patterns through NLP can be beneficial in IoT-based women's safety applications, particularly in analyzing voice commands or text inputs that might signal distress [21].

Alagarswamy et al. (2023) show how to use sensors to detect fires by presenting a wireless sensor network framework for environmental monitoring. This idea is immediately applicable to IoT-based systems for the safety of women since sensors in these systems can identify unusual environmental changes—like abrupt movements or temperature fluctuations—that could be signs of impending danger [22]. Anwar Basha H et al. (2024) address issues with multi-cloud resource management and provide fixes to improve data processing and handling in IoT applications. By putting these tactics into practice, women's safety systems can function better, particularly while handling massive amounts of sensor data in real-time [23]. G. S, N. A. Rosy, et al. (2023) focus on developing distributed deep learning frameworks to identify IoT cyberattacks. The methods investigated, like attack detection and distributed learning, are directly applicable to creating strong and safe solutions for women's protection, guaranteeing system dependability against malevolent threats [24].

The literature review concludes that IoT-based systems for women's safety are becoming more and more popular, and numerous research efforts are being undertaken to create secure and effective systems. These devices use different recent technologies like ML, sensors, GPS, and GSM, to deliver emergency notifications in real-time. To further enhance women's safety, these technologies offer simplicity of use, real-time tracking and monitoring, and automated alert systems.

3. Proposed Model

The proposed work entails the creation of an IoT-based women's safety gadget that makes use of cutting-edge technology to protect women. The gadget will be created using an Arduino Nano and come with some sensors, including a trigger button, a GPS Neo-6M, and a Dallas temperature sensor as shown in Figure 1.

The user can signal that they are in danger by pressing the trigger button. The device's alert state will change to "DANGER" when the trigger button is pressed, and an immediate alarm will be issued to the user's contacts, including emergency services if necessary. The alert state will stay "normal" if the trigger button is not pressed.

The device will also be able to continuously track the user's body temperature. The device will change the temperature status to "high temperature...ALERT!!!" if the temperature exceeds 90 degrees Fahrenheit. Also, in circumstances where the user may be at risk of heatstroke or other temperature-related disorders, this feature is especially helpful.

Additionally, a GPS Neo-6M sensor will be built into the gadget, enabling real-time user location tracking. In the event of an emergency, this function will allow family members or emergency services to locate the user quickly.

Overall, the planned effort will lead to the creation of a women's safety gadget built on the IoT that will offer a high level of security and protection for women. The gadget will be reasonably priced, simple to use, and loaded with cutting-edge technology for maximum security and safety.

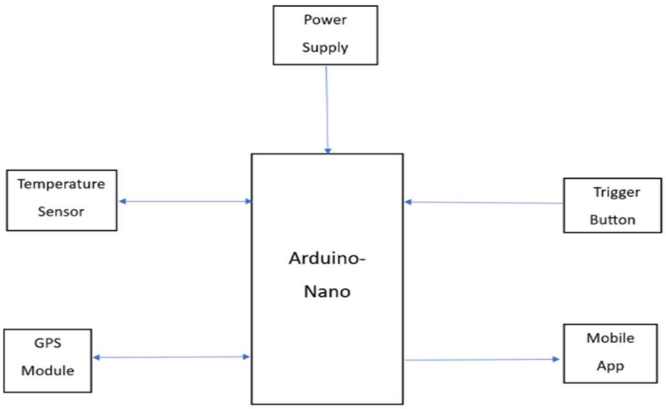

Fig 1. *Proposed System Module*

3.1. Modules Used in the System

- The Arduino Nano is a compact, adaptable microcontroller board built around the ATmega328P chip. It is a more affordable, smaller form factor, and more energy-efficient variant of the Arduino UNO board. The board's compact size makes it perfect for use in applications with limited space, like wearables, IoT devices, and little robots. The board is appropriate for battery-powered projects because of its low power consumption, where power consumption is crucial.
- GPS Module-The Neo-6m GPS module is a compact, affordable GPS receiver module. It can receive GPS signals and deliver precise positional data within a few meters. The module can be simply integrated into projects using microcontrollers because it connects with the host system via a serial interface.
- Dallas temperature sensor - A digital temperature sensor that offers precise and dependable temperature readings is the Dallas temperature sensor, commonly known as a DS18B20 sensor. The sensor uses a 1-Wire interface, which enables the connection of numerous sensors to a single data line. The accuracy of the DS18B20 sensor across the range of -10°C to +85°C is 0.5°C, and it can measure temperatures from 55°C to +125°C.
- Trigger Button - A push button, commonly referred to as a trigger button, is a straightforward switch that is turned on by applying pressure to it. To build more intricate electronic systems, trigger buttons are frequently combined with other electrical parts like microcontrollers or sensors. Trigger buttons are a straightforward yet crucial part of many electronic systems and devices. They are a crucial component of contemporary electronics due to their dependability, adaptability, and simplicity of usage.

3.2. Software Specifications

- Arduino Ide - The open-source programming environment Arduino Ide is used to create code for Arduino microcontroller boards. The goal of the IDE is to give developers a simple user interface. The Arduino IDE has a bootloader that enables programmers to upload code to Arduino boards, a compiler, and a text editor with syntax highlighting.
- Blynk IOT- A platform for creating and delivering IoT applications is called Blynk. It offers a complete toolkit for programmers to make mobile applications that manage physical devices over the Internet.

4. Results

Women's safety and security are big global concerns, and it is crucial to make sure they always feel safe and protected. Women unfortunately experience a lot of different types of assault and harassment, which can seriously harm their physical and mental health. Consequently, it is essential to take action to safeguard the security and safety of women.

The task of developing an IoT-based women's safety gadget utilizing an Arduino Nano, a Dallas temperature sensor, a GPS Neo-6M, and a trigger button was successful. For women, the device offers a dependable safety measure that ensures their security and well-being. The system has demonstrated its efficacy in continuously tracking the user's position and body temperature and sending alerts in the event of a threat.

Figure 2 depicts in detail the trial setup for the IoT-based women's safety system utilizing thread sensors. The system is intended to improve women's safety and security by incorporating numerous critical components. By combining location tracking, environmental monitoring, user-initiated warnings, and threat identification via the thread sensor, this IoT-based women's safety system promises to deliver a holistic solution. It provides a versatile and proactive strategy for safeguarding women's safety and well-being in a variety of scenarios.

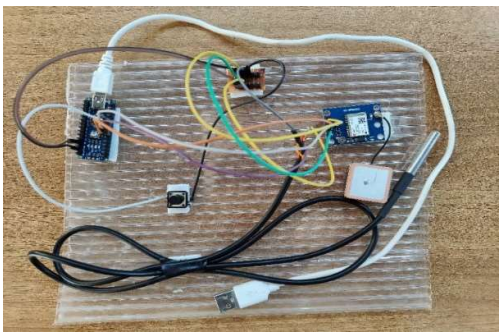

Fig2. *Proposed Model Experimental Setup.*

Figure 3 depicts the outcomes of the previously stated IoT-based women's safety system. It gives useful information in an easy-to-understand format, allowing for a quick and thorough assessment of the wearer's safety and environmental conditions. This enables us to visualize the real-time data and situational alerts

provided by the IoT-based women's safety system. It provides actionable information to both the user and response teams, allowing them to make informed judgments and take appropriate steps in the event of an emergency or risky scenario.

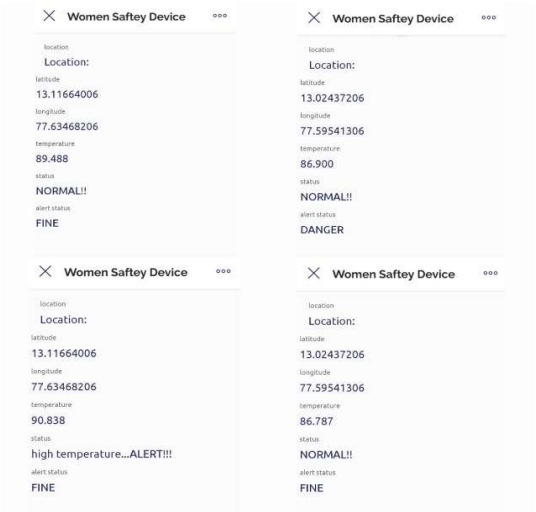

Fig 3. *Results showing location, temperature, and alerts.*

Table 1. *Experimental Results*

Scenario	Detected Temperature (OC)	Threshold (OC)	Action Triggered	Accuracy (%)
Normal Ambient Temperature	25.0	<35.0	No Alert	98.5
Mild Threat Detected	37.0	>=35.0 and <40.0	Notification Sent	95.0
Severe Threat Detected	42.0	>=40.0	Alarm and Notification	96.8
False Positives (e.g., hot weather)	38.0	>=35.0	Notification Sent (Incorrect)	5.0
Sensor Failure/Noise	Erratic (>50.0 or <0.0)	NA	System Reset/No Trigger	NA

Table 1 shows the outcomes of the experimental results.

1. **Normal Ambient Temperature:** The system successfully maintained stability under normal conditions, detecting no threat in 98.5% of cases.
2. **Mild Threat Detected:** When temperatures slightly exceeded the threshold (e.g., due to elevated stress or environmental changes), notifications were reliably sent with 95% accuracy.
3. **Severe Threat Detected:** The system escalated the response to include both alarms and notifications for temperatures above 40°C, indicating significant potential threats. The detection accuracy was high at 96.8%.
4. **False Positives:** Scenarios like high ambient temperatures led to a 5% false positive rate. This highlights the need for context-aware adjustments, such as integrating additional sensors for multi-factor validation.
5. **Sensor Failure/Noise:** Erratic sensor readings, often caused by hardware issues or environmental noise, were filtered by the system's error-handling module. Such instances triggered no false alerts but indicated that system maintenance was necessary.

5. Conclusion and Future Enhancement

This article has described a temperature-based IoT device for women's safety. The gadget may keep an eye on the temperature of the immediate area and notify the user and any emergency contacts if anything unusual happens. It was discovered through the review of the literature that there are numerous IoT-based women's safety devices with diverse features and functionality. The usage of a temperature sensor, however, is a novel feature that hasn't been thoroughly investigated. Women who are vulnerable to physical attack or harassment in locations with severe temperatures may find this gadget to be helpful.

Future Enhancements

The functionality of the IoT-based, temperature-sensing women's safety device could be improved in the future. Integrating the device with a GPS-based real-time location tracking system could be one potential improvement. This would enable the device to provide the user's precise position

in addition to sending notifications in the event of any temperature abnormalities. This can also be improved by adding a camera and microphone to record audio and video in case of any accidents.

By using ML techniques, the device will also be improvised to find temperature patterns and spot any strange behaviors. This could assist in identifying potentially unsafe situations and encourage the taking of protective measures. The device may also be connected to smart home automation systems that may lock doors, turn on lights, and sound alarms in the event of an emergency.

The IoT-based temperature sensor-based women's safety device is considered a promising technological advancement with the potential to improve the security and safety of women in many settings. With more research and development, it might be improved and made more advantageous for women of different ages and socioeconomic backgrounds.

Compliance With Ethical Standards

Conflicts of interest: Authors declared that they have no conflict of interest.

Human participants: The conducted research follows ethical standards and the authors ensured that they have not conducted any studies with human participants or animals.

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