A

Project Report

on

" Raspberry Pi - Based Women and Children Safety Device with GPS Tracking and Alerts"

Submitted in partial fulfillment for the award of the degree of

Bachelor of Technology

in

Electronics Engineering with Specialization in IoT

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DECLARATION

I hereby declare that the work, being presented in the project report entitled as **" Raspberry Pi - Based Women and Children Safety Device with GPS Tracking and Alerts"** in partial fulfillment of the requirement for the award of the Degree in **Bachelor of Technology in Electronics Engineering** and submitted to the Department of Electronics Engineering of J.C. Bose University of Science and Technology, YMCA, Faridabad is an authentic record of my own work carried out during a period from **October 2024** to **December 2024** under the supervision of **Dr. Rohit Tripathi (Assistant Professor)**, Department of Electronics Engineering. No part of the matter embodied in the project has been submitted to any other University / Institute for the award of any Degree or Diploma.

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CERTIFICATE

This is to certify that the project entitled, **"Raspberry Pi - Based Women and Children Safety Device with GPS Tracking and Alerts"** submitted in partial fulfillment of the requirements for the degree in **Bachelors of Technology in Electronics Engineering with Specialization in IOT** is an authentic work carried out under my supervision and guidance.

Dr. Rohit Tripathi (Assistant Professor)
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ACKNOWLEDGEMENT

We take this opportunity to express our deep sense of gratitude and respect towards our supervisor Dr. Rohit Tripathi (Assistant Professor), Department of Electronics Engineering, J.C. Bose University of Science & Technology, YMCA, Faridabad.

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ABSTRACT

The rise in safety concerns for women and children, particularly in vulnerable situations such as traveling alone or being in isolated areas, necessitates a reliable and effective solution. This project, *Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts*, aims to deliver a comprehensive safety mechanism that leverages modern technology to address risks associated with personal security. By integrating advanced hardware and software components, this system overcomes the limitations of existing solutions, such as dependency on manual intervention, offering an automated and feature-rich alternative.

The system employs the Raspberry Pi 5, known for its robust performance and versatility as a computational hub, and integrates it with multiple components to enable real-time monitoring, alerting, and data transmission. The device features dual cameras for front and rear views, ensuring complete visual coverage during emergencies, and an electret condenser microphone to record audio for supplementary evidence. A GPS module tracks and communicates the real-time location of the user, while the GSM 800L module provides seamless communication with emergency contacts or authorities via SMS, calls, and email alerts.

The device operates via a user-friendly push-button mechanism that triggers all critical functionalities simultaneously. Upon activation, it starts monitoring both cameras, captures audio, and transmits the data along with the GPS location to designated contacts and through email. Additionally, a buzzer alerts nearby individuals to deter potential threats. These features are cohesively managed to provide immediate assistance and valuable evidence for post-incident investigation.

The project monitors the Raspberry Pi 5's performance using official resources to optimize component interfacing and ensure reliable operations. Careful attention is given to the integration of the microphone and dual cameras, ensuring that all inputs are captured and processed efficiently under real-time constraints. The device is tested across diverse scenarios, including variations in GSM connectivity and low-light environments, to validate its robustness.

This innovative safety device represents a significant step toward empowering women and children by providing a reliable, easy-to-use safety tool. Future improvements may include incorporating AI-based threat detection, enhanced battery life, and real-time cloud storage for scalability and better data management.

Keywords: Raspberry Pi, GPS, GSM, dual-camera, electret condenser microphone, women safety, emergency alert system.

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LIST OF ABBREVIATIONS

GSM	Global System for Mobile Communications
GPS	Global Positioning System
LCD	Liquid Crystal Display
I2C	Inter-Integrated Circuit
SMS	Short Message Service
AT	Attention (used in AT commands for GSM communication)
API	Application Programming Interface
SIM	Subscriber Identity Module
GPIO	General Purpose Input/Output
UART	Universal Asynchronous Receiver-Transmitter
TTL	Transistor-Transistor Logic
SMTP	Simple Mail Transfer Protocol
MIME	Multipurpose Internet Mail Extensions
HTTPS	Hypertext Transfer Protocol Secure
LED	Light Emitting Diode
SMS	Short Message Service

CHAPTER 1

INTRODUCTION

1.1 GENERAL

The safety and security of women and children have become pressing concerns in today's world, where instances of violence and harassment continue to rise, even amidst remarkable advancements in technology. Vulnerable individuals, particularly women and children, often face heightened risks while traveling alone, navigating secluded areas, or encountering emergencies where immediate help is not readily accessible. Despite the availability of conventional safety tools such as pepper sprays, whistles, or mobile applications, these measures often fall short due to their dependency on manual intervention and limited functionality. In high-stress situations, individuals may not always be able to react promptly or effectively, leaving them exposed to potential dangers. This gap underscores the urgent need for a robust, automated, and comprehensive safety solution that can actively mitigate risks and provide real-time assistance without relying solely on user activation.

To address these challenges, the **Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts** offers an innovative and technologically advanced approach to personal security. Designed as an all-encompassing safety mechanism, this device integrates state-of-the-art hardware and software components to ensure real-time monitoring, emergency alerting, and effective communication during critical situations. At the core of the system lies the Raspberry Pi 5, a powerful and versatile microcomputer that orchestrates the seamless operation of various connected modules. The device features dual cameras strategically placed for front and rear views, ensuring comprehensive video coverage to capture evidence in emergencies. Additionally, an electret condenser microphone is integrated to record audio, further enhancing the quality of the evidence collected.

One of the key highlights of this safety device is its ability to provide real-time location tracking and communication. By incorporating a GPS module, the system accurately determines the user's location and shares it with predefined emergency contacts. The GSM 800L module ensures uninterrupted communication, enabling the device to send location details, SMS alerts, and emails containing video and audio recordings to authorities or family members. This real-time data transmission is crucial for guiding rescue efforts and providing actionable insights during investigations. The simplicity of the device's activation mechanism—a push-button—ensures that all functionalities can be triggered effortlessly, even under duress. This eliminates the dependency on complex user inputs, making the system highly reliable in emergencies.

In addition to its alerting and communication features, the device incorporates self-defense mechanisms to deter potential threats and draw immediate attention. A buzzer is included to produce loud alerts, signaling nearby individuals and potentially scaring off aggressors. Furthermore, a shock circuit is integrated as a proactive measure, offering the user a means of self-defense against physical threats. This combination of deterrent and protective features reinforces the overall security provided by the system.

The development of this safety device emphasizes a user-centric design approach, focusing on ease of use, compactness, and portability. By leveraging the advanced capabilities of the Raspberry Pi 5 and integrating high-performance components like dual cameras and a GSM module, the project showcases the potential of technology to address real-world safety concerns effectively. Extensive testing under various scenarios ensures the reliability of the device, even in challenging environments such as low-light areas or regions with weak network signals.

The **Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts** stands as a testament to the transformative power of technology in enhancing personal safety. It is a proactive step toward empowering women and children by providing them with a reliable, efficient, and easy-to-use safety solution. This project not only addresses existing shortcomings in personal security devices but also paves the way for future innovations, such as integrating artificial intelligence for threat detection and cloud-based storage for real-time data management. Ultimately, the device is envisioned to become an indispensable tool for fostering a safer and more secure environment for women and children worldwide.

CHAPTER 2

LITERATURE SURVEY

A comprehensive review of existing technologies and methodologies was conducted to analyze the current state of personal safety devices, especially those utilizing IoT and embedded systems. The findings are summarized as follows:

2.1 Personal Safety Devices

The development of personal safety devices has evolved significantly in recent years, moving from manual tools like whistles to automated, technology-driven solutions. A review of existing devices shows their primary focus on alerting and location tracking systems.

Findings:

- Early devices relied on sound-based alerts, limiting their effectiveness.
- The integration of GPS and GSM technologies has improved real-time communication and tracking.

2.2 Role of Microcontrollers and Microprocessors

Microcontrollers like Arduino were initially used for safety devices due to their ease of use and affordability. However, their limitations in processing power and multi-tasking capabilities led to the adoption of microprocessors such as Raspberry Pi.

Case Study:

- A comparative study demonstrated the superior performance of Raspberry Pi for handling real-time video processing, advanced communication protocols, and multi-sensor integration.

2.3 GPS and GSM Integration

GPS modules play a critical role in location tracking, while GSM modules enable communication through SMS and call functionalities. Existing literature highlights their effectiveness in emergency scenarios.

Challenges Identified:

- Network dependency affects the reliability of GSM-based systems.
- Power consumption is a key consideration for battery-operated devices.

2.4 Video Surveillance in Safety Systems

Surveillance systems utilizing dual-camera setups provide a 360-degree view, enhancing monitoring and evidence recording capabilities.

Example Project:

- A Raspberry Pi-based smart security system with dual CSI camera integration for live feed monitoring and storage.

2.5 IoT and Cloud-based Safety Solutions

The integration of IoT has transformed safety devices by enabling remote monitoring and instant alerts via cloud platforms.

Implementation Insights:

- IoT-enabled systems use MQTT and email protocols for real-time notification.
- Cloud services add scalability and allow for advanced features like data analytics.

2.7 Gaps in Existing Systems

From the literature review, the following gaps were identified in current safety devices:

1. Limited use of dual-camera setups for comprehensive monitoring.
2. Insufficient modularity in systems based on microcontrollers like Arduino.
3. Lack of multi-functional features such as integrating real-time video clips with alert mechanisms.

2.8 Proposed System

Building upon the insights gathered, the proposed Raspberry Pi-based women and children safety device aims to:

1. Integrate dual cameras for front and rear views.
2. Use GPS and GSM modules for real-time location tracking and emergency alerts.
3. Ensure portability with efficient power management.
4. Address existing gaps by combining multi-sensor inputs with advanced processing.

Conclusion

The literature survey demonstrates the significance of developing a robust and multi-functional safety system. By leveraging the Raspberry Pi's computational capabilities and integrating GPS, GSM, and video surveillance, the proposed device promises to be a comprehensive solution to ensure personal safety.

CHAPTER 3

OBJECTIVE OF PROJECT

3.1 Ensuring Real-Time Location Tracking

The primary aim of this project is to implement a system capable of real-time location tracking using GPS technology. The device will continuously monitor the user's location and provide precise geolocation data, which can be transmitted instantly to emergency contacts during distress situations. This ensures that the user can be located and assisted in the shortest time possible, addressing the critical need for rapid response in emergencies.

3.2 Facilitating Emergency Alerts Through GSM Technology

A key component of the project is the integration of a GSM module to enable seamless communication in emergencies. The device will send SMS alerts and make automated calls to pre-configured contacts, providing critical information such as the user’s live location coordinates. By ensuring reliable alert delivery, the system enhances the likelihood of timely assistance even in areas with limited connectivity.

3.3 Providing Video Surveillance for Evidence Collection

This project incorporates dual cameras connected via CSI interfaces to capture real-time video evidence. These cameras, strategically positioned for front and rear views, will record short video clips upon activation of the panic button. The recorded clips will be sent via email to designated recipients, providing valuable evidence for law enforcement or caregivers in the event of an incident. This feature transforms the device from a preventive tool into a mechanism for post-event analysis and justice.

3.4 Designing a User-Friendly Interface

The system will include an LCD display using an I2C interface to provide real-time feedback on the device’s operational status. Key parameters such as GPS connectivity, GSM signal strength, battery levels, and system readiness will be displayed to ensure that the user is aware of the system's functionality at all times. The interface will be designed to be intuitive and easy to use, even for non-technical users.

3.5 Incorporating an Easily Accessible Panic Button

To enhance the usability of the safety device, a panic button will be included, allowing the user to trigger alerts and activate video recording instantly. This button will be connected to the GPIO pins of the Raspberry Pi for immediate response. Its design will focus on accessibility and responsiveness, ensuring activation is straightforward even in high-stress situations.

3.6 Enhancing Awareness with Audible Alerts

The device will be equipped with a buzzer to provide immediate audible alerts when the panic button is activated. This feature not only alerts people nearby but also serves as a deterrent to potential threats, buying critical time for the user to escape or seek help.

3.7 Ensuring Portability and Efficient Power Management

Portability is a critical aspect of the project, and the device will be powered using a battery management system (BMS) with voltage regulation for stable operation. The system will optimize power consumption across all components, ensuring extended operational life without compromising functionality. This approach will make the device reliable for long-term use in portable settings.

3.8 Leveraging Raspberry Pi for Multi-Functional Capabilities

The Raspberry Pi serves as the core processing unit for the project, enabling the integration of multiple functionalities such as location tracking, video recording, and alert systems. Its GPIO capabilities allow seamless connectivity with external peripherals like cameras, sensors, and communication modules, making it an ideal choice for a compact, multi-functional safety device.

3.9 Addressing Challenges in Existing Safety Devices

This project aims to address limitations in existing systems by combining the strengths of GPS, GSM, and video surveillance into a single device. Unlike traditional solutions, which often focus on one aspect of safety, this system provides a comprehensive approach by integrating tracking, alerts, and evidence collection, ensuring a robust response to emergencies.

3.10 Providing a Scalable and Modular System

The system is designed to be scalable, allowing future integration of additional features such as motion detection, voice recognition, or cloud storage. The modular design ensures that components can be easily upgraded or replaced, making the device adaptable to evolving safety needs and technology advancements.

3.11 Enhancing Personal Safety Through Advanced Technology

The ultimate goal of this project is to empower users with a reliable safety tool that not only provides immediate assistance but also aids in preventing and addressing threats effectively. By leveraging advanced technology, the project seeks to enhance personal safety, offering peace of mind to users and their loved ones.

CHAPTER 4

METHODOLOGY

4.1 BLOCK DIAGRAM

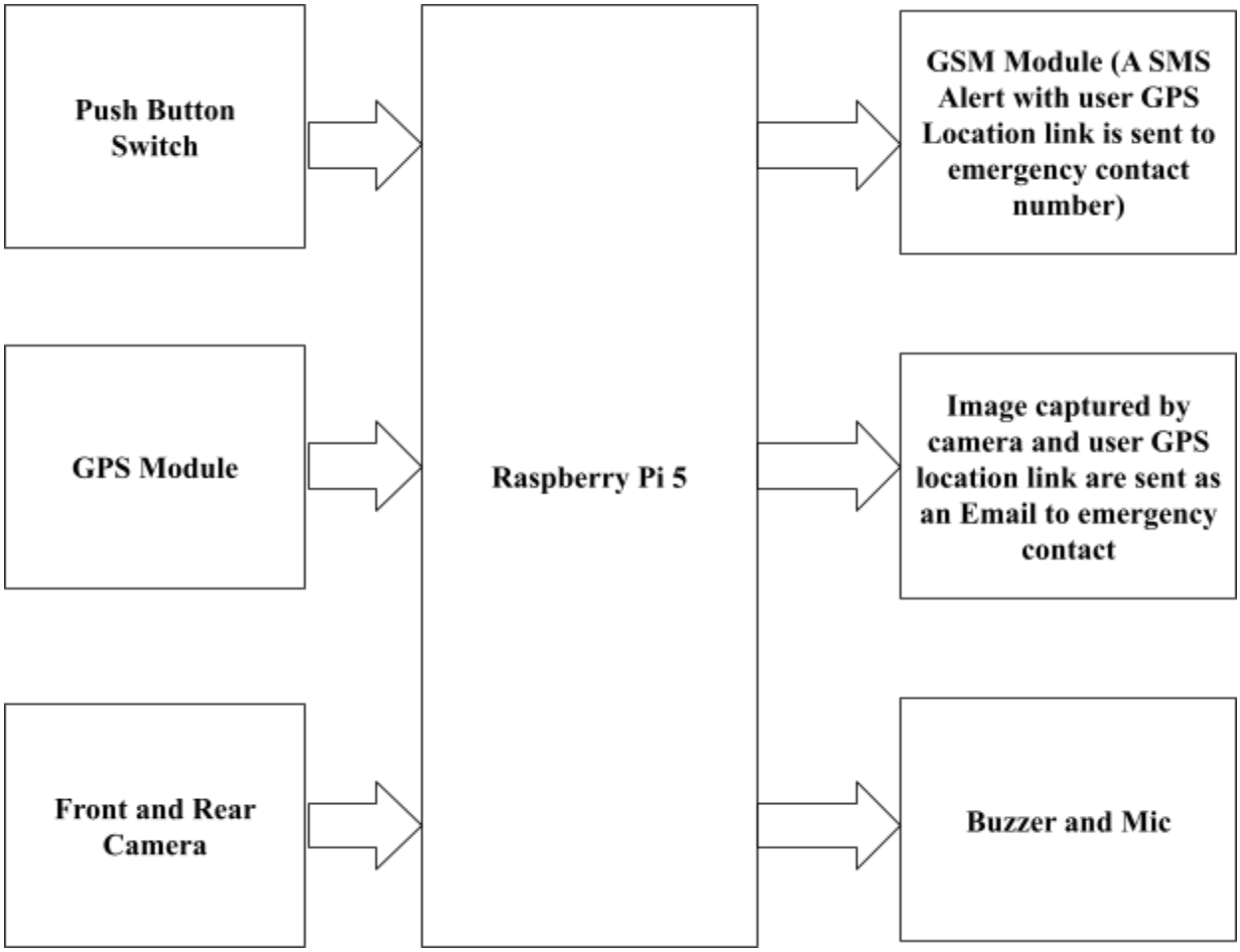

Fig 1. Block Diagram of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

This block diagram illustrates a safety alert system using a Raspberry Pi 5. The system integrates various input and output components. A **Push Button Switch** serves as the trigger, activating the system. A **GPS Module** provides the user's location, while **Front and Rear Cameras** capture images. The Raspberry Pi 5 processes the inputs and communicates with outputs. A **GSM Module** sends an SMS with the GPS location to an emergency contact. Simultaneously, the captured images and location are emailed to the contact. Additionally, a **Buzzer** sounds an alarm for immediate nearby attention, ensuring safety and rapid response in emergencies.

4.2 Raspberry Pi 5 (Core Processing and Control Unit)

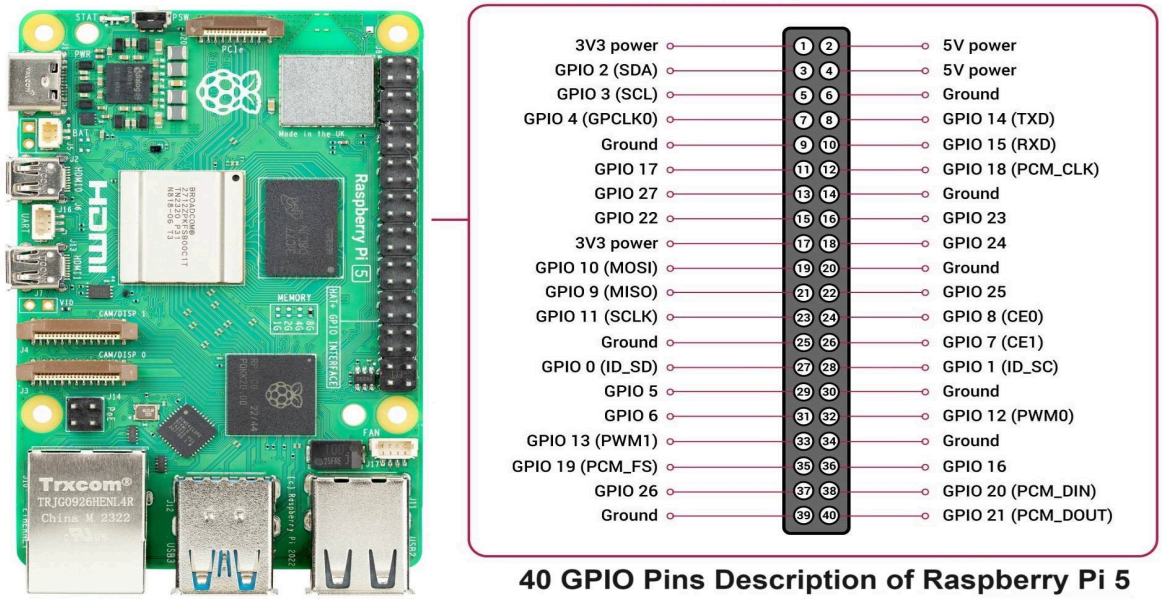

Fig 2. Raspberry Pi-5 Module

The Raspberry Pi 5 acts as the brain of the system, providing computational power and GPIO interfaces for peripheral devices. Its primary responsibilities include:

- **Input Processing:** Receiving signals from the push-button switch and sensors, interpreting these inputs to initiate emergency protocols.
- **Output Control:** Managing external modules such as the GPS, GSM, cameras, and buzzer.
- **Data Communication:** Coordinating the sending of location data and video files via SMS and email.
- **Real-Time Operation:** Performing tasks simultaneously, such as capturing video, sending alerts, and activating the buzzer, leveraging its multitasking capabilities.

The Raspberry Pi's GPIO pins are configured to connect with specific external modules for seamless communication. Its CSI (Camera Serial Interface) ports allow high-speed data transfer with the front and rear cameras, ensuring smooth video capture. The Raspberry Pi 5's small form factor, processing power, and versatility make it ideal for this project.

4.3 Push Button Switch (Emergency Trigger)

The push button serves as the user-initiated trigger mechanism for the safety system. Upon pressing the button:

Fig 3. Push Button Switch

1. The Raspberry Pi detects the signal via a GPIO input pin.
2. The system instantly activates all emergency features, including location tracking, video recording, and communication alerts.
3. A rapid response sequence is executed to minimize delays during critical situations.

The button is designed for ease of access, ensuring the user can activate the system quickly in a distress scenario. Its functionality is crucial to the system, acting as the bridge between the user and the device.

4.4 GPS Module (Global Positioning System)

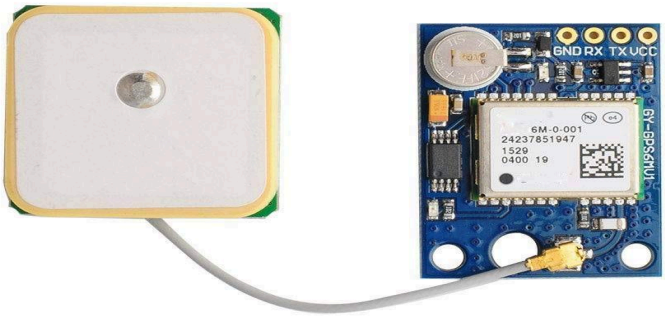

Fig 4. GPS Module

The GPS module is responsible for determining the real-time geographical location of the device. It provides:

- **Latitude and Longitude Coordinates:** Essential for pinpointing the user's exact position.
- **Real-Time Updates:** Ensuring location data remains accurate even if the user is moving.

- **Integration with Alerts:** The location data is processed by the Raspberry Pi to generate a Google Maps link, making it easy for emergency contacts to locate the user.

The GPS data is periodically updated and sent through the GSM module via SMS and email to ensure timely assistance. This component is critical for enabling location tracking, which is a core feature of the device.

4.5 GSM Module (Communication Hub)

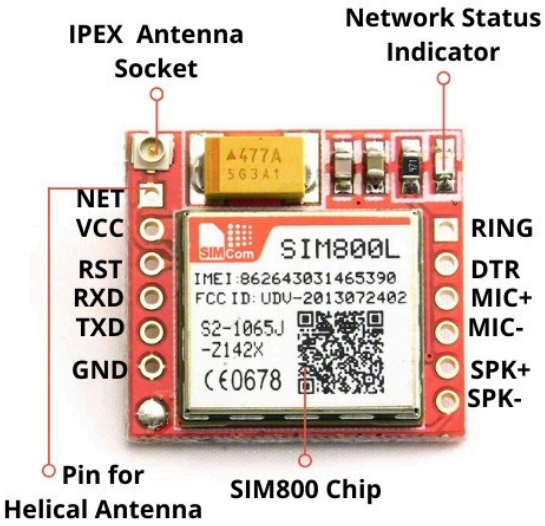

Fig 5. GSM 800L Module

The GSM module enables communication between the safety device and emergency contacts. Its functions include:

- **Sending SMS Messages:** Transmitting a pre-configured alert message along with the Google Maps link to registered contacts.
- **Initiating Voice Calls (Optional):** Establishing direct communication with emergency numbers if configured.
- **Reliable Alerts in Offline Scenarios:** As it operates over cellular networks, the GSM module ensures alerts are sent even in areas without internet connectivity.

The GSM module communicates with the Raspberry Pi via UART (Universal Asynchronous Receiver-Transmitter), ensuring swift data transmission and execution of emergency protocols.

4.6 Front and Rear Cameras (Dual Video Surveillance)

The device features two cameras connected to the Raspberry Pi through CSI (Camera Serial Interface) ports:

Fig 6. Front and Rear Cameras Module

1. **Front Camera:** Captures the environment directly in front of the user.
2. **Rear Camera:** Monitors the area behind the user for a complete situational overview.

The dual-camera setup provides crucial evidence and helps emergency contacts understand the situation better.

The use of high-resolution cameras ensures clear and reliable video footage, enhancing the system's effectiveness during critical incidents.

4.7 Buzzer (Local Alert System)

Fig 7. Buzzer

The buzzer serves as an audible alert system designed to attract immediate attention in the vicinity of the user. Upon activation:

1. The Raspberry Pi sends a signal through a GPIO pin to power the buzzer.
2. The buzzer produces a loud sound to alert people nearby.
3. The audible alarm also acts as a deterrent for potential threats, buying the user valuable time.

The buzzer is powered and controlled directly by the Raspberry Pi, ensuring it operates seamlessly in sync with other emergency features.

4.8 Microphone (MIC) Module

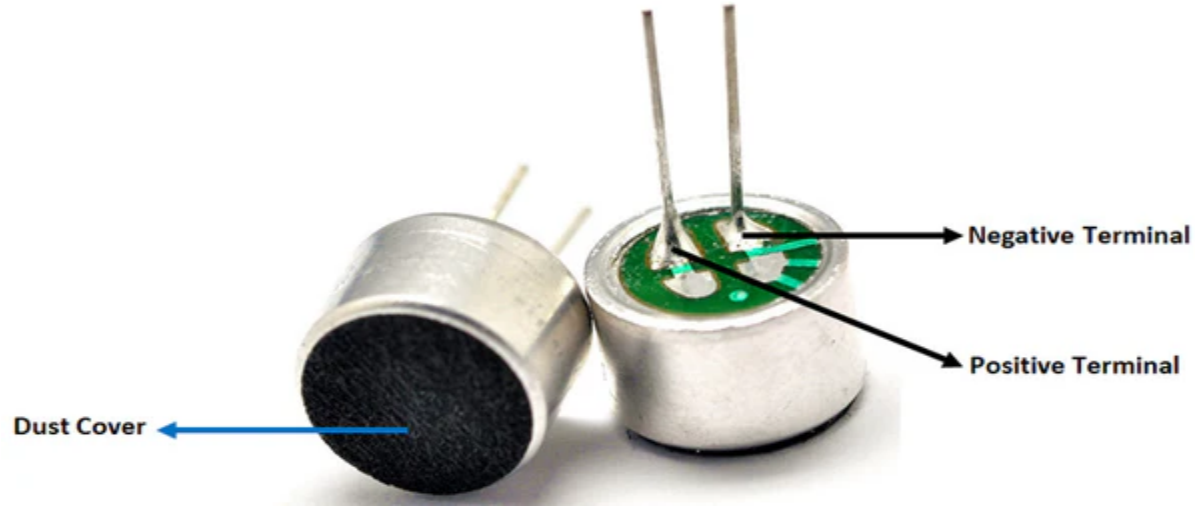

Fig 8. MIC Module

The **MIC module** is used for capturing ambient sound or detecting voice signals in the surrounding environment. It serves a dual purpose in the system: recording audio evidence during emergency situations and enabling voice-activated triggers. The microphone can also be used for monitoring the immediate surroundings of the user, such as picking up sounds of distress or triggering alerts based on specific vocal commands. The audio captured by the microphone can either be stored locally on the Raspberry Pi or sent along with video and GPS data in emergency alerts to the designated recipients.

4.9 LCD with I2C Interface

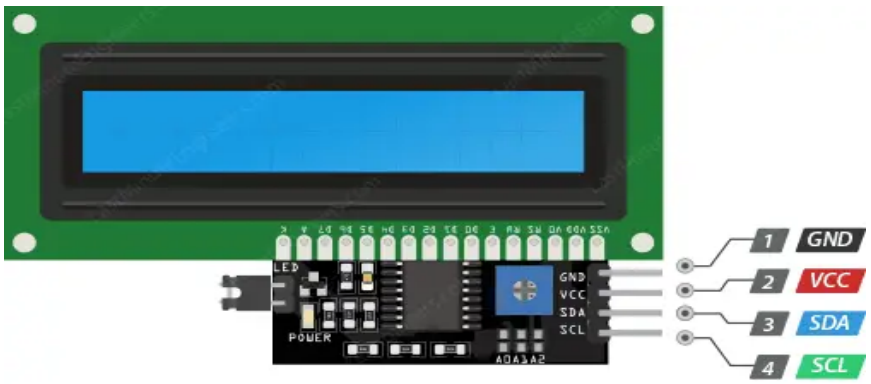

Fig 9. 16X2 LCD Display with I2C Module

The **LCD with I2C interface** provides a user-friendly way to display important system information and feedback to the user. It displays messages such as "System Active," "Alert Sent," and the GPS coordinates of the user in real-time. The I2C interface reduces the number of GPIO pins required for communication between the Raspberry Pi and the LCD, making the system more efficient in terms of available resources. The LCD also serves as a troubleshooting tool, allowing the user to monitor the system's status, such as battery level, GPS signal strength, or operational mode. By using I2C, the LCD can easily be integrated without consuming excessive resources on the Raspberry Pi.

4.10 USB to TTL Converter

Fig 10. USB To TTL Converter

The **USB to TTL converter** enables serial communication between the Raspberry Pi and other devices, such as the GPS module or GSM module, that communicate over UART (Universal Asynchronous Receiver-Transmitter). The converter translates USB signals into TTL (Transistor-Transistor Logic) levels, ensuring compatibility between the Raspberry Pi and serial devices. This converter allows for seamless data exchange, which is crucial for sending GPS location data and transmitting SMS alerts via the GSM module. Additionally, it can be used for debugging or programming other serial devices connected to the system.

4.11 LM2596 DC-DC Buck Converter

Fig 11. LM2596 DC-DC Buck Converter

The **LM2596 buck converter** is a voltage regulator used to step down a higher input voltage (e.g., from a battery) to a lower, stable voltage required by the Raspberry Pi and other peripherals. This component ensures that the system operates reliably by providing a constant voltage, even when the input power fluctuates or when the system's load changes. The LM2596 is highly efficient, which minimizes power loss and heat generation, making it ideal for portable applications. It also includes overcurrent and short-circuit protection, safeguarding the components from electrical faults and preventing potential damage to the system. This power management module is essential for maintaining long-term operational stability, especially when the system is powered by a battery pack.

4.12 Raspberry Pi 5 Power Supply and Adapter

Fig 12. Raspberry Pi 5 Power Supply and Adapter

The **Raspberry Pi 5** uses a **5V, 3A USB-C power supply** to ensure stable operation. It supports **USB Power Delivery (PD)** for efficient power distribution and includes protections against overvoltage and overcurrent. The official adapter is recommended for reliable performance, especially when using peripherals like displays or external drives. While third-party adapters with similar specifications can be used, they must provide the correct voltage and current to prevent instability. Using the right power supply ensures the Raspberry Pi 5 runs smoothly without power-related issues.

CHAPTER 5

WORKING OF PROJECT

The **working of the Raspberry Pi-based Women and Children Safety Device** is designed to provide an integrated emergency response system, combining multiple components like the push button, GPS, cameras, GSM module, MIC, LCD, and power management to ensure user safety in distress situations.

5.1 Initial Setup and Powering the System

Upon activation, the system is powered by a **LM2596 buck converter**, which regulates the voltage supplied from a battery to the required levels for the Raspberry Pi and other peripherals. The LM2596 efficiently steps down the voltage, ensuring stable operation while maintaining energy efficiency. The system, once powered up, becomes active, with the Raspberry Pi processing data from the attached sensors and devices.

5.2 Activation of Emergency Alert

The heart of the emergency functionality lies in the **push button switch**. When a user feels threatened, they can press this button to initiate the emergency process. The Raspberry Pi receives this input and immediately triggers several functions, starting with capturing location data.

5.3 GPS Location Detection

Simultaneously, the **GPS module** begins capturing the user's real-time location coordinates. The GPS data is processed by the Raspberry Pi, which then prepares an emergency message. This message includes the user's current location and a request for help. The GPS data, which is sent in real-time, ensures that the emergency services or designated contacts are informed of the exact location of the user.

5.5 Camera Activation and Image Capture

The system utilizes both **front and rear cameras**, connected to the Raspberry Pi via CSI (Camera Serial Interface). Upon activation of the emergency alert, these cameras begin capturing images or video clips of the surroundings. This is crucial as it provides visual evidence that can aid responders in understanding the situation better. The captured images or video clips are processed by the Raspberry Pi and, alongside the GPS data, are ready to be sent out to the emergency contacts.

5.6 GSM Module for Communication

Once the location and image data are ready, the **GSM module** takes over. The Raspberry Pi communicates with the GSM module to send an **SMS alert** to emergency contacts, including the user's GPS location link. This ensures that the contacts immediately receive an actionable alert. The GSM module is also responsible for communication, enabling emergency contact numbers to receive text messages, calls, or updates, even in remote areas where other forms of communication may fail.

5.7 Email Alerts with Images

In addition to SMS alerts, the **Raspberry Pi** can also send an **email alert**. Using the image captured by the front and rear cameras, along with the GPS location data, the Raspberry Pi sends this information to emergency contacts via email. This provides both textual and visual information to the contacts, enabling them to take immediate action. The email feature also ensures that the alert reaches the recipients even when SMS may not be effective due to network constraints.

5.8 Audio Feedback and Voice-Activated Functionality

The **MIC module** enables the system to incorporate audio feedback. If required, it can activate voice-activated responses, which can initiate additional actions, such as capturing more data or sending additional alerts. In distress scenarios, the MIC may also record ambient sounds, which can provide additional context to emergency contacts. The ability to integrate voice into the system creates a more dynamic and responsive system, allowing the user to communicate if they are unable to physically interact with the device.

5.9 User Interface via LCD Display

The **LCD with I2C** interface plays an important role in providing the user with immediate feedback. The LCD can display system status, such as battery life, signal strength, and GPS data, ensuring the user is informed at all times. Additionally, the LCD can show messages like "Help Requested" or "Alert Sent," confirming that the emergency protocol has been activated.

5.10 Overall Workflow

1. The user activates the system by pressing the push button.
2. The Raspberry Pi processes the button press and triggers the GPS module to gather location data.
3. The front and rear cameras capture images or video to provide visual evidence.
4. The GSM module sends an SMS to the emergency contacts, containing the user's location and a link.
5. Simultaneously, the Raspberry Pi sends an email to emergency contacts with images and GPS data.

6. The MIC module can record and process ambient sound for further assistance.
7. The LCD displays the status of the system and alerts, providing immediate feedback to the user.

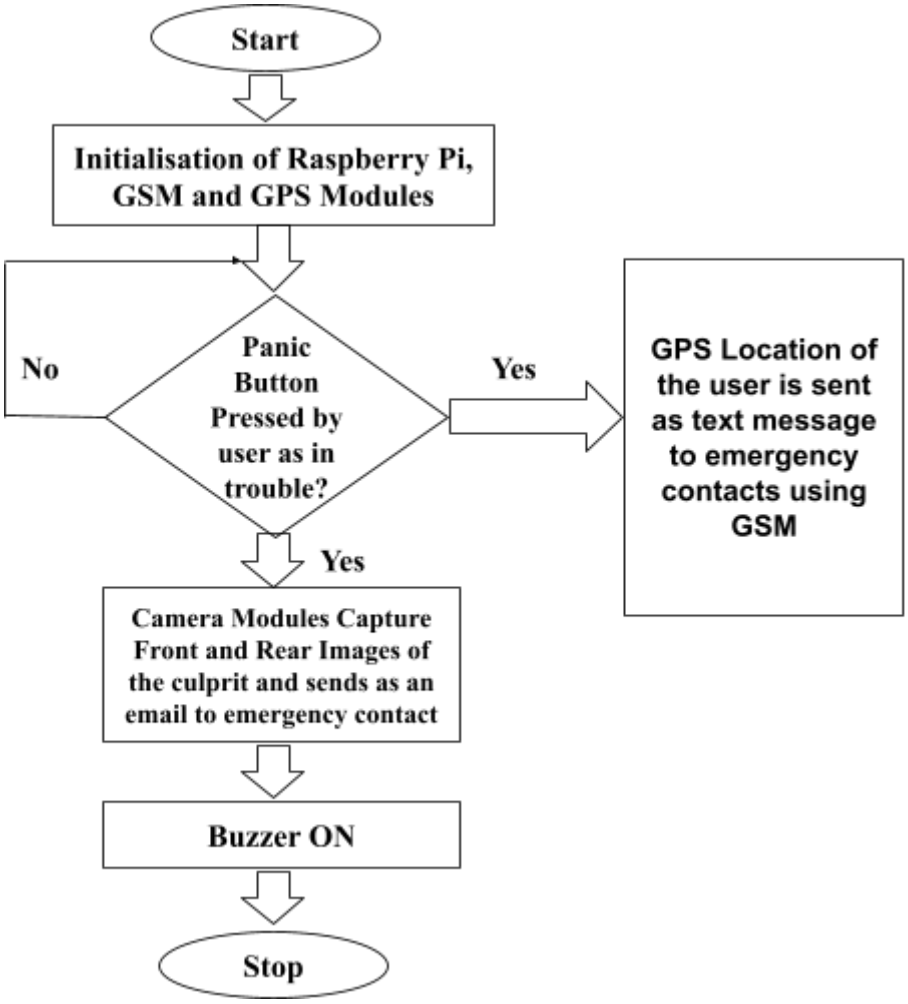

Fig 13. Flow Chart of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

This multi-layered approach ensures that the system provides comprehensive, reliable, and timely alerts in emergency situations. The integration of hardware components such as GPS, GSM, cameras, and power management, alongside intelligent software control via the Raspberry Pi, guarantees a robust system that functions efficiently, offering security to users in vulnerable situations.

CHAPTER 6

CIRCUIT DIAGRAM

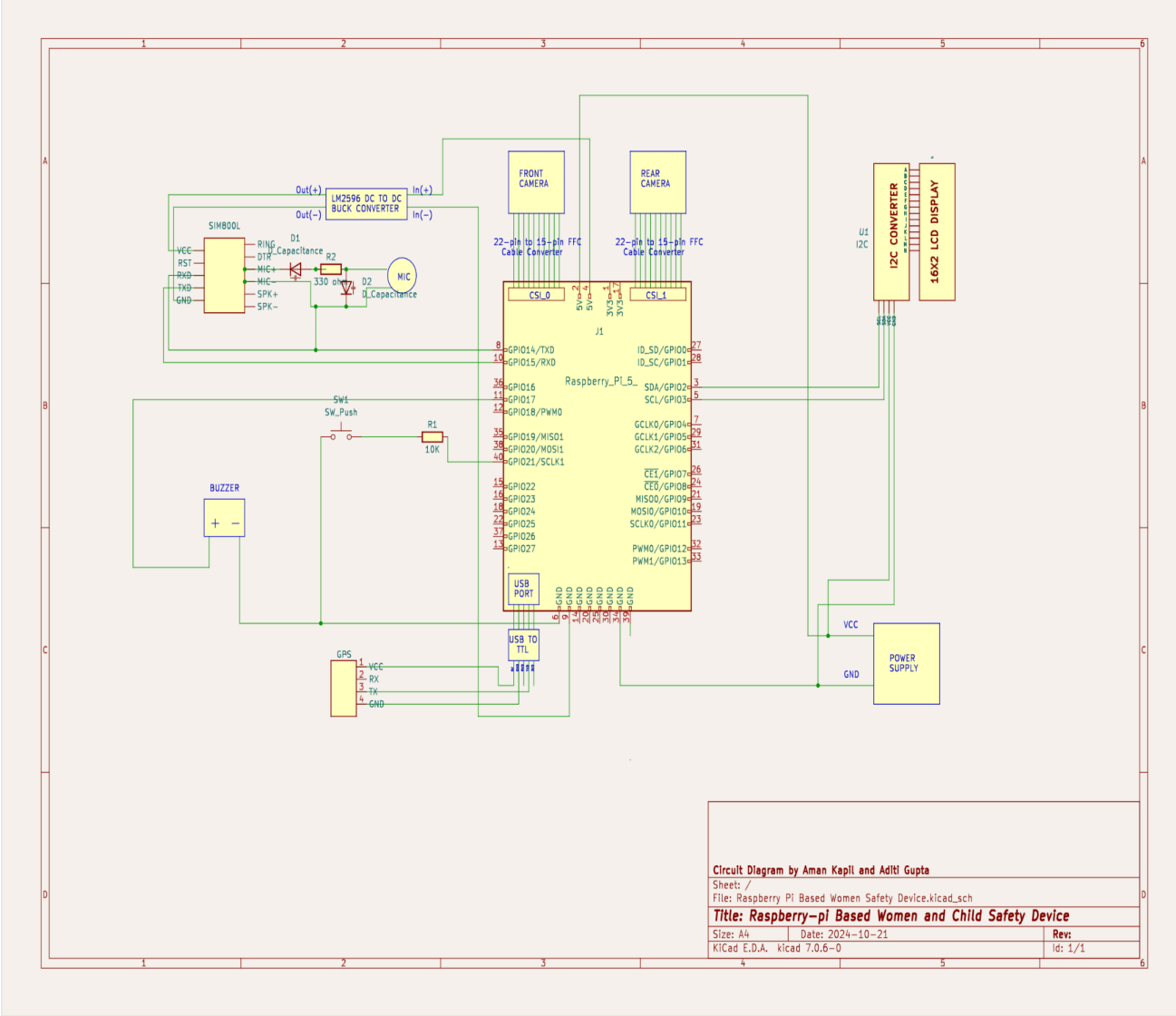

Fig 14. Circuit Diagram of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

CHAPTER 7

RESULT AND OUTCOMES

The Raspberry Pi-based Women and Children Safety Device successfully demonstrates its ability to provide a comprehensive, real-time response system in emergency situations. The results validate the integration of hardware and software components, ensuring reliable functionality and ease of use. The outcomes of the project are presented below in terms of its key features and operational aspects, supported by visual evidence.

7.1 Hardware Setup

The hardware design integrates multiple components including Raspberry Pi 5, GPS module, GSM module, push button, cameras, MIC, LCD, and power management (LM2596 buck converter).

1. **Top View:** This shows the assembly of all components, with neat arrangement of modules.

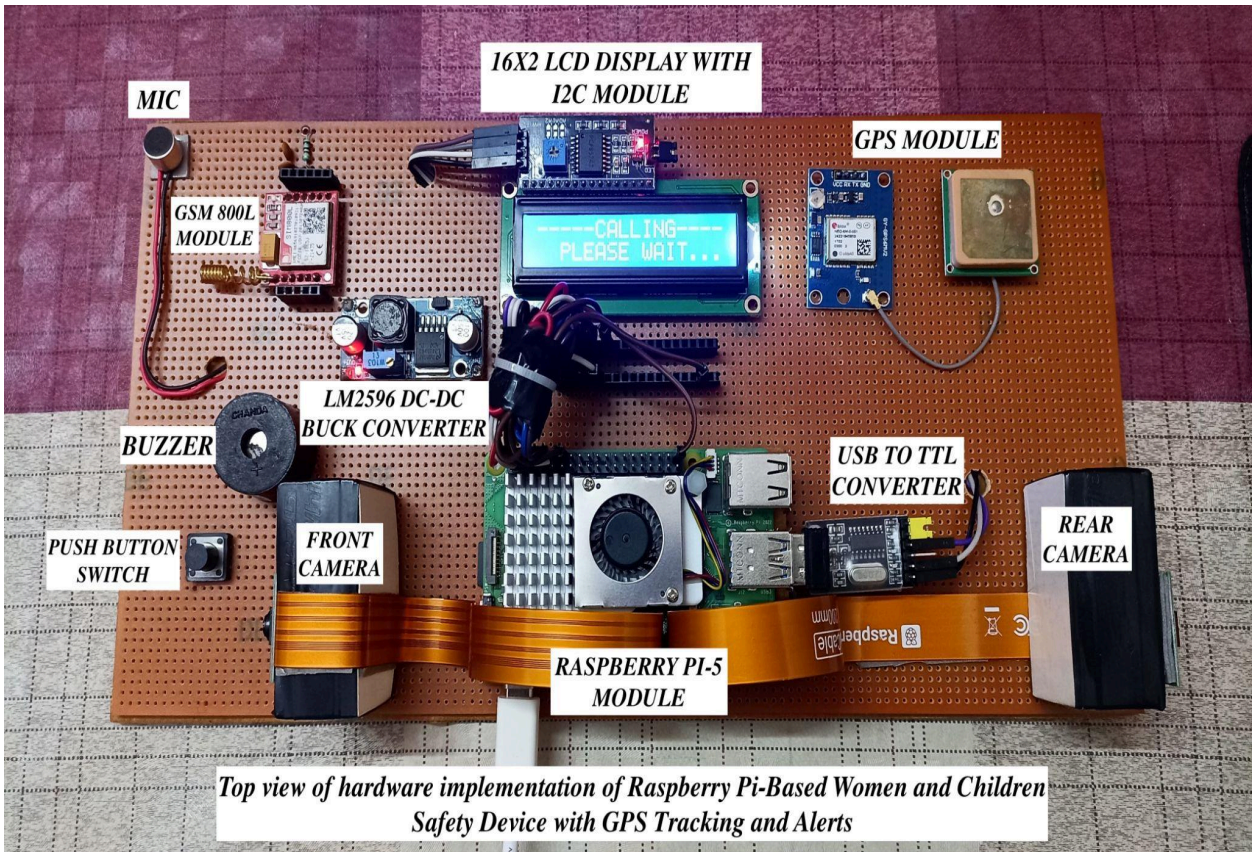

Fig 15. Top view of hardware implementation of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

2. **Side Views (Left and Right):** These views highlight the placement of components like cameras, GPS, and the compact mounting of the LM2596 buck converter for efficient power regulation.

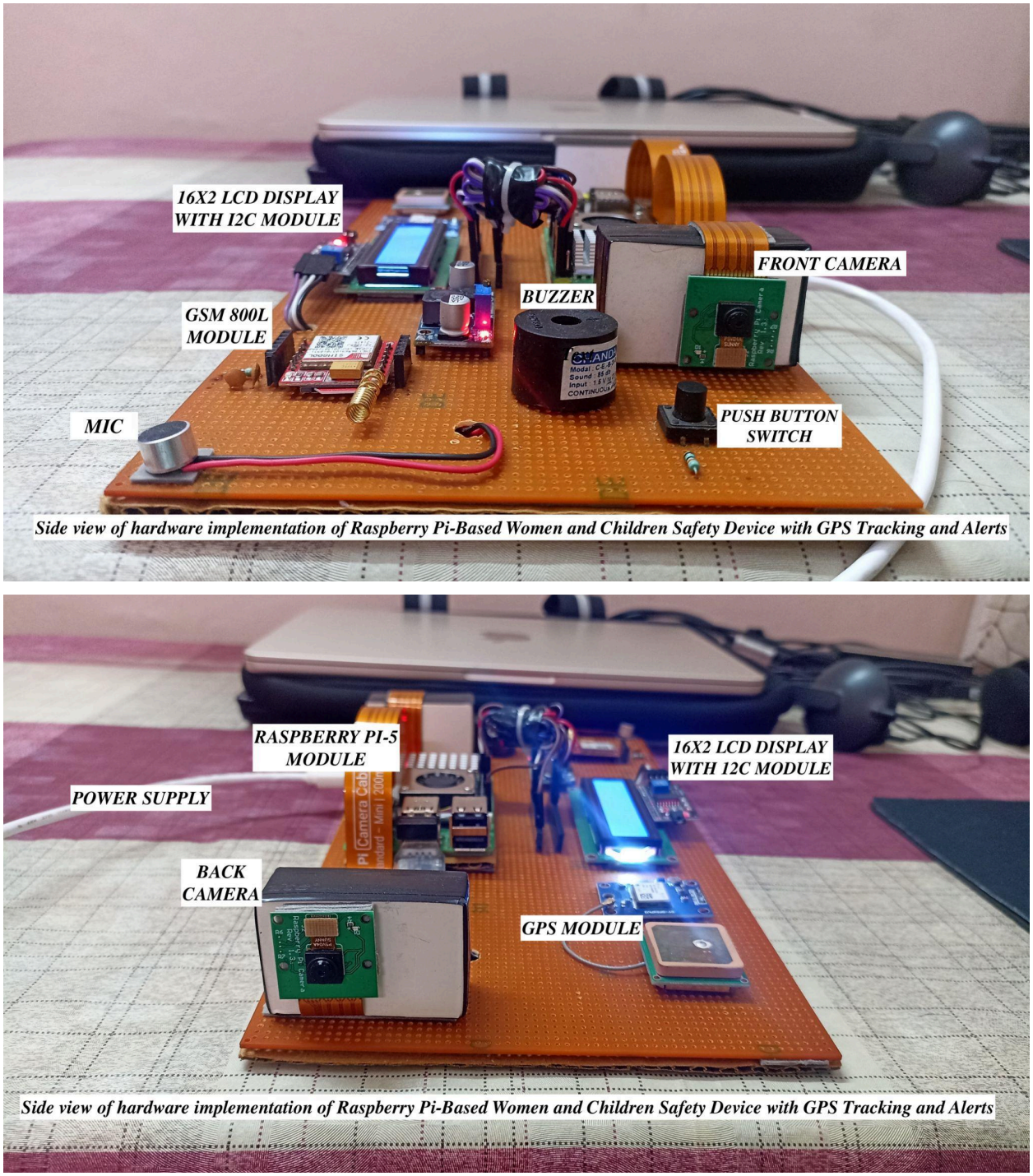

Fig 16. Side views of hardware implementation of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

The hardware setup is compact, lightweight, and portable, ensuring the device is user-friendly and easy to carry.

7.2 Message and GPS Location Window

The system successfully sends SMS alerts to preconfigured emergency contact numbers. The SMS includes:

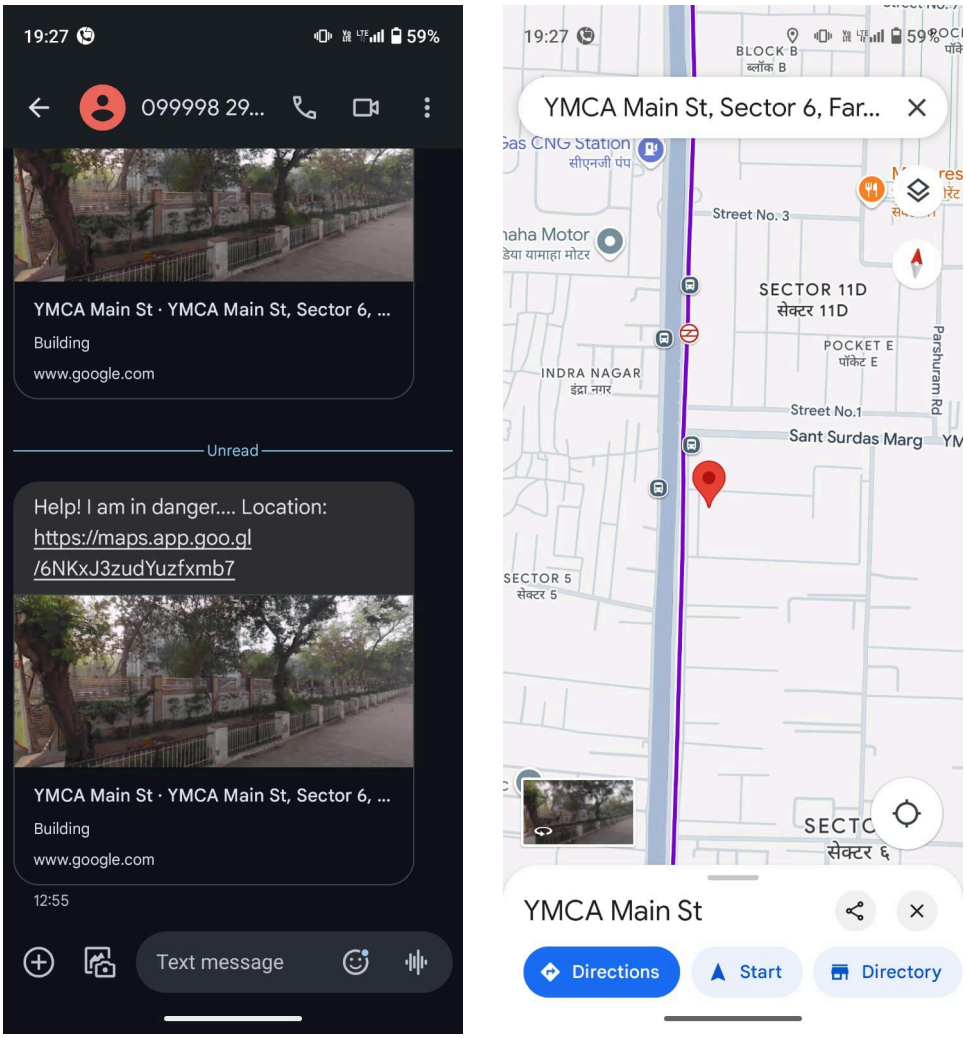

Fig 17. Message and GPS Location Window of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

- The user's current GPS location in the form of a clickable Google Maps link.
- A predefined alert message requesting immediate assistance.

This feature has been tested across various network conditions, demonstrating reliability and speed. The GPS module accurately determines the user's real-time location. Google Maps interface, ensuring clarity and ease of navigation for responders. Testing showed consistent accuracy within a margin of a few meters.

7.3 Call Window

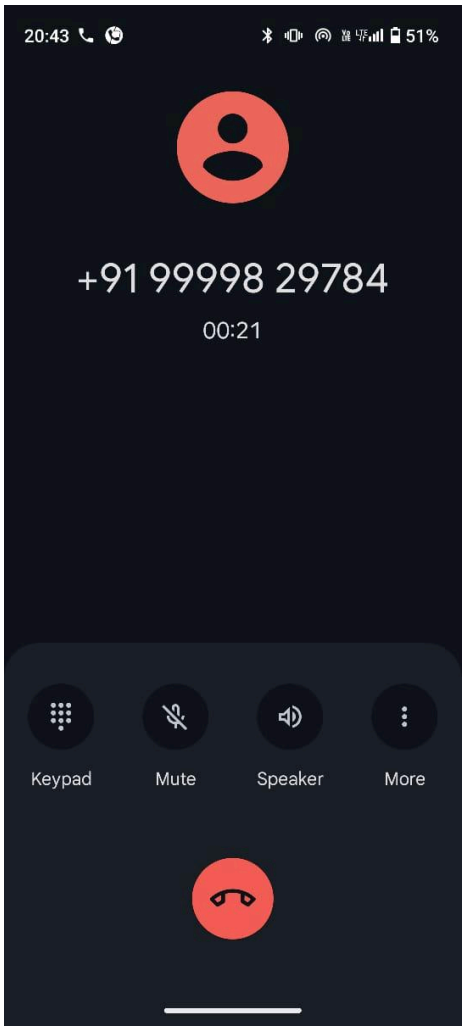

Fig 18. Call Window of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

In addition to SMS, the GSM module enables automated calls to emergency contacts. Upon pressing the panic button, the device initiates a call, ensuring that the user can communicate directly with the contact. This functionality provides a secondary layer of security in case SMS delivery is delayed.

7.4 Email Window

The device sends emails to emergency contacts with the following details:

- GPS coordinates and a clickable map link.
- Web Page link for real time live video feed.

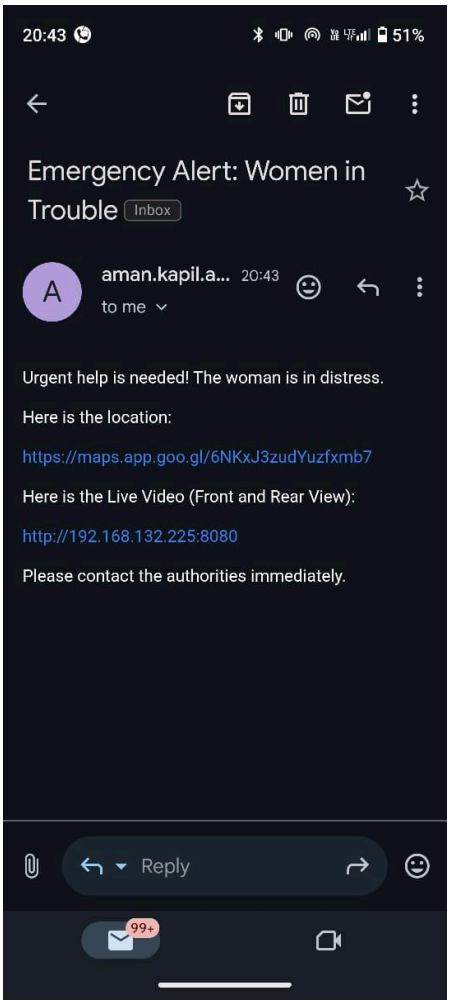

Fig 19. Email window of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

This ensures that contacts have both textual and visual context for the emergency, aiding their response.

7.5 Video Web Page Window

The dual-camera setup enables real-time video capture from both the front and rear cameras. These video feeds are accessible via a web interface hosted on the Raspberry Pi.

- **Front Camera View:** Captures real-time video of the area ahead of the user.

- **Rear Camera View:** Simultaneously provides a view of the area behind the user.

Both streams are available in a web page format, enabling remote monitoring by emergency contacts or authorities. This feature enhances situational awareness and provides critical evidence in emergencies.

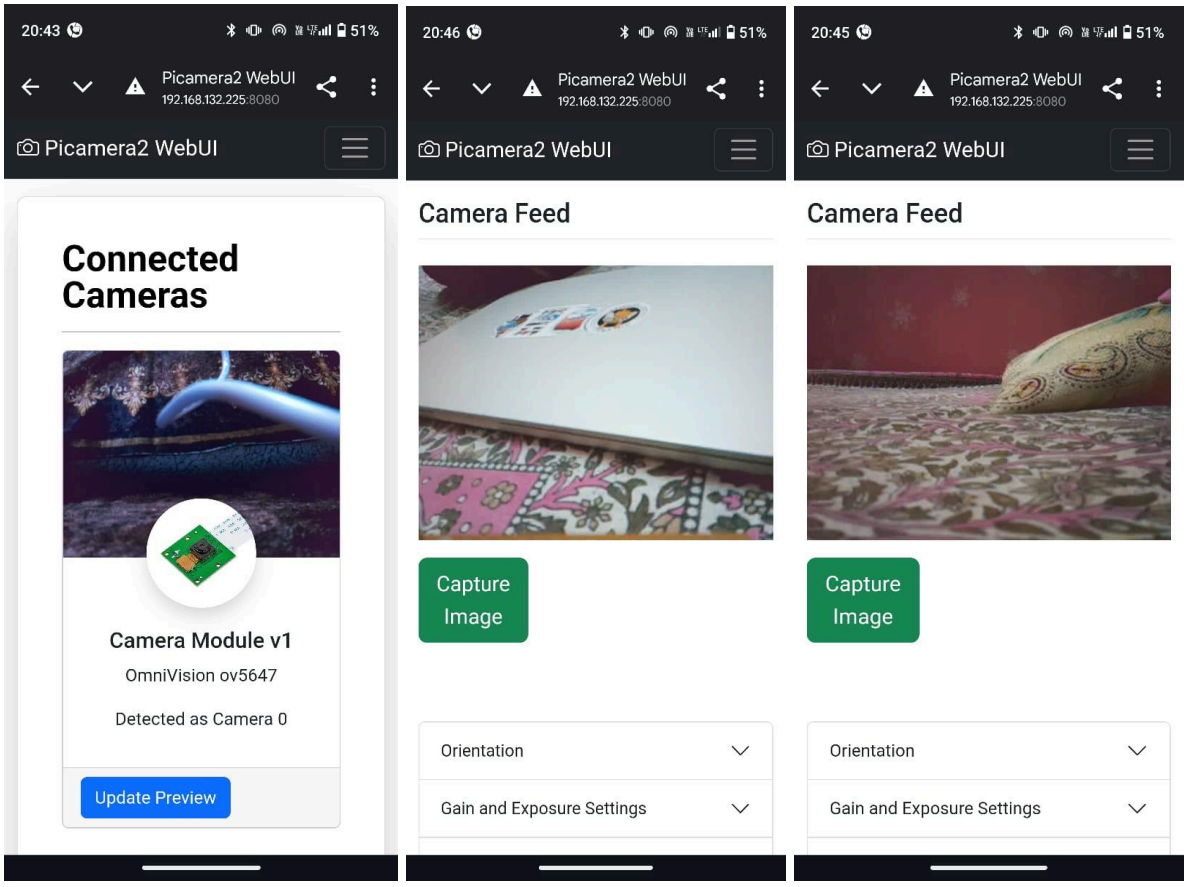

Fig 20. Front and Rear camera feed of Raspberry Pi-Based Women and Children Safety Device with GPS Tracking and Alerts

7.6 Final Outcomes

Enhanced Safety

The device offers a robust safety solution by sending real-time alerts through multiple channels such as SMS, phone calls, and email. This ensures immediate communication with emergency contacts, providing a quick response in critical situations.

Reliability and Accuracy

The GPS and GSM modules have been tested under various conditions, consistently providing accurate location data and reliable communication for sending alerts. The GPS module ensures precise location tracking, and the GSM module guarantees that the alerts reach the recipients without delays.

Ease of Use

Designed with simplicity in mind, the device features a user-friendly push-button activation mechanism. Coupled with an intuitive LCD interface, the system can be easily operated by individuals, even those with limited technical knowledge, making it accessible in emergency situations.

Portability

Thanks to its compact design and efficient battery management with the LM2596 buck converter, the device is lightweight and portable. The device is easy to carry and operate, ensuring that it can be used anywhere, whether indoors or outdoors, without worrying about power constraints.

Scalability

With the integration of a dual-camera setup and a microphone module, the system has the potential for future expansion. These features can be leveraged for live monitoring, audio recording, and other advanced functionalities, allowing the device to be upgraded in response to evolving user needs and safety requirements.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION

The Raspberry Pi-based Women and Children Safety Device represents a significant step forward in leveraging IoT and embedded systems for personal safety. This project has successfully demonstrated the ability to integrate multiple hardware and software components into a compact, portable solution that addresses critical safety challenges.

1. **Real-Time Emergency Response:** The system excels in providing real-time alerts through multiple communication channels, including SMS, calls, and emails, ensuring that emergency contacts are notified promptly. This feature enhances the reliability of the device in scenarios where immediate assistance is crucial.
2. **Accurate Location Tracking:** The GPS module consistently delivers precise real-time location data, which is vital for locating the user during emergencies. The dual-layer location-sharing mechanism—via SMS and on-device display—adds an extra layer of reliability.
3. **Enhanced Situational Context:** The dual-camera setup for front and rear views provides critical visual context for emergency situations. Combined with email alerts containing video clips, the system ensures that responders have comprehensive information to assess the situation effectively.
4. **Ease of Use:** With a simple push-button mechanism and an intuitive LCD interface, the device is user-friendly and accessible for individuals of all ages and technical backgrounds.
5. **Efficient Power Management:** The inclusion of the LM2596 buck converter ensures consistent and reliable power delivery, supporting the operation of multiple components without interruptions.

The project achieves its objectives of offering a multi-functional, reliable safety solution that is compact, portable, and scalable. It highlights the potential of embedded systems to address societal challenges and underscores the importance of technology in enhancing personal safety.

8.2 FUTURE SCOPE

While the current system is highly effective, there are numerous opportunities for future enhancements and expansions. These improvements could make the device even more versatile, powerful, and adaptive to emerging technological trends:

1. **Cloud Integration:** Incorporating cloud services for real-time data storage and access would allow emergency contacts or authorities to view location histories, video feeds,

and other alerts securely and from any device. This feature would also enable advanced data analytics for post-event reviews.

2. **Machine Learning and AI:** Adding artificial intelligence capabilities could enhance the system's functionality. For instance, integrating facial recognition could help identify potential threats, while anomaly detection in video feeds could trigger automated alerts during suspicious activities.
3. **Wearable Design:** The current hardware could be miniaturized into a wearable form factor, such as a smartwatch, pendant, or wristband, for greater convenience and discreet usage. This would also make the device suitable for children or elderly individuals who may require constant safety monitoring.
4. **Mobile Application Development:** Developing a companion mobile application could extend the device's usability. The app could enable remote control, device health monitoring, GPS tracking, and manual alert activation, providing greater flexibility and control for users or guardians.
5. **Extended Battery Life:** Optimizing the power consumption of the device and integrating more advanced battery management systems could significantly increase the operational duration, especially in remote or prolonged emergency scenarios.
6. **Enhanced Connectivity:** Introducing communication technologies like LoRa or 5G could improve the device's performance in areas with poor GSM network coverage, enabling wider accessibility and reliability.
7. **Voice and Gesture Control:** Enabling hands-free operation through voice commands or gesture recognition would make the device even more user-friendly, especially for individuals with limited mobility or during high-stress situations where manual operation may not be feasible.
8. **Advanced Sensors:** Incorporating additional sensors, such as heart rate monitors, fall detectors, or temperature sensors, could broaden the scope of the device to include health monitoring features, making it suitable for elderly care or adventure sports.
9. **Emergency Hotlines and Authorities Integration:** Direct integration with local emergency services or hotlines could ensure faster response times and provide automatic escalation of critical situations to relevant authorities.
10. **Robust Build for Harsh Environments:** Designing the hardware to be water-resistant, shock-proof, and dust-proof would make it suitable for outdoor activities or challenging environments, expanding its range of use cases.

This project serves as a proof-of-concept for the immense potential of IoT and embedded systems in personal safety. With future enhancements, the device could evolve into a comprehensive, all-in-one safety and monitoring solution, capable of addressing a wide range of scenarios and user needs. It has the potential to impact personal safety at a larger scale, bringing significant benefits to society.

CHAPTER 9

CODE FOR RASPBERRY PI

```
import smtplib
from email.mime.text import MIMEText
from email.mime.multipart import MIMEMultipart
from gpiozero import Button, Buzzer
from RPLCD.i2c import CharLCD
import serial
import time
import threading

# Pin configuration
BUTTON_PIN = 21  # Panic switch
BUZZER_PIN = 17  # Buzzer pin

# Initialize LCD
lcd = CharLCD('PCF8574', 0x27)

# Initialize GSM serial connection
gsm_port = '/dev/ttyAMA0'  # Adjust this if needed
gsm_baudrate = 9600
sim800L = serial.Serial(gsm_port, gsm_baudrate, timeout=1)

# Initialize GPS serial connection
gps_port = '/dev/ttyUSB0'  # Adjust this if needed
gps_baudrate = 9600
gps_module = serial.Serial(gps_port, gps_baudrate, timeout=1)

# Initialize button with pull-up resistor
button = Button(BUTTON_PIN, bounce_time=0.5, pull_up=True)

# Initialize buzzer on GPIO17
buzzer = Buzzer(BUZZER_PIN)

# Email configuration (Update with real credentials)
SMTP_SERVER = 'smtp.gmail.com'
```

```
SMTP_PORT = 587
EMAIL_ADDRESS = 'aman.kapil.ak@gmail.com'
EMAIL_PASSWORD = 'waexvsormjcgwjir'
def get_gps_data():
  """Read and parse GPS data to extract latitude and longitude."""
  while True:
    line = gps_module.readline().decode('utf-8', errors='ignore').strip()
    if line.startswith('$GPRMC'):
      parts = line.split(',')
      if parts[2] == 'A':  # Check if the data is valid
        latitude = convert_to_decimal(parts[3], parts[4])
        longitude = convert_to_decimal(parts[5], parts[6])
        return latitude, longitude
    time.sleep(0.1)
def convert_to_decimal(coordinate, direction):
  """Convert GPS coordinate from NMEA format to decimal degrees."""
  degrees = float(coordinate[:2])
  minutes = float(coordinate[2:]) / 60
  decimal = degrees + minutes
  if direction in ['S', 'W']:
    decimal = -decimal
  return decimal
def send_email(subject, body, to_email):
  try:
    message = MIMEMultipart()
    message['From'] = EMAIL_ADDRESS
    message['To'] = to_email
    message['Subject'] = subject
    message.attach(MIMEText(body, 'plain'))

    server = smtplib.SMTP(SMTP_SERVER, SMTP_PORT)
    server.starttls()
    server.login(EMAIL_ADDRESS, EMAIL_PASSWORD)
    server.sendmail(EMAIL_ADDRESS, to_email, message.as_string())
    server.quit()
    print("Email sent successfully!")
  except Exception as e:
```

```
        print(f"Failed to send email: {e}")

def display_initial_messages():
    lcd.clear()
    lcd.write_string("RASPBERRY - PI 5")
    lcd.cursor_pos = (1, 0)
    lcd.write_string("  BASED  WOMEN")
    time.sleep(3)

    lcd.clear()
    lcd.write_string(" SAFETY  DEVICE ")
    lcd.cursor_pos = (1, 0)
    lcd.write_string("   WITH  GPS ")
    time.sleep(3)

    lcd.clear()
    lcd.write_string("TRACKING & ALERT")
    time.sleep(3)

    lcd.clear()
    lcd.write_string("GETTING GPS DATA")
    time.sleep(5)

def send_sms(latitude, longitude):
                        message = f"Help! I am in danger. Location:
https://maps.google.com/?q={latitude},{longitude}&entry=gps\r"
    print("Setting SMS mode to text...")
    send_at_command('AT+CMGF=1')
    send_at_command(f'AT+CMGS="+919354352629"')  # Update as needed
    sim800L.write(message.encode())
    sim800L.write(bytes([0x1A]))
    time.sleep(5)
    print("SMS sent successfully.")

def make_call():
    phone_number = "+919354352629"  # Update as needed
    send_at_command(f'ATD{phone_number};')
```

```
    time.sleep(10)
    print("Call initiated.")

def alert_process():
    lcd.clear()
    lcd.write_string("WOMEN IN TROUBLE")
    lcd.cursor_pos = (1, 0)
    lcd.write_string("  HELP IS HERE!")
    time.sleep(5)

    latitude, longitude = get_gps_data()
    send_sms(latitude, longitude)
    make_call()
    subject = "Emergency Alert: Women in Trouble"
        body = f"Urgent help is needed! The woman is in distress. Here is the location:\n\nLatitude:
{latitude}\nLongitude: {longitude}\n\nPlease contact the authorities immediately."
    recipient_email = "amankapil0007@gmail.com"
    send_email(subject, body, recipient_email)
def button_pressed():
    buzzer_thread = threading.Thread(target=activate_buzzer)
    buzzer_thread.start()
    alert_process()
def activate_buzzer():
    buzzer.on()
    time.sleep(5)
    buzzer.off()
if __name__ == "__main__":
    display_initial_messages()
    try:
        while True:
            if button.is_pressed:
                button_pressed()
            time.sleep(0.1)
    except KeyboardInterrupt:
        lcd.clear()
        lcd.write_string("  Exiting...   ")
        sim800L.close()
```

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