Design and Implementation of Smart Portable Safety Alert System for Vulnerable Individuals

A Project report is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Electrical and Electronic Engineering

Submitted by

Manos Mazumder ID: 213-33-1413

Riaj Ahmed ID: 213-33-1429

Asif Al Masrur ID: 213-33-1431

Khalid Saifullah ID: 213-33-1432

Supervised by

Ms. Kanij Ahmad

Assistant Professor

Department of Electrical and Electronic Engineering

Department of Electrical and Electronic Engineering

Faculty of Engineering

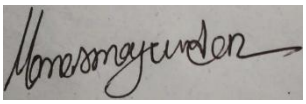
DAFFODIL INTERNATIONAL UNIVERSITY

NOVEMBER, 2025

DECLARATION

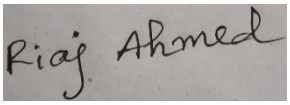
We therefore hereby declare that this project, "**Design and Implementation of Smart Portable Safety Alert System for Vulnerable Individuals**" is our original work and has not previously been included in a thesis or dissertation submitted to this or any other institution for a degree, diploma, or other qualifications. It was completed in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering at Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. We have made an effort to list any potential dangers associated with this research, secured the necessary ethics and safety approvals (where applicable), and recognized our responsibilities as well as the participants' rights.

Signature of the candidates



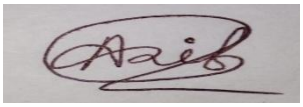
Manos Mazumder

ID: 213-33-1413



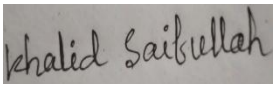
Riaj Ahmed

ID: 213-33-1429



Asif Al Masrur

ID: 213-33-1431



Khalid Saifullah

ID:213-33-1432

APPROVAL

The project entitled **"Design and Implementation of Smart Portable Safety Alert System for Vulnerable Individuals"** submitted by **Manos Mazumder (213-33-1413), Riaj Ahmed (213-33-1429), Asif Al Masrur (213-33-1431), Khalid Saifullah (213-33-1432)** has been done under my supervision and accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** in **November, 2025.**

Signed

Ms. Kanij Ahmad
Assistant Professor
Department of Electrical and Electronic Engineering
Faculty of Engineering
Daffodil International University

Dedicated

To

Our

Parents

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BAETE	Board of Accreditation for Engineering and Technical Education
DIU	Daffodil International University
IIC	Inter Integrated Circuit
GSM	Global System for Mobile Communications
GPS	Global Positioning System
Li-Po	Lithium Polymer
BMS	Battery Management System
SIM	Subscriber Identity Module
BC	Boost Converter
AU	Arduino UNO

ACKNOWLEDGEMENT

We would like to thank **Almighty Allah Ta'ala** first and foremost. We are able to finish our work as best we can with his blessing.

We would like to express our gratitude to our supervisor, **Kanij Ahmad, an Assistant Professor** in the **EEE Department at Daffodil International University**, for providing us with the opportunity to work on a concept that has a significant impact and for handling all of the development-related issues. Subsequently, we would like to take this chance to thank our supervisor for his or her unwavering support, encouragement, and direction during this endeavor. We would be unable to complete our endeavor without his insightful counsel. I would also like to thank him for providing us with the chance to collaborate on this project.

We would also want to express our gratitude to **Md. Dara Abdus Satter**, who serves as the **Head of the EEE Department at Daffodil International University**, for his encouragement and assistance. Aside from that, we want to express our gratitude to every student for contributing to this initiative and sharing information with us. We would want to express our sincere love and thanks to our family, who have been so supportive and who have also served as an inspiration and motivator for us while we have been studying at this institution.

ABSTRACT

Safety is a basic need, but not everyone has equal access to it, especially vulnerable groups like the elderly, children, people with disabilities, and women. This paper introduces a Smart Portable Safety Alert System designed to offer immediate support in emergency situations for these persons. The system was built using an Arduino UNO integrated with a SIM808 GSM/GPS module and also an additional GPS tracker for better accuracy to detect the user's location and send an alert message or make a phone call via GSM communication by pressing the emergency switch. This prototype is powered by a rechargeable battery and was programmed through embedded C, ensuring fast response and low power consumption. The system can transmit location data accurately and deliver SMS/call alerts promptly within a few seconds, as confirmed by experimental testing. The system is compact, portable, economical, and dependable. These features make it suitable as personal safety for vulnerable persons during critical conditions.

Keywords: Safety Alert System, GSM Module, GPS Tracker, Portable Device.

CHAPTER 1
INTRODUCTION

1.1 Introduction

Despite living in an era when technology allows us to speak with anyone anywhere on the planet in a matter of seconds, many vulnerable people (including women, children, elderly, and disabled individuals) still cannot be guaranteed that they won't go missing or become isolated simply because they are unable readily access assistance. This is a bitter irony of our time. In spite of living in a "global village" where the world is connected, safety in real time remains a big concern. Women walking home, elderly people missing or disabled people in distress – these are all simply examples of why we need accurate personal safety solutions to make sure that at no point are we ever truly alone.

The aim of this project is to create a reliable and affordable portable safety alert system for vulnerable individuals. This new system will provide a simple and trustworthy solution that ensures quick help during emergencies. It includes features such as real-time location tracking, instant communication, and loud alerts. It is designed to be cost-effective and easy to carry for everyday use. We are dedicated to making safety available for everyone.

The GPS module finds the user's location in real time. In emergencies, this location information helps caregivers, family members, or authorities quickly and accurately locate the person. The GPS module gets signals from satellites that orbit Earth. It calculates the user's current position in latitude and longitude. This location is then sent through the GSM module to emergency contacts that are registered.

The GSM module allows the safety device to send SMS messages or make phone calls to set emergency contacts when an alert is triggered. It works with a SIM card, just like a mobile phone. When the emergency button is pressed, the system sends a message that includes the user's location from the GPS. It can also place a call through the GSM network. This ensures that help can be reached right away, even without internet access. It is a low-cost wireless data communication system provided by cell phone operators. The best possible communication media for the present and the future is GSM which is low cost and is easiest available worldwide through mobile phone.

1.2 Problem Statement

Problem Statement:

The Vulnerable groups, such as the elderly, people with disabilities, children and women often face serious safety risks, including medical emergencies and harassment. Traditional safety methods like talking and reporting by hand, can be unreliable and slow. Although smartphones offer emergency calling and location-sharing features, these might not be accessible during crises because of physical limitations or panic.

Proposed Solution:

To meet the safety needs of those who are vulnerable, we have suggested designing and producing a portable safety-alert system that incorporates GSM with GPS tracking technology. Its system will comprise a small device fitted with an emergency switch, which users can use to trigger it if they are in trouble. Once triggered, a GSM signal will be sent automatically via the mobile network to a family member, carer, or emergency service contact. It will also include the user's current GPS location. The rationale of this work is to keep this solution simple, convenient, and reliable so that users are able to operate it quickly even under stress or difficult scenarios. Unlike smartphone-based applications, this product operates independently, and it is suggested that the range of usefulness for this device in an emergency would be superior. This combined system provides for a quicker form of response that may enable guardians or authorities to directly locate and aid its users while possibly minimizing threats, avoiding harm, and increasing safety.

1.3 Objectives

The objective of this project is to:

- Develop a compact, light-weight and user-friendly safety alert system that can be swiftly activated in critical situations.
- Capable of sending messages or calls to predefine contacts through GSM communication, with real time location by GPS location tracking in case of emergency.
- Ensure reliable performance with fast response and ease of use during emergencies.

1.4 Brief Methodology

The system is developed based on the safety requirements of vulnerable populations. It plays an important role in function such as GSM communication, GPS tracking and emergency switch. Arduino-based microcontroller with GSM modem is used to send alerts, GPS module helps us in real time tracking of location and a very simple emergency key is pressed to on the device under emergent situations powered by rechargeable battery. The software does detect emergencies and automatically sends the user's location to preprogrammed contacts. The whole system is implemented in a portable prototype to test its performance under various situations for the accuracy, reliability and description time of the response. After testing, it is improved based on user feedback after testing.

Benefits of Safety Alert System with GSM and GPS:

a. **Flexibility and Adaptability**

   This is a modular system and the system will be able to add new update or improvement in future. Upgrade: With the latest technology electronics easily replaced for upgrading GSM module, GPS tracker quality or microcontroller.

b. **Prototype and Incremental Development**

   It's built for quick prototyping and frequent development, e.g., when we later have requirements for higher tracking precision or faster alert transmission, we can always add more sensitive GPS modules and a lower power GSM, without having to redesign the whole system. The system is equipped in addition with a rechargeable battery, and hence we can further optimize our modifications in future experiments for longer operation or powering out of other sources.

c. **Patient-Focused Strategy**

   That's cheaper than other monitoring or emergency services, so that it can be accessed by individuals, families and care organizations.

d. **Rapid Deployment and Time-to-Market**

   Splitting the development into smaller time-boxed iterations enables early implementation of mission-critical safety features. This process facilitates rapid notification, location sharing and easy access to carers or the emergency services.

e. Risk Mitigation

It is safer for users with these DC power gadgets such as GSM and GPS. DC voltage is preferable for cordless devices and AC voltage being capable of powering both wired and wireless enabled devices**.**

f. Long-lasting and easy to maintain

The system is also low maintenance: It has few moving parts and relatively rudimentary electronics. This arrangement can have lower cost and reduced downtime.

g. Ongoing Improvement

It permits an iterative improvement procedure based on feedback from users. Any feedback of this kind plays a part in further development of this appliance that has made both use and alarm accuracy and reliability possible.

In short, the project delivers an affordable, easy-to-use and all-purpose safety feature that ensures quick protection and confidence for those at risk.

1.5 Implementation Schedule with Gantt Chart

Implementation schedule in the form of a work breakdown structure (WBS) and a Gantt Chart for the Solar-based grass cutter with weather monitoring system:

Work Breakdown Structure (WBS):

1. **Project Initiation**
    - Define the project scope, objectives and target users, including the elderly, disabled individuals and women.
    - Identify stakeholders and gather requirements
2. **Research and Technology Selection**
    - Study existing safety devices to identify their limitations.
    - Select the appropriate microcontroller (Arduino), and determine the necessary GSM module, GPS module, and power source.
    - Choose suitable communication and tracking technologies.
3. **Hardware Development**
    - Integrate the GSM module for message and call alerts.
    - Incorporate the GPS module for real-time location tracking.
    - Design an emergency or panic switch for easy accessibility.
    - Develop a compact circuit with a rechargeable battery.
4. **Software Development**
    - Program the microcontroller to manage GSM-based alerts and GPS location tracking.
    - Implement functionality for automatic messages and calls, including location coordinates.
    - Include fail-safe features, such as resending messages if the first attempt fails.
5. **System Integration**
    - Assemble the hardware components into a portable prototype
    - Integrate the software with the hardware to ensure full system operation.

6. **Testing & Quality Assurance**
    - Assess the reliability of GSM communication and the response times.
    - Test GPS accuracy in various conditions, including both indoor and outdoor environments.
    - Run usability tests with end users to gather their feedback.
    - Find solutions for technical and operational issues.

7. **Validation & Optimization**
    - Evaluate system performance against established requirements.
    - Enhance the design to improve reliability, battery life, and user-friendliness.
8. **Documentation & Training**
    - Create a user manual to facilitate operation.
    - Provide guidelines for maintenance and troubleshooting.
9. **Monitoring and Maintenance**
    - Develop monitor and evaluate mechanism to ensure continuous monitoring and provide feedback.
    - Plan for regular maintenance, software patches, and future enhancements.

Gantt chart

Phase/Task	Month					
	1-2	3-4	5-6	7-8	9-10	11-12
1. Project Initiation	✓					
2. Literature Review	✓					
3. Materials Collection		✓	✓	✓	✓	
4. Frame Design				✓	✓	
5. Validation & Optimization				✓	✓	
6. System Integration					✓	
7. Testing and Debugging					✓	✓
8. Final Documentation					✓	✓

NB: The durations listed for each activity are provisional, and the actual time required will vary depending on project specifics, team size etc. Furthermore, testing and maintenance activities are executable continuously during the life of the project and after completion. The Gantt chart serves as a map of project schedule, you can see all critical chain and resource dependencies.

1.6 Structure of the Report

1. **Introduction**

   - **Project Overview and Significance:**

     In this work, we design a security alarm system for vulnerable groups such as the elderly, physically disabled, and women by communicating through GSM and locating the exact position using GPS. "This system is designed to provide citizens with immediate and reliable access to timely emergency alerts and notifications, location-based information for personal safety, and whether services are available," the statement continued.

   - **Problem Statement and Objectives:**

     Current safety systems are largely not working, as they are frequently inaccessible. The goal of this project is to design an easy-to-use and small safety tool that can provide emergency alerts and real-time GPS position information without the need for a smartphone.

   - **Motivation for GSM and GPS Use:**

     GSM makes it available for widespread emergency communication, and GPS can provide your exact location. In combination the technologies offer an affordable and practical safety option for anyone potentially at risk.

2. **Literature Review**

   - **Review of existing systems in personal safety:**

     Systems today, including smartphone apps and wearable devices, can provide emergency alerts. But they are generally unsuccessful owing to network problems, low battery or user unavailability at critical times of distress.

   - **Exploration of GSM and GPS applications in safety and monitoring:**

     GSM is pervasive in remote control and measurement, and GPS location has become important for tracking applications. In safety applications, these techniques ensure the trustworthiness of location sharing and alerting. They prove useful in emergency systems.

- **Identification of relevant technologies and best practices:**

  Microcontrollers such as Arduino, GSM modules, GPS modules, and rechargeable batteries are required technologies. The best practices are to use low power, offer fast response times, and have easy activation.

- **Detailed explanation of selected components:**

  The system consists of a microcontroller as core controller, GSM module for communication, GPS module for tracking the location in real time and panic button for emergency alerting system, along with battery unit.

3. System Design and Development

The system consists of a microcontroller as the central processing device, GSM module for communication, GPS module for live tracking, emergency switch in case of accident and power source from battery.

- **Description of the system architecture:**

  When emergency button is pressed, the microcontroller receives the location as GPS coordinate from GPS module. It subsequently transmits this data to contacts stored in the GSM module over SMS or phone calls.

- **Overview of the development process:**

  The process of this development involves: requirements analysis, hardware combination, writing codes, connecting components, and testing the system.

- **Integration and control arrangements:**

  The control logic is programmed to make the emergency button functional, in which the GSM module and GPS module are activated as soon as button is pressed by user.

4. System Design Implementation

- **How GPS gathers location data:**

  The GPS module is permanently receiving signals from the satellite to gain latitude and longitude. This information is specified in the alert message.

- **User interface design:**

  The system's interface is straightforward as possible. It contains a single emergency button that doesn't need any advance mechanism to press. Activating that button, the device works automatically as well as smoothly.

5. Implementation and Development

- **Step-by-step process**:

  The developed model was implemented in several stages. First of all, hardware checked including connecting and testing, microcontroller was programmed to configure GSM/GPS, and lastly everything was assembled into working prototype.

- **Testing and validation**:

  Testing evaluated response time, message delivery success rate, and GPS accuracy in different environments.

- **Challenges faced**:

  Challenges were suboptimal network coverage, delayed GPS signals indoors and powering the application for long periods of time.

- **Improvements and updates**:

  Several updates were applied to make the model more efficient. We worked to reduce power usage, improved the consistency of delivering message, and adjusted the emergency button so that it can start easily.

6. Results and Findings

- After testing, the configuration was able to send alerts successfully via GSM as well as GPS location through GPS module. In most cases, the device responded quickly and communication remained stable whenever the network coverage was strong.

7. Discussion

- The GSM and GPS module together performed well and offered real-time alerts and precise location tracking respectively. However, the system's performance relied on network coverage and the capability of the GPS signal as well.
- The design of the emergency switch made the device easy to use for vulnerable users. This addressed an important limitation of safety solutions that rely on smartphones.

8. Conclusion

- The proposed safety alert system is a dependable, easy-to-use, and budget-friendly solution that improves personal safety for vulnerable individuals.
- While it works well now, future upgrades like better battery backup and hybrid communication (GSM + IoT) can further boost reliability and usability.

9. Recommendations

- Increase battery storage or integrate solar charging for more usage time during emergencies.
- Switch between networks with their respective network limitations, the two networks, GSM and IoT (or GSM and Wi-Fi), reduce the probability of a failure due to one single network.
- Supplement it by a vibration/LED response for the user to know that the alert message is received.
- Design a waterproof and tough case for outdoor and rugged use.
- Provide an accompanying mobile or desktop interface for caregivers to listen in on alerts and follow users live.

1.7 Summary

The purpose of this paper is to design and develop a replacement for the traditional safety alert system that uses GSM with GPS for real-time location tracking. It aims at the vulnerable segments of society, consisting of the elderly, people with disabilities, and women, to provide a sleek and user-friendly standalone service in times of distress without reliance on smartphones. Technical values of the microcontroller, GPS module, GSM module, emergency switch, and battery system, as well as recommendations for safe use and the user manual, are given in the appendix. The system is provided with low-voltage DC components so that the work is completed safely and reliably. Both strengths, fast emergency response and accurate tracking, as well as potential weaknesses are addressed, including dependency on the GSM network and battery life.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The project will provide an intelligent portable alert system based on GSM and GPS technologies to keep vulnerable people safe through efficient communication with the outside world, as well as accurate machine-to-machine positioning service in real-time. Key features consist of one-touch emergency switch for an instant reaction, automatic notification via SMS and calls as well as location tracking. This system also allows to easily alert family or caregivers in case of panic situation, making it easier to communicate and reduce response times. It is specially designed with elderly, disabled, and women at risk who are not easy to carry a mobile phone during an emergency or going out. This paper presents the design and implementation of smart portable safety alert system, enables real-time safety, and peace of mind.

2.2 Related Research

One of the first implementations of GSM-based tracking to monitor real-time movements was a simulation system presented by Tamil et al. in 2007. The authors introduced a mobile vehicle tracking system using GPS and GSM to track the location of a vehicle at any time [1]. Another early case study was adopted by Akinode et al. in 2011, which tested a general view of experience from GSM-based tracking and focused on how the GPS tracking system could improve national security [2]. Automatic vehicle accident detection and messaging system was developed by Prabha et al. in 2014 using GSM and GPS modems. The designed system will automatically send a message alerting to emergency contact for emergency issues immediately after the accident is detected [3]. Also, an accident detection and notification system with GPS and GSM navigation technology by Dilkhush et al. in 2020 were designed to allow for and faster emergency response. This was an integration to help with communicating during emergencies and tracking location [4]. Another work carried out by Olaniyan et al. cites a microcontroller-based GSM alert distress system to achieve an effective means of communication during emergency situations in 2021 [5]. Further, in 2022 Wankhade et al. also make a step ahead in a more beneficial women's safety device through the use of pre-defined consumers and GPS tracking [6].

Secondly, Chinnasamy et al. in 2022 used MQTT and GSM/GPS modules to create an IoT-based emergency alert and GPS tracking system. Among other benefits, this system has helped optimize the communication process and made the response time shorter [7]. Thirdly, Singh et al. implemented a fingerprint-activated GPS and GSM-based device for women's safety in 2023 [8]. More recently, Kar et al. of the year (2024) developed a low-cost intelligent female surveillance system using GPS, GSM, and Arduino to track the females in real time and send the emergency message in minimum time frame [9]. In addition, an IoT-based Smart Emergency Response System was developed by of the year (2024) to monitor vehicle, residence, and health conditions to assure the safety in many areas with the help of GPS and wireless communication [10].

2.2.1 Background Information

This project is aimed at creating a portable smart alert device for people who are at risk. Some of the most significant features are an Arduino microcontroller, a GSM module for sending SMS, a GPS module for real-time tracking, a manual switch for easy use, and a rechargeable battery for portability. The person who are in danger can call caregivers for help and send location using GPS in an emergency through the use of communication technologies and personal safety solutions.

2.2.2 Summary of Similar Designs, Processes

In some research work, GSM and GPS safety systems for the elderly are described. These reports highlight the significance of GPS-enabled privacy proving and sending SMS or calling the user's registered contacts instantly during an emergency.

2.2.3 Strengths of Proposed Design

- **Safety and Reliability:** The design employs low-voltage DC devices, which amount to a safety guarantee for distress persons, and reliable emergency communication or positioning.
- **Affordable:** It is a budget-friendly, self-contained device which doesn't depend on smartphone, less reliance on expensive tech but still remains safe.
- **Maintenance:** GSM, GPS, and microcontroller are the basic modules which are used. If these products face damaging issue, these are recoverable independently to keep the cost in range.

- **Convenience:** The machine has a single push button that can activate easily by pressing in case of emergency. So, it is very user-friendly. Thus, this straightforward design makes it suitable to be used by the elderly and even people with disabilities in critical situation.

2.2.4 Weaknesses and Prospects for Improvement

- **Scalable:** By providing connectors to wider smart city and health context, the system can be scaled. This would enable the utility for widespread use in community, hospital and public settings.
- **Power Saving:** There is the potential to provide a longer device lifetime with consideration of energy aware components like low-power GSM and GPS modules. This enhancement in performance would enable operation of longer duration without frequent recharging.

2.2.5 Comparison and Research Gaps

Many of these personal safety devices rely on mobile phones or battery-operated gadgets that can fail when anyone need them most. This prototype model introduces a portable safety device for quick alerts, combining GPS tracking, GSM communication, and an alarm system.

Currently, there's little research on compact, all-in-one safety systems for vulnerable groups of people because most either use smartphones or specialize to perform a single function. Our project attempts to address these gaps by developing a robust on-demand emergency response model.

2.2.6 Challenges and Future Directions

Despite the potential advantages of smart mobile safety assistance systems, there are still issues that must be resolved. Inadequate connectivity in remote locations, the need for a reliable power source for recharging, and affordability for all users are the main obstacles. In order to assess the dependability, durability, and user acceptability of such safety alarm systems in real-world settings, more work is required to enhance battery performance, look at other communication technologies (such as LoRa or satellite links), and carry out long-term field experiments.

2.3 Summary

The literature review discusses the feasibility of a smart mobile safety alert system in terms of cost, usability, maintenance-related considerations and scalability. It then discusses limitations and constraints to these systems like user acceptance, battery life, connectivity issues. The study also takes into account the background of the personal safety of vulnerable social groups such as women, elderly people and persons with disabilities. It demonstrates the increasing interest in professionally manufactured safety items. This review reveals that there is limited amount in-depth studies and possibility for further research on the improvements of real-time alert devices like GPS location accuracy and availability, as well as interlocking intelligent feedback to immediately trace back sources from which risks emanate when emergency arise. In general, the literature review provides a summary of research, innovations, and developments regarding intelligent wearable safety alert systems. It emphasizes how important these kinds of systems are for ensuring people's personal safety, offering prompt assistance, and preserving the independence of those who are most in need.

2.4 Conclusion

In summary, research indicates that smart portable safety alert systems for vulnerable individuals are becoming more and more popular. Studies show that these kinds of devices can improve our personal safety, despite problems with battery life, connectivity, and user adoption. Research: Novel approaches: in order to fully achieve the potential benefits of such warning systems in terms of timely help, expanding independence, and increasing safety for women, the elderly, and people with disabilities, research and development efforts must continue.

CHAPTER 3
MATERIALS AND METHODS

3.1 Introduction

The material and method sections of this study presented a detailed description of the component/materials used in the construction, technology innovations/new technique application testing approach, and data obtained/gathered, as well as minimum safety precaution measurements or procedures established during production processes until actual design field tests for the Safety Alert System with the GSM/GPS module. This section attempts to define the components and methods of producing a working, efficient solution. The effective adoption of the system relies on appropriate material selection, clear processes, and integrated technologies. This framework is proposed in order to lead the work towards the expected results.

3.2 System Design and Components

The development of a safety alert system based on the GSM/GPS module goes through some aspects and steps.

❖ **Design & Manufacture of Alert Mechanism:**

1. **Requirement Analysis:** The project focuses on developing a safety alert system for vulnerable persons. It uses an Arduino based setup to connect GSM/GPS module for sending SMS/call alerts and GPS location respectively. Also, it uses a Li-Po battery for long-lasting power support. Moreover, it employs a push switch to activate the device.
2. **Conceptual Design:** The device is small enough to fit in a pocket and designed to be easy to use. When activated, it sends call or message alerts promptly to selected contacts, also shares victim's real-time location and ensures quick response in case of emergency situation. Overall, the design focuses on simplicity, comfort, reliability for users.

3. **Selection of System Components:** This project utilizes several types of electrical components, such as:
    - **a.** Arduino UNO R3
    - **b.** GSM/GPS SIM808
    - **c.** GPS Location Tracking Module
    - **d.** Li-Po battery
    - **e.** BMS module TP4056
    - **f.** Boost converter XL6009
    - **g.** Any operator SIM card
    - **h.** Connecting wires

4. **Device Housing & Construction:** The casing forms core of the system that secures all electrical equipment safely. Each part is positioned for stable mounting and easy access during maintenance. The enclosure is designed to withstand physical impact and protect internal parts from dust and accidental knocks.
5. **Device Alerting System Integration:** The alerting unit combines multiple functions within a single compact module. It includes an emergency switch, GPS tracker and GSM function to support critical alert operations. The layout ensures that each component is both easily accessible and efficiently transmitted to a nominated contact or authority.

❖ **Power System Integration:**

1. **Battery Power rating:** The product runs on a rechargeable battery that delivers stable power for continuous operation. The battery capacity was selected to support GSM, GPS, and notification response throughout a full day of use without interruption.
2. **System Enclosure and Orientation:** The parts inside are constructed for efficiency, access and longevity. In this kind of construction those who use the system get a good grip as well as convenience in carrying it from one place to another.
3. **Electrical Wiring Safety:** All internal wiring connects the battery to the alert and tracking/receive notification systems via the power management module. The apparatus constructs suitable connectors, and safety protections to assure proper operation and a safe system.

❖ **Development Tools and Technologies:**

1. **GSM/GPS SIM808 module:**

   The SIM808 module integrates GSM (Global System for Mobile Communication) and GPS (Global Positioning System) systems on a single board. In this project, this module seeks to send alerts through SMS or make phone calls to some emergency contact number along with the real-time location tracking. When the user activates the emergency switch, the module quickly dials pre-stored emergency numbers to provide assistance. The SIM808 can make calls and send SMS using a standard SIM card. In our case, we use this capability to have the device send emergency SMS alerts and make automatic calls to preflight numbers when the user activates the emergency. The GPS location tracking module detects the user's positional coordinates by receiving signals from an appropriate number of satellites.

   The GPS location tracking module's accuracy in an open environment, ranges from 80 to 100 meters, providing sufficient information to locate weak points during emergencies. The location information can also be transmitted to family members, carers, or even emergency services via SMS.

2. **Li-Po Battery:**

   It is powered by a rechargeable Li-Po battery. The Li-Po battery considered is chosen owing to its high energy density, light-weight, and steady power supply for the portable devices. This feature guarantees that the safety notice system is in use at all times.

3. **BMS module (TP4056):**

   The Battery Management System (BMS) is built to charge and protect the Li-Po battery safely. It prevents overcharging, over-discharging, and short circuits. This helps the battery last longer and ensures the system works reliably.

4. **Boost converter (XL6009):**

   The boost converter raises the voltage of the Li-Po battery to the necessary level for different modules in the system. It delivers stable and regulated power to the Arduino, GSM/GPS module, and other electronic parts.

5. **Arduino UNO R3:**

   It is an open-source microcontroller-based board that helps to operate the device by including programs on it. For writing different types of programs Arduino. cc or Arduino IDE is used. The programs are stored in the ATmega328P microcontroller. It has digital and analog input/output pins. It has 14 digital I/O pins and 6 analog I/O pins. Pin numbers 3,5,6,9,10 and 11 are the PWM pins. The programs are included via a type B USB cable. For ON Arduino, it can be powered by a USB cable or Voltage input pin. The board has a reset button to reset programs to re-run the programs or include new programs. The input voltage can be 5 volts to 12 volts.

6. **SIM card (for any operator):**

   A standard GSM SIM card of any operator is inserted into the SIM808 module to enable network connectivity. This setup allows the system to send SMS alerts, make emergency calls, and transmit GPS location data to designated contacts or authorities.

❖ **Implementation of Alert System:**

1. **Alerting Mechanism Design:** An emergency switch is placed in the system that can be triggered easily by the user in case of emergencies. When enabled, the device will automatically turn on the GSM/GPS SIM808 module and send SMS alerts, make phone calls to a registered number, and broadcast the users' live location to pre-defined contacts.
2. **Module Part:** The GSM/GPS module is fed from a rechargeable Li-Po battery with a boost converter used to have a constant supply voltage. During long usage, this arrangement allows the alert device to work functionally at all times.
3. **Compact Node Design:** All the key components, such as the Arduino UNO, SIM808 module, Li-Po battery, and BMS are enclosed in a portable housing. Its compact structure makes it portable, reliable, durable, and capable of observing the daily activities of vulnerable people.

❖ **Testing & Validation:**

1. **Functional Test:** Li-Po battery is the power source for this device. We tested our device in a controlled environment. We pressed the emergency button multiple times to check the triggering of GSM and GPS modules. During testing, when the switch was activated, we were failed to send call alerts on the first attempts. Only message could send properly.

Then we identified the bugs via programming and located the fault. After solving these problems, we were able to send both message and call alerts at a time. After resolving these issues, we faced another problem of delivering the location data and it was addressed in the next phase of testing. Finally, the system successfully sent the SMS/phone call to pre-set contact numbers including victim's accurate location. The GPS coordinates were verified through google maps to ensure location accuracy.

2. **Field Test:** We tested the device outdoors in different areas like open field, near buildings, inside rooms to assess the performance under various signal strengths. By testing, we observed that the system could send alerts and share location data within 10-15 seconds in strong network areas and within 30-40 seconds in weak zones. The device was tested to perceive how its functions change with environmental conditions.
3. **Safety and Durability:** The circuit was continuously operated to check overheating or component failure for several hours. We checked the voltage output of the Li-Po battery to confirm whether it stayed within the range (3.7V - 4.2 V) or not. We dropped the casing a few times and handled it roughly to check if it could survive normal use without getting damaged. All the components kept function properly even under low voltage condition, and there was no risk of electrical shock to users.

❖ **Optimization and Refinement:**

1. **Feedback Analysis:** The project design and performance will be improved through feedback analysis.
2. **Iterative Refinement:** Relies on user experience, performance information feedback, alert system realization, and GSM/GPS module effectiveness & reliability.
3. **Future Work:** The limitations would be exposed and then can be modified over time by monitoring it constantly. This will lead to greater capacity and efficiency.

This section provides a nice synopsis of the work that needs to be done. Its development consists of conceptual design, device packaging and fabrication, power system integration, alert system operation demonstration, testing/verification, and optimization/refinement of the smart portable safety alert apparatus. Every step is carefully planned to ensure that the system operates effectively, efficiently, and safely, thereby protecting people in vulnerable situations and facilitating quick emergency assistance.

3.3 Design Specifications

Technical parameters of a security alert device with a GSM/GPS module may differ according to changes in design philosophy or a customer's requirements. Each component was selected carefully to meet the desired goal, as explained below:

1. **Microcontroller (Arduino UNO R3)**

   Arduino UNO R3 is the central processing unit of the system. We selected this component for its ease of programming, wide compatibility with GSM/GPS as well as GPS tracker modules. Also, it has enough I/O pins, a stable 5V logic level, provide serial communication for data exchange, easy to program and debug using Arduino IDE. These are essential for this project.

   The comparison with other microcontrollers is shown in tabular form (Table 3.1).

   Table 3.1: Arduino UNO vs Arduino Nano vs Arduino Mega

Microcontroller	Logic Level	I/O Pins	Form Factor	Current Handling	Advantages/ Remarks
Arduino UNO	5V	14 Digital/6 Analog pin	Medium	Good	Stable power supply, sufficient I/O pins, widely supported, fulfill project needs.
Arduino Nano	5V	14 Digital/8 Analog pin	Small	Less	Though it is Compact, but limited current handling.
Arduino Mega	5V	54 Digital/16 Analog	Large	Good	More pin and memory than required, increases cost and size unnecessarily.

   Among the available microcontrollers, we chose Arduino UNO because of its stable power supply, adequate I/O ports, ease of programming and debugging, which make it economical.

2. GSM/GPS Module (SIM808)

We used SIM808 module because it provides both GSM communication and GPS location in a single unit. It supports SMS or voice call by using any SIM operator, while also providing real-time location tracking.

The built-in GPS performs slow to lock location signals, especially in indoor or weak signal areas. Therefore, we used additional GPS tracker for better accuracy, faster satellite acquisition, and backup tracking if the SIM808's internal GPS fails or delays. It delivers real-time location accuracy up to 80-100 meters in an open environment. It makes our project more reliable and confidential as we have mainly focused on reliability issue.

The difference between built-in SIM808 GPS and external GPS tracker is shown (Table 3.2).

Table 3.2: Built-in GPS vs External GPS Tracker

Feature	SIM808 (built-in GPS)	External GPS Tracker
Functionality	GSM + GPS in single unit	Dedicated GPS Tracking.
Signal Sensitivity	Moderate (slow in weak signal areas)	High (better satellite acquisition).
Startup	Slower signal locking	Faster GPS lock
Overall Suitability	Compact and power efficient	More accurate and reliable for real-time tracking.

In spite of SIM808 handling GSM function and basic GPS as well, we integrated an external GPS tracker to ensure better accuracy and compatibility.

3. Li-Po Battery

We chose a Li-Po battery because it's light-weight, compact, and rechargeable, so it makes the device easier to carry. Moreover, it offers a stable voltage output and higher energy density than lead-acid or Ni-MH batteries.

The features that set the Li-Po battery apart from other types are illustrated in (Table 3.3).

Table 3.3: Li-Po Battery vs Ni-MH Battery vs Lead-acid Battery

Parameter	Li-Po Battery	Ni-MH Battery	Lead-acid Battery
Energy Density	High	Moderate	Low
Weight	Very light	Heavy	Very heavy
Size	Very flexible (thin)	Cylindrical	Bulky
Discharge Rate	High	Low	Low
Cost	Moderate	Low	Low

After comparing these components, we selected the Li-Po battery. Its high energy density, light-weight design, flexible form factor makes it ideal for a compact and portable safety alert system.

4. Battery Management System (TP4056)

We incorporated a BMS module to enhance the safety of the Li-Po battery. It helps to prevent over-charging, over-discharging, and protects the battery from short circuit problems. This helps the battery last longer and to work properly.

5. Boost Converter (XL6009)

We applied a boost converter since our Li-Po battery has a nominal voltage of 3.7 V, whereas SIM808 module and Arduino microcontroller requires around 5V. Boost converter steps up the voltage from 3.7 to a stable 5V, ensuring the system runs reliably even when the battery voltage have faced slight drop during discharge. Comparison between Boost converter vs other alternatives is depicted (Table 3.4).

Table 3.4: Boost Converter vs Buck Converter vs Linear Regulator

Parameter	Boost Converter (Step-Up)	Buck Converter (Step-Down)	Linear Regulator (e.g., LM7805)
Function	Increases voltage (e.g., 3.7V → 4.2V)	Decreases voltage (e.g., 12V → 5V)	Provides fixed step-down voltage
Efficiency	High (80–95%)	High (80–95%)	Low (30–60%)
Voltage Stability	Stable at output	Stable (when stepping down)	Stable (for small load)
Size and Cost	Compact / Moderate	Compact / Moderate	Bulky / Low cost

Through comparison, we chose boost converter because it offers high efficiency, better stability, compact size, and cost-friendly.

6. **SIM Card (for any operator)**

   A standard GSM SIM card enables the device to connect into any mobile network for sending SMS alerts, making emergency calls. In this system any standard operator SIM card can be used.

3.3.1 Rationale for Design Selection

The rationale for the particular overall system design was based on achieving a balance between portability, reliability, affordability, and quick response. Such a design ensured the most efficient interaction between the components, which thus allowed for the quick passage of emergency alerts while remaining within the low power consumption limits. Although there were numerous alternative designs and possible components available, such as a different microcontroller, communication module, and others, these would be either more costly, less feasible for the small size of complexity of the device, or that would otherwise inappropriate. Therefore, the chosen system design suited the project's requirements most accurately and ensured the optimal accommodations through which it achieves its goals.

3.3.2 Design Components

To make the whole system of a safety alert for vulnerable individuals, here in this project we use Arduino UNO, GSM & GPS module, boost converter, rechargeable battery, operator SIM, BMS module etc.

3.3.3 Required Component List

The components list for this project are listed in tabular form (Table 3.5).

Table 3.5: Required Component List

Serial No	Name	Quantity
01	Arduino UNO R3	1-P
02	GSM/GPS SIM808	1-P
03	Li-Po battery	1-P
04	BMS module TP4056	1-P
05	Boost ConverterXL6009	1-P
06	Operator SIM	1-P
07	GPS Location Tracking Module	1-P
08	Connecting Wires	As Per Required

3.3.4 GSM/GPS SIM808

The GSM/GPS SIM808 module combines GSM and GPS functionalities to enable communication and location tracking. It connects to cellular networks through a SIM card, allowing it to make and receive calls, send and receive SMS messages. The GPS receiver calculates precise location coordinates by analyzing signals from satellites. To ensure global connectivity and accurate positioning, internal components such as the SIM808 chipset, GPS receiver (MT3337), antenna, and power management system work together. As a result, the module produces both communication signals and location data.

The information of GSM/GPS SIM808 is illustrated in (Table 3.6).

Table 3.6: Basic Information's of GSM/GPS SIM808

Parameter	Specification
Chipset	SIM808
Communication Modes	GSM, GPS
Supported Bands	Quad-Band: 850/900/1800/1900 MHz
Network Compatibility	2G (Global Connectivity)
Functions	Send/Receive SMS, Make/Receive Calls, GPRS Internet Access, GPS Tracking
GPS Receiver	MT3337 (Built-in)
GPS Accuracy	165 dBm precision
Operating Voltage	3.1V – 5V
Power Consumption	~1 mA (Sleep Mode, ultra-low power)
Interfaces	Compatible with Arduino, Microcontrollers
Applications	Tracking, Remote Monitoring, IoT Devices, Safety Alert Systems

Figure 3.1: GSM/GPS SIM808

3.3.5 Li-Po Battery

The Li-Po batteries are used in our application. This technology, lithium-ion polymer, is popular in rechargeable batteries. Contrary to the conventional cells with liquid electrolyte, a Li-Po battery features polymer electrolyte, which is thinner and relatively soft. A Li-Po battery has multiple elements, which are the anode and cathode, each with a metallic current collector, surrounded by a separator membrane soaked with electrolyte in an aluminum or plastic case. These are the materials that can store and release the electric energy with outstanding efficiency.

Fig 3.2: Li-Po Battery

3.3.6 BMS Module

This is a multifunctional Battery Management System (BMS) module for single-cell Li-Po and Li-ion batteries. It also contains a built-in linear charging circuit working in constant current and constant voltage (CC/CV). This module is safe for portable applications and has some important protection functions, such as short circuit, overcharge, and over-discharge protection.

The TP4056 module commonly has 6 pins: BAT+, BAT–, B+, B–, IN+, and IN–.

- IN+ & IN– pins: Connect to the 5V DC power source (for example, a USB plug or adapter).
- B+ & B– Pins: Connect to battery directly.
- BAT+ & BAT– pins: These two are regulated outputs for charging the battery while using and supplying power to the load device.

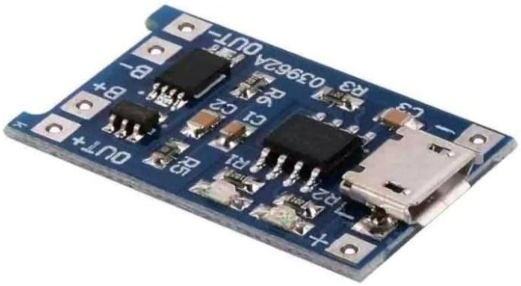


Fig 3.3: BMS Module

3.3.7 GPS Location Tracking Module

The GPS Tracking Module System allows you to track the location live or in real-time emergency; the emergency contact can easily locate the user. The system is lightweight to conserve battery life. It also provides adequate adhesion for portable devices.

The Information of GPS Location Tracking Module is depicted as tabular form (Table 3.7).

Table 3.7: Basic Information's of GPS Location Tracking Module

Feature	Specification
Connectivity	Bluetooth 5.2 (BLE)
Transmission Range	80–100 m (open environment)
Compatibility	Android 9.0 and above
Power Supply	CR2032 Lithium Battery (2.6V–3.6V)
Battery Life	6–8 months (typical usage)
Power Consumption	9.5 mA (max)
Operating Temperature	-20°C to 60°C
Material	PC+ABS (impact resistance)

Figure 3.4: GPS Location Tracking Module

3.3.8 Arduino UNO

It is an open-source microcontroller-based board. It works by including programs on it. The programs are stored in the ATmega328P microcontroller (MCU). It has digital and analog input/output pins. It has 14 digital I/O pins and 6 analog I/O pins. Pin numbers 3,5,6,9,10 and 11 are the PWM pins. The programs are included via a type B USB cable. For ON Arduino, it can be powered by a USB cable or Voltage input pin. The board has a reset button to reset programs to re-run the programs or include new programs. The input voltage can be 5 volts to 12 volts.

Figure 3.5: Arduino UNO

The Information of Arduino UNO is represented in tabular form (Table 3.8).

Table 3.8: Specifications of Arduino UNO

Feature	Specification
Operating Voltage (VDC)	5~12 V
Digital Pin	2 - 13
Analog Pin	A0 - A5
USB	Program include or power pin
Power Supply Pin	Power pin
Push Button	Reset or restart program

3.3.9 Boost Converter

An apparatus that raises the output voltage from a low input voltage is called a boost converter. An inductor, a diode, a capacitor, and an MOSFET are among the parts used in a boost converter design. PWM (Pulse Width Modulation) signals are used to turn on and off the control switch, which stores energy in the inductor and releases it to the output at a higher voltage.

Fig 3.6: Boost Converter

The information of Boost Converter is demonstrated as tabular form (Table 3.9).

Table 3.9: Basic Information's of Boost Converter

Input voltage range	DC 3V-35V
Output voltage range	DC 5V-55V
Output current, Imax	2A (continuous), up to 3A (peak)
Efficiency	Up to 95%
Maximum Output Ripple	30 mv (Maximum)
Switching Frequency	150KHz
Work temperature	-40°C to +85°C

3.3.10 Circuit Diagram

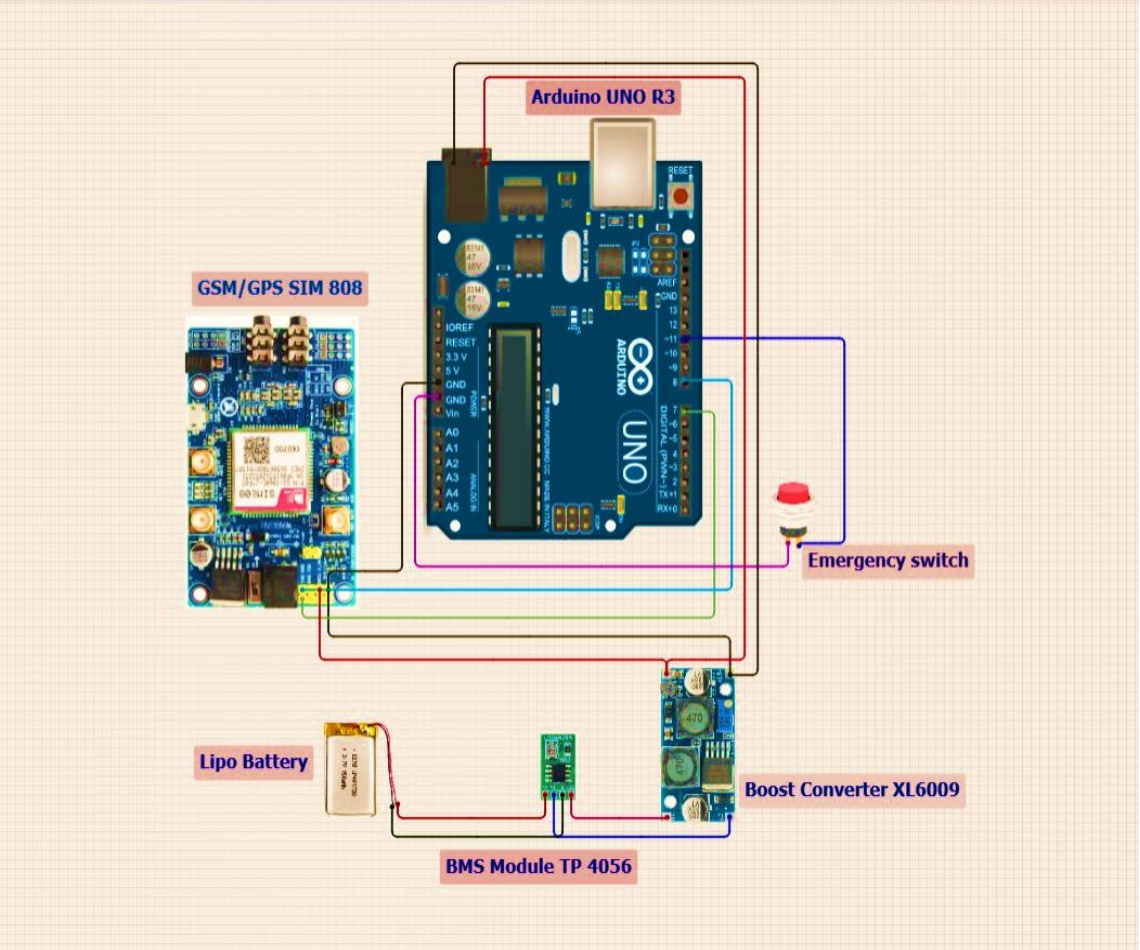


Fig. 3.7: Circuit Diagram of the Project

3.3.11 Flowchart

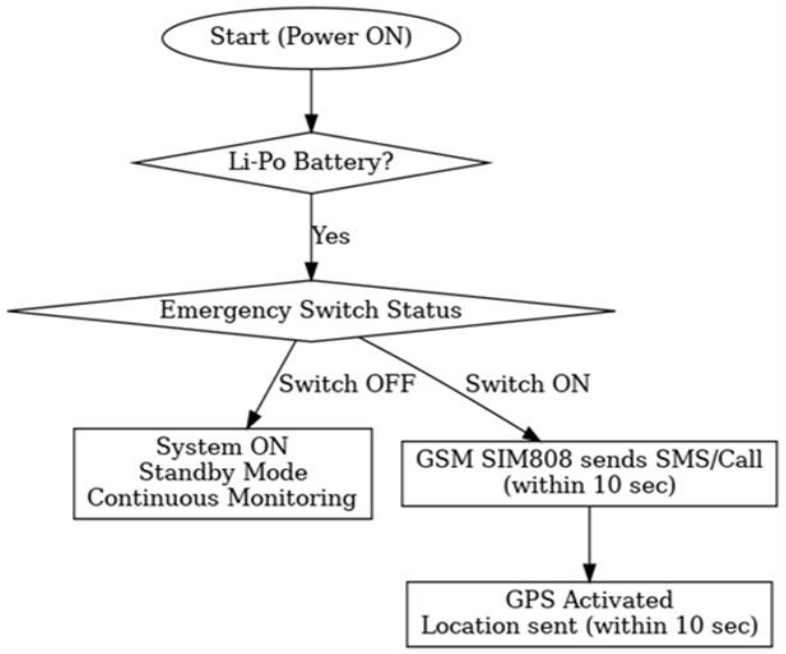


Fig 3.8: Flowchart of the Project

When the system is in ON state, first of all it ensures the availability of Li-Po battery. If Li-po battery provides stable power for operation then Arduino UNO (microcontroller) activates all modules including GSM/GPS unit. After activation, the system continuously follows the emergency switch status. If the switch remains in OFF state, then it will perform continuous monitoring but in standby mode without any triggering alert. However, when the switch is pressed (ON), the SIM808 module sends an alert message (SMS) or make phone calls to pre-stored contact numbers as well as locates the real-time territory for accurate tracking within few seconds. After completing the process, it resumes standby monitoring operation and waits for the next activation.

3.4 Design Analysis

This design has several advantages and disadvantages that we can evaluate through analysis:

1. **Benefits:**
    a. **Enhanced Safety:** Provide people at risk, such as elderly citizens, women, and disabled people, with a direct method of communicating an emergency to the police dispatchers.
    b. **GPS Real-Time Positioning:** The device based on GSM/GPS can provide position information, such as the last recorded position, more accurately than the latest cell network positioning. This will save lives better and be more timely than GSM location methods.

c. **Economical:** Uses low-voltage devices and a rechargeable Li-Po battery; it has a lower operational cost in the long run. The maintenance of this device is cheap, as only defective parts have to replace or repair when needed.
d. **Portability:** Compact design allows for easy portability—so distress persons are ready to bust out those tunes wherever they go.
e. **Dependable Communication:** It is compatible with SIM of any mobile operator, providing wide geographic coverage.

2. **Drawbacks:**
   a. **Network Dependence:** This system works only when there is proper availability of GSM networks, which are not basically available in remote areas as well as territories with poor mobile connectivity.
   b. **Battery Limitation:** The system operation is depended on battery capacity. So, if it works continuously then heavy use may require frequent charging.
   c. **Initial Cost:** The initial setup, which is enhanced by modules like GSM/GPS and power management units, comes at a much higher cost than the basic safety devices.
   d. **Maintenance:** The Li-Po battery should be replaced when it reaches its useful life; the wiring and modules should be observed regularly to keep everything reliable.

In the end, a smart portable safety alert system is an important project as the personal security of vulnerable people. Though it has its weaknesses, but better power management, a longer network range, and a modular design can make the system more efficient with higher reliability.

3.5 Implementation

However, we can provide a step-by-step guide outlining how to implement a safety alert system with GSM/GPS module and describe the experiment design and analysis process. All of this can be improved or corrected through proper analysis.

3.6 Summary

Documentation of the entire experiment design, setup, and analysis process are available. Include diagrams, photos, and screenshots of the hardware setup, it gives a proper idea on how we are preparing this project and what components are involved in preparing it and given ideas on how to develop it.

CHAPTER 4
RESULTS AND DISCUSSIONS

4.1 Results

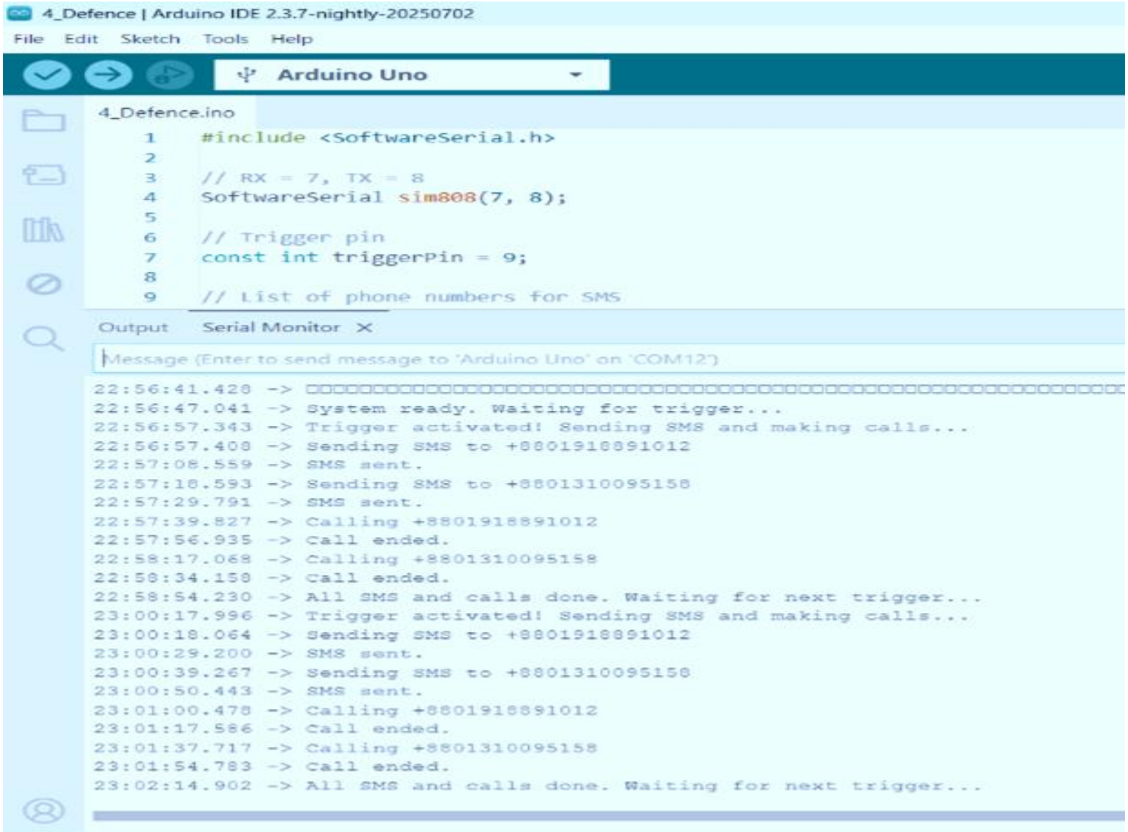
After the complete completion of a safety alert system with GSM/GPS module, we got our expected results successfully. So, the output came out of the functions are given in tabular form (Table 4.1).

Table 4.1: Output Result

Power Source	Emergency Switch	Output Results	Run Time
Li-Po Battery	Off	System is ON. Standby mode.	Continuous
Li-Po Battery	On	GSM SIM808 sends calls/SMS to predefined contacts.	Within 10 sec
Li-Po Battery	On	GPS module activated: location data shared with contacts.	Within 10 sec

The system showed stable performance in different environmental conditions. It handled changes in signal strength, temperature, and power supply. The components, such as the Arduino UNO, GSM/GPS SIM808 module, Li-Po battery, and boost converter, stayed functional and accurate during the testing period. This indicates that the system is reliable and strong enough for real-world emergency situations.

4.1.1 Result and Data Analysis



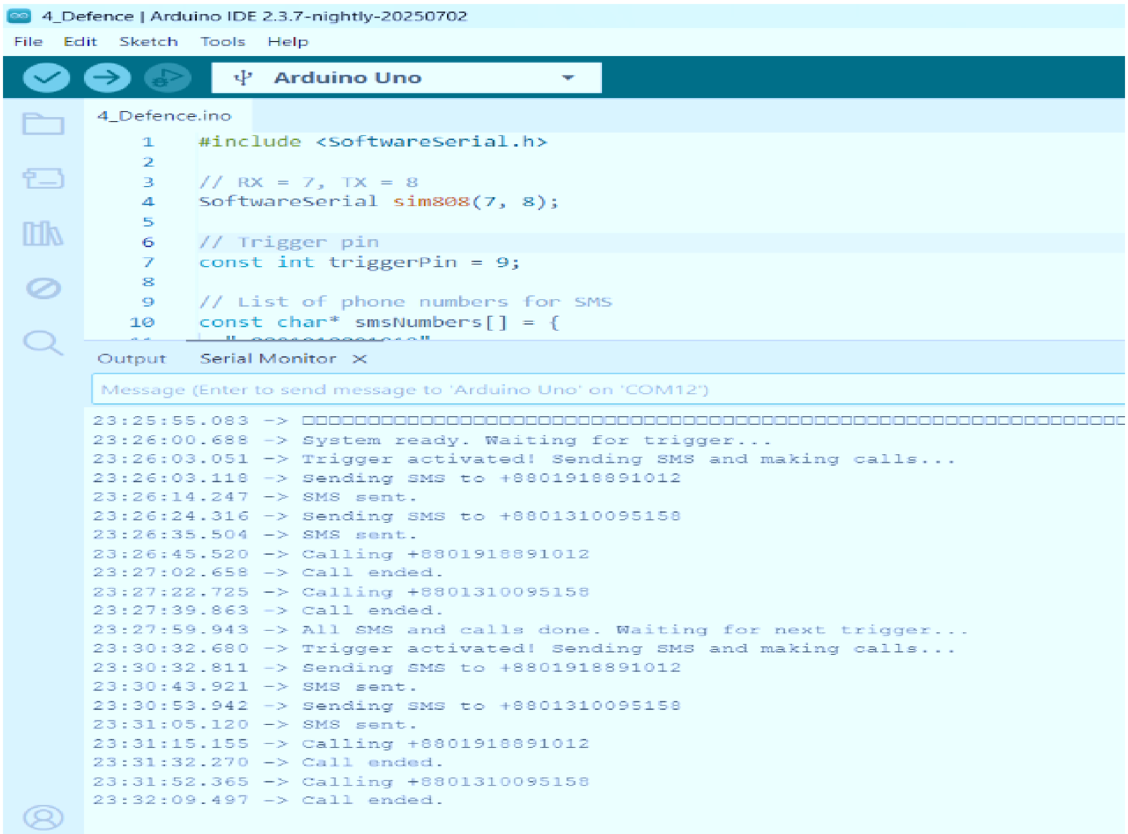


Fig 4.1: SMS/Call Checking by GSM Module (indoor and outdoor)

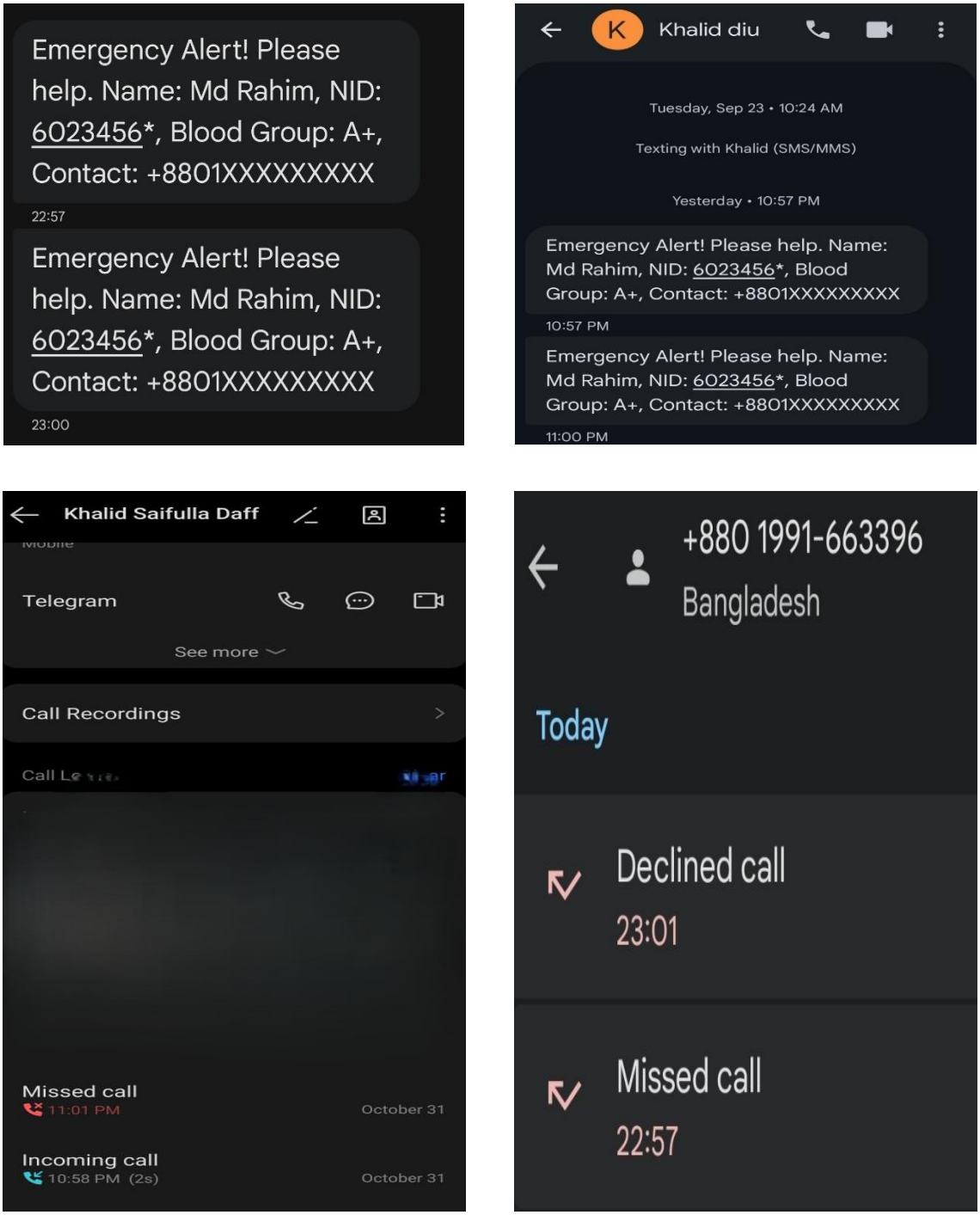


Fig 4.2: SMS/Call receiving (indoor and outdoor)

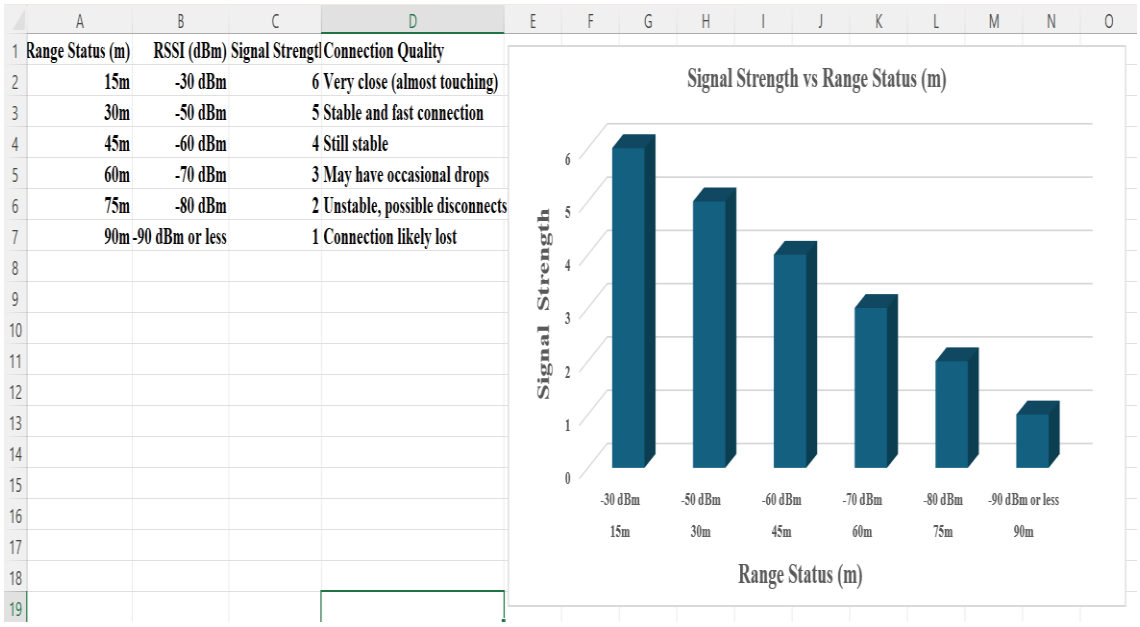
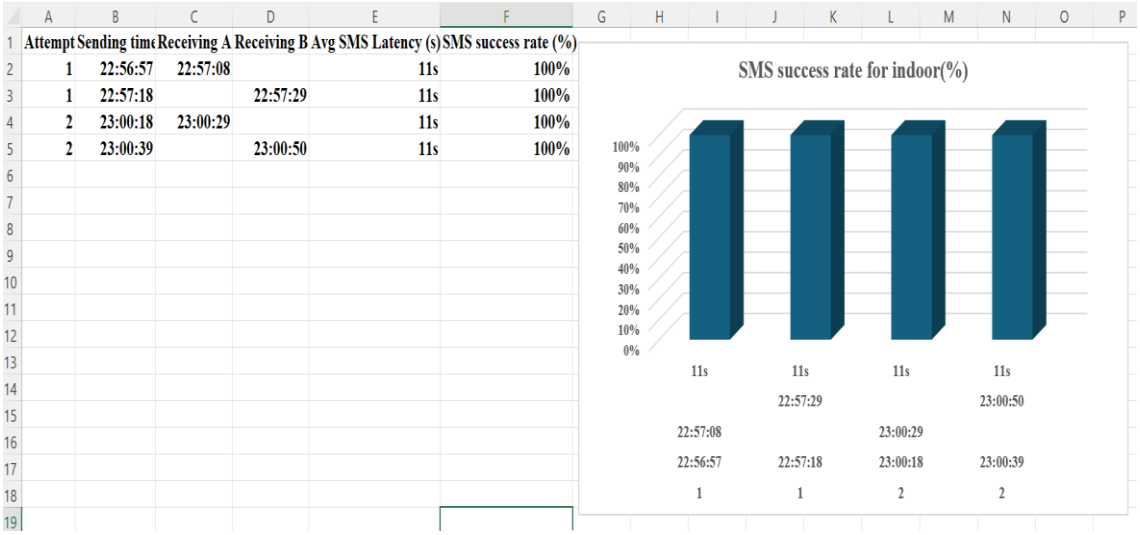


Fig 4.3: Signal Strength vs Range Status (m)



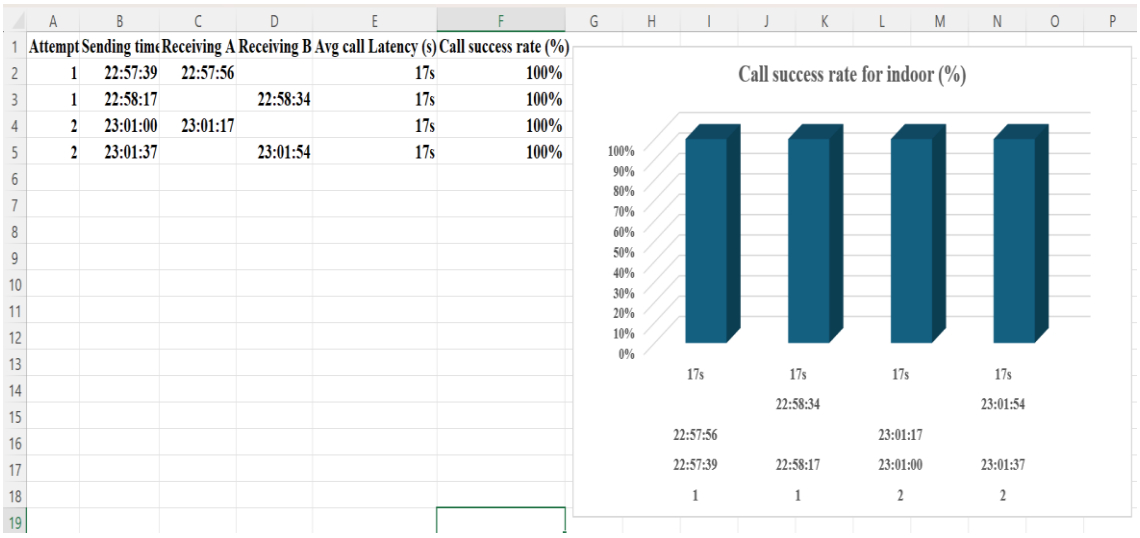
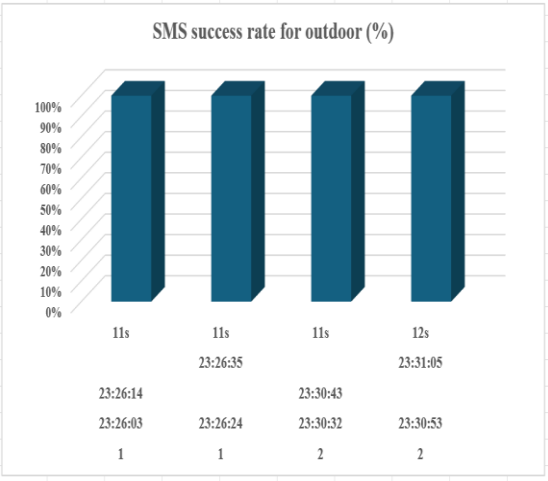


Fig 4.4: SMS/Call success rate (%) for indoor

Attempt	Sending time	Receiving A	Receiving B	Avg SMS Latency (s)	SMS success rate (%)
1	23:26:03	23:26:14		11s	100%
1	23:26:24		23:26:35	11s	100%
2	23:30:32	23:30:43		11s	100%
2	23:30:53		23:31:05	12s	100%



Attempt	Sending time	Receiving A	Receiving B	Avg call Latency (s)	Call success rate (%)
1	23:26:45	23:27:02		17s	100%
1	23:27:22		23:27:39	17s	100%
2	23:31:15	23:31:32		17s	100%
2	23:31:52		23:32:09	17s	100%

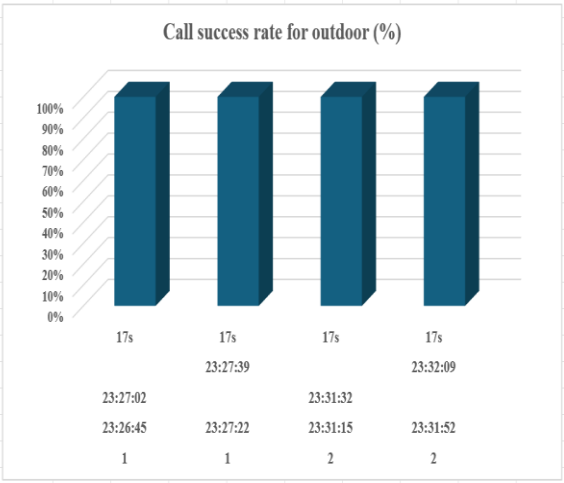


Fig 4.5: SMS/Call success rate (%) for indoor

Fig. 4.6: Real-time Location Tracking by GPS Module

4.2 Discussions

We have designed our product as a secure and safe system to safeguard vulnerable individuals. In this result and data analysis part, we have illustrated the graph between signal strength and range status and seen how the signal strength varies frequently as per range distance. Also, we have checked the SMS/call via GSM module and as well as validated the sending call or message alerts by victim as feedback. Moreover, we have collected the data of average SMS/call latency and SMS/call success rate over several trials. The obtained results state that both latency and success rate were promising. This project aims to provide a dependable and portable safety solution by combining a rechargeable power system, a boost converter, and a GSM/GPS module with an easy-to-use emergency switch. When an emergency happens, it offers a convenient method for women, children, disabled and old people to send out where they are with distress call.

CHAPTER 5
PROJECT MANAGEMENT

5.1 Resources & Cost Management

Project management is an elaborate version of how we think about and plan and execute our project and how we manage resources & tasks. And budget control is essential to make sure the project achieves success and that it keeps to the allocated funds.

Project Planning:

We attempted to design a smart mobile personal security signaling device for vulnerable groups in society, including the elderly, women, and disabled. This project is special because it provides instant emergency notification and location tracking on a portable, easy-to-use device. Several safety devices are currently in use that are expensive, not portable, or have limited functionality. For this reason, we pursued developing the economical method that can be reasonable and reliable with GSM and GPS technologies, fueled by a rechargeable battery.

Resource Allocation:

We distributed the resources, such as electronic components, modules, casing material and tools, budget etc., according to our project plan. We designed the device to maintain a low budget, ensuring accessibility for individuals from a wide range of socio-economic backgrounds. Every stage of the project was well-supported to ensure it succeed.

Design & Development:

The system is intended to be efficient, safe, portable, and durable. Its main components are an Arduino UNO, a GSM/GPS module, and a Li-Po battery with charging protection and voltage boosting. We fabricated and tested the prototype to check the performance of the device and safety-related issues.

Procurement:

For this project, we needed modules like Arduino UNO, SIM808 module, 3.7V lithium polymer battery, BMS module (TP4056), Boost Converter (XL6009) module, emergency switch and casing. We got these from trustworthy suppliers, so they are quality tools that should last.

Assembly & Integration:

The instrument was built by mounting several components on a portable case. We plugged Arduino to GSM/GPS, the battery, and the emergency switch connected carefully to ensure that the power supply regulated as safe and stable. We did integration testing to prove that all systems were communicating properly.

Testing & Quality Assurance:

Thereafter, we determined the system performance to verify the function, efficiency, and security. We tested multiple activations of emergency switch functionalities, the effectiveness of messaging and call alerts, GPS precision, and battery impact under different scenarios. Any issues found during testing were fixed, and additional developments were made to help improve performance and the user experience.

Deployment:

The full safety alert system was also tested in realistic situations, and its performance was assessed. The subject was presented with a guide on how to use this device which included turning alerts on, checking battery power and recharging the system.

Monitoring & Control:

We tested the device during its various tests of use, for example network latency, GPS location accuracy, battery duration and the user experience. We monitored the system for indicators of its performance, such as cost, efficiency and reliability, made adjustments in accordance with these readings and corrected any deviations found.

Closure:

The project successfully retrieved all of their completed and tested products. We created a test plan complete with "lessons learned," technical information, and user instructions. The successful conclusion to this process marks the strong start toward delivering affordable and dependable safety tools for those in need.

5.2 Cost Management

The estimated cost of the project components is shown in (Table 5.1).

Table 5.1: Cost Management

Serial No.	**Equipment's Name**	**Quantity**	**Cost**
1.	GSM/GPS SIM808	1	3450/=
2.	3.7v 1 cell Li-Po Battery	1	620/=
3.	GPS Location Tracking Module	1	800/=
4.	Boost Converter XL6009	1	70/=
5.	BMS Module TP4056	1	40/=
6.	Arduino UNO R3	1	400/=
		Total	5380/=

5.3 Conclusion

During the project management, effective communication, collaboration, and leadership are essential for managing the team members involved in designing and implementing a state-of-the-art smart portable safety alert system with a GSM/GPS module for elderly and vulnerable individuals.

CHAPTER 6

IMPACT ASSESSMENT OF THE PROJECT

6.1 Economical Impact

The intelligent portable security alert system is very economical compared to other security or monitoring systems. Traditional security systems are characterized by high costs and maintenance associated with CCTV cameras, security guards, and expensive mobile apps. Our approach is cheap, energy efficient, easy to maintain, and enables wide availability. By doing so, the device makes personal safety achievable for ordinary people without the use of expensive technologies. It also presents business opportunities or start-ups, as well as companies to produce an affordable, reliable safety device as a springboard into a new field of safety innovations.

6.2 Societal Impact

The device invented has a public safety aspect, especially in cases where particular groups (such as women, elderly persons, children or people with disabilities) are most at risk. It contributes to the security of society by giving community members a quick a reliable response system for emergency help when they need it. This system not only boosts personal safety but also reduces the negative impact upon such concerns as harassment, accidents or loneliness. Healthy mental attitudes and a greater sense of community spirit led to better inclusion into society - but it also aids family loving families in taking care of their own, engendering trust and confidence. If more of this technology is used, then crime will fall and people will feel less insecure. This in turn will strengthen both residents and communities in a concrete fashion.

6.3 Global Impact

This device boosts digital safety solutions and contributes to United Nations Sustainable Development Goals (SDGs) issues, including safety, well-being, and innovation at an international level. These smart safety systems, if adopted widely, could provide standard, simple, and scalable protection to at-risk groups. It could revolutionize the way we respond to emergencies around the world, limiting dependence on costly security infrastructure and delivering a small package. Additionally, growing foreign interest in these technologies will help drive further study and partnership around IoT-based safety

devices, helping to improve public safety technology.

6.4 Environmental Issues

The service also comes large terrestrial cameras; in addition, they are marketing the tiny and environment friendly device that implies a different type of environmental care. The appropriate disposal/recycling of rechargeable lithium-polymer (Li-Po) batteries will help minimize e-waste, and the snipping of components that have been ethically sourced has begun to influence our carbon footprint. With low power consumption and a long service life, this LED light is durable in use and ideal for sustainable use. It can be more environmentally friendly and socially beneficial to manage e-waste than to generate new electronic products.

6.4.1 Manufacturing and Disposal:

Several electronic parts are used in the manufacturing of smart safety appliances, including sensors, batteries, and semiconductors. This practice can cause environmental problems, including energy consumption, material extraction, and electronic waste (e-waste). While these effects may not have as strong of consequences as a large-scale surveillance infrastructure, it's important to practice responsible and environmentally conscious manufacturing practices and recycling just in case for long-term environmental implications.

6.4.2 Resource Intensity:

These devices require batteries, sensors, semiconductors, and communication modules, all of which rely on various metals and minerals. If these materials are not obtained sustainably, it can result in significant environmental harm. By emphasizing energy-efficient designs, using recyclable materials, and maintaining responsible supply chains, we can reduce the resource intensity involved in future production.

6.4.3 End-to-End Life Management:

To minimize pollution, it is important to establish appropriate recycling and disposal facilities for end-of-life devices. Recycling batteries and reutilizing parts can substantially reduce the risk of toxic substances finding their way into the environment.

6.5 Ethical Issues

Advantages of safety alert system for older adults Safety alert systems have several potentially desirable features; however, there are also important ethical considerations as described below.

6.5.1 Equity and Access:

Although the benefit of increased safety is achieved by utilizing the device, it’s expensive, and many low-income or rural communities will not be able to afford it. Acting to guarantee affordability and access is perceived as a 'rights-based' argument; all members of society, regardless of socioeconomic status, should be entitled to personal safety technologies—not just those within 'elite communities.'

6.5.2 Privacy and Data Security:

Such a system should include GPS location-following, messaging warnings, and user data storage / caching, which raises privacy concerns and risk of personal information being misused. To guard against such dangers, we need strong encryption libraries and ethical data processing standards to support the safety of user information and ensure secure communication links.

6.5.3 Technological Dependency:

Overreliance on smart-safety systems themselves also carries risks. The technology can prove hard to maintain, for example because equipment malfunctions, batteries go flat, or communications fall out. To safeguard against this risk, ensure that you have backup systems, manual emergency procedures, and additional safety precautions covering all eventualities.

6.5.4 Labor and Human Impact:

New safety technologies, therefore, could cut the need for conventional human guards or employees. Reskilling schemes, work in tech support services, and machine upkeep will be opportunities for dealing with these changes.

6.5.5 Resource Allocation and Ethics:

The mining of minerals for electronic components in their source regions may raise human rights and environmental issues. We must safeguard not only responsible sourcing and transparent supply chains but also ethical procurement policies to mitigate exploitation and enhance sustainability.

6.6 Utilization of existing standards or codes

The utilization of prevailing standards and codes in solar-powered grass cutting cannot only provide a suitable technical direction for the various stages of implementing the same but also ensure that rules and regulations are complied with.

6.6.1 Safety Standards:

The design and construction of safety alert devices, workmanship, and performance shall comply with the relevant international standards for electrical safety alert devices and wearables. Compliance with these standards requires ensuring the users' safety from electric shock hazards and assures dependability and authenticity in use under harsh conditions.

6.6.2 Data Protection and Privacy Regulations:

Compliance with data privacy laws such as GDPR and applicable national laws is imperative. They save personal and location data. Paying heed to these goes a long way in winning over the trust of the users and handling their data in a responsible fashion.

6.6.3 Environmental Regulations:

Adhere to rules on e-waste, battery disposal, and sustainable electronics across the production/life/destruction cycle. This is a useful exercise in damage limitation as well as in devising an approach to technology that isn’t so destructive.

6.7 Other Concerns

Still, as good as the smart portable safety alert system sounds, there are some caveats and downsides to be aware of:

6.7.1 Network Dependence:

The equipment works on GSM/GPS networks to get location information and send messages. In places with spotty coverage or no connectivity, the device has trouble sending a notification out.

6.7.2 Battery Life:

It is a mobile device that relies on battery power. Poor battery life may also lead to poor performance, particularly during emergencies when the system has not been charged regularly.

6.7.3 Initial Cost:

The apparatus can afford the alleviation of long-term risk exposure and enhanced personal safety. Their cost factors in designing and furnishing may have an effect on first-time users living in low-income-based societies.

6.7.4 Technological Limitations:

Performance—Since the accuracy of GPS positioning, sensor stability, and the reliability or durability of components are all affected by how well an environment meets design rules. False triggering, or false alarm, is among the possible incidents of malfunctioning.

6.7.5 Regulatory Barriers:

There are diverse legal and compliance issues when transferring tracking and emergency alert devices from one country or continent to the next. These are the laws that legal use requires to be followed.

6.8 Conclusion

This article will explore the concept and problems associated with patients at high risk, based on the smart portable safety alert system. This tool enhances the safety of seniors, individuals with disabilities, and women by facilitating quick communication during emergencies and enabling real-time location tracking. There are several advantages to this system. It can slash response time in emergency situations and provide increased safety and independence for seniors and people with weakness and frailness. Furthermore, the device is convenient, with easy manipulation and modest technical requirements for numerous people. There are some caveats, though. Some of these are issues around network coverage, battery life challenges, etc. The system also faces privacy concerns and regulatory issues. These challenges may be addressed by better programming solutions, stronger data protection, more rigorous pricing mechanisms, and enabling policies that can help facilitate the efficient operation of this system.

Despite these obstacles, economic and social perspectives portray the safety alert system as a feasible undertaking. It enhances the safety of people and contributes to building better neighborhoods and cities. As it progresses, this project may very well evolve into a widely adopted and reliable tool in the fight to defend vulnerable communities across the globe.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The Smart Portable Safety Alert System for At-risk communities has passed a round of development and deployment. It meets the demands of the projects and explains its practical significance. The aim is to design a safety tool, which should be an affordable, low-cost device, and it also needs to be a convenient tool. This product is designed for the users with a detailed map location inquiry. With this website, the products have stable features, safety, and ease of use. It is designed to assist older people, disabled individuals, women, and other vulnerable communities in accessing resources during an emergency. The system has resulted in:

1. Emergency Alert System:

Simple to Use: The emergency button has an urgent call function and can send SMS or make a phone call by the press of the button.

Trustworthy: World-class customer service, world-class technical support, no worry after sale besides the security camera system is kept in a room (need to confirm participation as participating seller).

Security: If you are a parent, babysitter, or law enforcement official, this alert feature helps reduce response time for better security and assistance.

2. GPS Tracking and Location Sharing:

Accuracy: The GPS module is able to locate position rapidly and with high accuracy so that coordinates can be transmitted instantly for immediate assistance.

Versatility: The tracking system functions effectively in all terrains, whether rural or urban.

3. Feedback and Communication Mechanism:

Response: It is capable of two-way communication, such that recipients of the alert (e.g., guardians, family members, etc.) may respond to cause an acknowledgment to be made. This acknowledgement feature gives elderly people the assurance that their requests for help will receive attention and action.

High-Quality Meter: It is made from high-quality material and has a long service life under normal conditions of use. The design can weather light rain, high temperatures and dirt without failure as often seen when being put to typical use.

User-friendly: Among other things, we also need zero-effort, highly intuitive operation of the system, for universal use by people with low technical skill. The time saved in an emergency and chance to avoid complicating the response are worth a single button-press.

Cost-adjustments: These include using reliable, low-cost components such as rechargeable batteries and microcontrollers. The solution optimizes use of expensive, complex monitoring infrastructure. It lets masses open access to this safety feature which they can afford.

In summary, the portable electronic alert system makes a good socially beneficial application and also has good performance in general: fast, reliable and cheap. This complete application also does well at extending the safety of the vulnerable parts of society and their urgent need for security; being inexpensive to start with is another advantage of bringing about its return.

7.2 Recommendations

For the purpose of the smart portable safety warning system can work better and more efficiently, we make the following recommendations:

1. GSM/GPS for Safety Modules: Choose a more high-grade SIM808 or similar for GSM and GPS module to assure network stability as well as precision of positions.

2. Small Form Factor and Wearable Device: Productize it into small, lightweight wearable devices like pendants or wristbands or other clip-on styles of the product to make them highly acceptable to the users on a day-to-day basis.

3. High Power Management: Optimize the charge system and allow it to connect fly continuously for a long time. You can play in the park all day without going back home to run out of power. The rechargeable battery car pack with high capacity could support you 100% as much as necessary for indoor flight.

4. Two-Way Voice Dialogue: Optional voice call or beeper makes this system truly interactive.

5. Mobile Combine: The mobile tracking app that should be developed will track, receive alerts, and display user settings in order to provide even more caregiver oversight and system control.

6. Durable Construction: Durable craftsmanship; press them, then get top reliability and a long lifetime of use—they never die while working for you. Super Portability Lightweight follow-up and portable little one-hand battery tester Cranking charge for finer compaction of use.

7. Regular Maintenance and Monitoring: Establish a simple maintenance routine that includes checking your battery health and network connectivity to avoid issues while traveling.

8. User Education and Awareness: Develop end-user-level manuals/guidelines for respective users as well as caregivers to operate the system during emergencies in case of need.

Once such recommendations are followed, the smart portable safety alerting system will achieve higher usability, dependability, and better scalability. Making this feature even smarter will turn the system into a life-saving device that actually helps people in need around the world.

REFERENCES

1. Tamil, E.M., D.B. Saleh, and M.Y.I. Idris, "A Mobile Vehicle Tracking System with GPS/GSM Technology," Proceedings of the 5th Student Conference on Research and Development (SCORED), Permala Bangi, Malaysia, May 2007.
2. Akinode 1.1., Alawode A.J. and Ojuawo O.O., "Improving National Security Using GPS Tracking System Technology," Proceedings of the 1st International Technology, Education and Environment Conference African Society for Scientific Research (ASSR), Ogun State, Nigeria, 2011.
3. Prabha, C., R. Sunitha, and R. Anitha. "Automatic vehicle accident detection and messaging system using GSM and GPS modem." *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* 3.7 (2014): 10723-10727.
4. Dilkhush, Nikhil Pal, et al. "Accident Detection and Notification System using GPS and GSM navigation technology." (2020).
5. Olaniyan, O. M., U. C. Ogude, and J. A. Subair. "Implementation of a Microcontroller Based GSM Alert Distress System." *LAUTECH JOURNAL OF COMPUTING AND INFORMATICS* 2.1 (2021): 41-48.
6. Wankhade, Hrucha, et al. "Women's safety device with GPS tracking and alert." International journal for research in applied science and engineering technology 10.8 (2022): 1177-1183.Technology, Sathyabama University, Chennai - 600119, Tamil Nadu, India.
7. P. Chinnasamy, P. P. S, C. Sivakrishnaiah, T. Sathiya, I. Alam and D. P. Degala, "Design and Implementation of an IoT-based Emergency Alert and GPS Tracking System using MQTT and GSM/GPS Module." (2022).
8. K. U. Singh, V. Chaudhary, P. K. Sharma, P. Kumar, N. Varshney and T. Singh, "Integrating GPS and GSM Technologies for Enhanced Women's Safety: A Fingerprint-Activated Device Approach." (2023).
9. Design and Practical Application of a Cost Effective Intelligent Female Surveillance System Using GPS, GSM, and Arduino Technology — Kar R.K., Murugan A.S.S., Obulesu D., & Shravani Ch. (2024). DOI: 10.1051/e3sconf/202447203007.
10. IoT-based Smart Emergency Response System (SERS) for Monitoring Vehicle, Home and Health Status — (2024). Discover Internet of Things, Vol 4, article 22.

APPENDIX A

TURNITIN REPORT

213-33-1431

ORIGINALITY REPORT

13%	12%	3%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Daffodil International University Student Paper	3%
2	dspace.daffodilvarsity.edu.bd:8080 Internet Source	2%
3	ijsrem.com Internet Source	<1%
4	www.coursehero.com Internet Source	<1%
5	www.ifs.org.uk Internet Source	<1%
6	Punetha, Deepak, and Vartika Mehta. "Protection of the child/ elderly/ disabled/ pet by smart and intelligent GSM and GPS based automatic tracking and alert system", 2014 International Conference on Advances in Computing Communications and Informatics (ICACCI), 2014. Publication	<1%
7	ijsrset.com Internet Source	<1%
8	Submitted to Universiti Kuala Lumpur Student Paper	<1%
9	s3-eu-west-1.amazonaws.com Internet Source	<1%
	www.cibisa.ulaval.ca	

10	Internet Source	<1 %
11	discol.umk.edu.my Internet Source	<1 %
12	Submitted to International Islamic University Malaysia Student Paper	<1 %
13	Submitted to FICT Student Paper	<1 %
14	Submitted to University of Northampton Student Paper	<1 %
15	www.irjet.net Internet Source	<1 %
16	vfast.org Internet Source	<1 %
17	doaj.org Internet Source	<1 %
18	laujci.lautech.edu.ng Internet Source	<1 %
19	www.rcaddict.co.uk Internet Source	<1 %
20	1library.net Internet Source	<1 %
21	Submitted to Indiana University Student Paper	<1 %
22	riunet.upv.es Internet Source	<1 %
23	eece.mist.ac.bd Internet Source	<1 %
	Submitted to Info Myanmar College	

24	Student Paper	<1%
25	Submitted to Victorian Institute of Technology Student Paper	<1%
26	accentsjournals.org Internet Source	<1%
27	www.f4grx.net Internet Source	<1%
28	openscholar.dut.ac.za Internet Source	<1%
29	www.ijirset.com Internet Source	<1%
30	www.jica.go.jp Internet Source	<1%
31	www.bransonmo.gov Internet Source	<1%
32	Submitted to University of Northumbria at Newcastle Student Paper	<1%
33	Submitted to The University of Wolverhampton Student Paper	<1%
34	Submitted to University of New South Wales Student Paper	<1%
35	digital.library.adelaide.edu.au Internet Source	<1%
36	Submitted to Institute of Technology, Nirma University Student Paper	<1%
37	ajourneywithtime.weebly.com Internet Source	<1%

38	dspace.bracu.ac.bd Internet Source	<1 %
39	ir.unimas.my Internet Source	<1 %
40	www.semanticscholar.org Internet Source	<1 %
41	www.stuvia.com Internet Source	<1 %
42	www.bluetraker.com Internet Source	<1 %
43	www.gwcet.ac.in Internet Source	<1 %
44	www.ledsmagazine.com Internet Source	<1 %
45	electronicsworkshops.com Internet Source	<1 %
46	repository.up.ac.za Internet Source	<1 %
47	www.hotron.com Internet Source	<1 %
48	dalspace.library.dal.ca Internet Source	<1 %
49	elegocart.com Internet Source	<1 %
50	juniperpublishers.com Internet Source	<1 %
51	robu.in Internet Source	<1 %
	www.docme.ru	

52	Internet Source	<1%
53	www.i-scholar.in Internet Source	<1%
54	www.mdpi.com Internet Source	<1%
55	www.researchbank.ac.nz Internet Source	<1%
56	"Smart Data Intelligence", Springer Science and Business Media LLC, 2026 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		

Appendix B

COMPLEX ENGINEERING PROBLEM SOLVING & ENGINEERING ACTIVITIES

Give an explanation of the complicated engineering problems that the project is designed to answer and how we are being solved. P1 is required, as well as any or all of P2 to P7.

Complex Engineering Problems (P) Solving		
	Attributes	Statement from students
P1	Depth of knowledge required	Related studies include learning about GPS/GSM modules (SIM808), GPS tracking systems, Li-Po battery management, emergency switching circuits, and programming languages for microcontroller-based alert systems.
P2	Range of conflicting requirements	Balancing GPS accuracy regarding power efficiency, message timing, and system reliability with low cost has needed careful consideration. The system is enhanced to maintain performance without degrading portability of battery life.
P3	Depth of analysis required	
P4	Familiarity of issues	The improvement of personal safety, quicker emergency response periods, and protection of underprivileged groups such as the elderly, the disabled, and women are some of the system's benefits. The system offers an innovative and efficient solution to empowering individuals and is a strong social good.
P5	Extent of applicable codes	
P6	Extent of stakeholder involvement and level of conflicting requirements	Immediate notifications, accurate location pinpoints, and true accurate functioning of the gadget are some of the several expectations that family members, caregivers, and emergency responders, as stakeholders of a scenario, hold. Shrink the data spent and the overall budget needed, and the system finds a way to achieve the set goals.
P7	Interdependence	For the device to work properly, GSM, GPS, an emergency switch, and power management modules must all be integrated. Because of their interdependencies, modules must be carefully designed, tested, and programmed to satisfy project requirements.

Give our opinion on which of the intricate engineering tasks the planned project is resolving. List any or all of the following qualities.

Complex Engineering Activities (A) Solving		
	Attributes	Statement from students
A1	Range of resources	Research on GPS/GSM module integration, Li-Po battery technology, the C programming language, and project planning techniques.
A2	Level of interactions	
A3	Innovation	The basics of GPS/GSM modules operation, including how the GSM operates when emergency switch is activated as well as how GPS module track location through programming language.
A4	Consequences to society and the environment	
A5	Familiarity	

APPENDIX C

PROGRAM CODE

```
#include <SoftwareSerial.h>

// RX = 10, TX = 11 (Arduino -> SIM808)
SoftwareSerial sim808(10, 11);

// List of phone numbers
const char* phoneNumbers [] = {
  "+8801310095158",
  "+8801918891012",
  "+8801774331580",
  "+8801521344964"   // Add more numbers here
};
const int numPhones = sizeof(phoneNumbers) / sizeof(phoneNumbers [0]);

void setup () {
  Serial.begin(9600);
  sim808.begin(9600);

  Serial.println("Initializing SIM808...");
  delay (2000);

  // Set SMS mode to text
  sim808.println("AT+CMGF=1");
  delay (1000);

  sim808.println("AT+CSCS=\"GSM\""); // Set GSM charset
  delay (1000);

  // Loop through all numbers
  for (int i = 0; i < numPhones; i++) {
    sendSMS(phoneNumbers[i],
      "Emergency Alert\n"
      "Help me! I am in danger.\n"
      "Name: Md Rahim\n"
      "NID: 6023456*\n"
      "Blood Group: A+\n"
      "Contact: +8801XXXXXXXXX"
    );
    delay (2000); // Small delay between SMS

}

  Serial.println("All SMS done.");
}

void loop () {
  // Nothing to do here
}
```

```
// Function to send SMS
void sendSMS(const char* number, const char* text) {
  Serial.print("Sending SMS to ");
  Serial.println(number);

  sim808.print("AT+CMGS=\"");
  sim808.print(number);
  sim808.println("\"");
  delay (1000);

  sim808.print(text);
  delay (500);

  sim808.write(26); // CTRL+Z to send
  delay (5000);

  Serial.println("SMS sent.");
}
void setup () {
  // put your setup code here, to run once:

}

void loop () {
  // put your main code here, to run repeatedly:

}
```