SMART SOS SYSTEM FOR EMERGENCY LOCATION TRACKING USING ARDUINO NANO

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

This project report presents the design and development of an SOS Alert System using GPS and GSM modules. In the present scenario, the safety and security of individuals—especially women, children, and the elderly—is of paramount importance. The proposed system is designed to help the user send an immediate emergency alert to predefined contacts along with their live GPS location coordinates via SMS, ensuring timely assistance during unforeseen situations. The system consists of an Arduino Nano microcontroller, which acts as the central unit interfacing with the GPS and GSM modules. The NEO-6M GPS module continuously acquires the user's current latitude and longitude. The Arduino collects this GPS data and transmits it through the SIM800L GSM module as an SMS alert to the emergency contact. The entire circuit is built using a minimal number of components, making the system compact, portable, and cost-effective for students and hobbyists. The system is powered by a simple 3.7V lithium-ion battery, directly connected to the GPS and GSM modules as required. The project emphasizes easy implementation, low cost, and practical usability in real-life emergency situations. The SOS Alert System can be applied in various scenarios such as personal safety for women and children, support for elderly individuals living alone, assistance for travelers in remote areas, and emergency alerts in accident- prone zones. Future enhancements can include IoT integration and mobile app connectivity for real-time monitoring and control.

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CHAPTER 1

INTRODUCTION

In today's world, ensuring the safety and security of individuals has become one of the major concerns for families and society. With the increasing number of crimes, accidents, and unexpected emergencies, there is a growing need for simple and effective safety systems that can provide immediate help when required. Technology plays a crucial role in building such solutions to ensure that help can reach people at the right time.

The "SOS Alert System using GPS and GSM Module" is designed as a cost-effective and user-friendly safety device that can send the real-time location of a person to their family members, guardians, or emergency contacts in the form of a text message. This project mainly targets women, children, senior citizens, and individuals who frequently travel alone or work in remote or unsafe environments.

The main objective of this project is to develop a portable and reliable emergency alert system using minimal components. The system uses an Arduino Nano microcontroller, a NEO-6M GPS module to determine precise location coordinates, and a SIM800L GSM module to send an SMS alert with the location details. An LED along with a current-limiting resistor is connected to the system to indicate the status of the message transmission and help users visually confirm the system is active.

1.1 OVERVIEW OF THE SYSTEM

In today's fast-moving world, safety and security have become a major concern, especially for women, elderly people, and travelers. The SOS Alert

System Using GPS and GSM Module is a simple, low-cost, and effective mini project designed to provide immediate help during emergency situations. The primary aim of this project is to develop a portable and user-friendly device that can automatically send an alert message with the user's real-time location to a pre-stored emergency contact number when an emergency arises.

This system mainly consists of three core components: the Arduino Nano microcontroller, the NEO-6M GPS module, and the SIM800L GSM module. The GPS module continuously tracks the user's geographical coordinates (latitude and longitude) and sends this data to the Arduino Nano. When the system is triggered, the Arduino processes the GPS data and instructs the GSM module to send an SMS containing a Google Maps link to the user's current location to the designated emergency contact. An LED indicator or buzzer can also be used to provide a visual or audible indication that the alert has been sent.

The device operates on a small battery supply, making it lightweight, portable, and easy to carry. It can be easily installed in a vehicle, carried in a bag, or used as a wearable unit. The SOS Alert System is highly reliable in areas where network coverage is available and can play a vital role in saving lives during critical situations such as accidents, medical emergencies, or when someone is lost and needs help.

1.2 IMPORTANCE OF THE PROJECT

In today's society, personal safety and quick access to emergency support are essential needs that must be addressed with practical and cost-effective solutions. The SOS Alert System Using GPS and GSM Module plays an important role in fulfilling this demand, especially for vulnerable groups such as women, children, elderly people, and individuals who often travel alone or live in

remote areas. The primary objective of this project is to ensure that help can be reached quickly and accurately in emergency situations where the user may not have the time or ability to call for help manually.

The importance of this project lies in its ability to combine two powerful technologies: Global Positioning System (GPS) and Global System for Mobile Communications (GSM). The GPS module provides accurate real-time location tracking, while the GSM module ensures that the location information is instantly communicated to family members, friends, or emergency services through a simple text message. This immediate sharing of location information can help save valuable time during critical moments, potentially saving lives.

Another significant aspect of this project is its portability and affordability. By using low-cost, easily available components like the Arduino Nano, SIM800L GSM module, and NEO-6M GPS module, this system can be developed within a student budget. Its compact size allows it to be easily carried in a pocket, attached to a bag, or installed in a vehicle. This makes it an ideal project for students to implement as a practical safety device that is not just theoretical but can be demonstrated and used in real life.

The system also serves as a stepping stone for learning IoT and embedded systems concepts, helping students gain hands-on experience in hardware interfacing, serial communication, and real-time data processing. Understanding how different modules communicate with each other through the microcontroller builds a strong foundation for more advanced projects in automation and smart technologies.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION TO EMERGENCY ALERT SYSTEMS

Ensuring the safety and security of individuals has become one of the top priorities in modern society. With increasing incidents of crimes, accidents, and health-related emergencies, there is a pressing need for reliable emergency alert systems that can quickly inform trusted contacts or authorities about a person's location and situation. Over the years, researchers and technologists have explored various ways to design systems that make use of mobile communication and positioning technologies to address this issue effectively.

2.2 EVOLUTION OF LOCATION TRACKING TECHNOLOGY

The concept of location tracking has evolved significantly with advancements in satellite and wireless communication. Early tracking systems relied heavily on manual methods or landline communication. The introduction of Global Positioning System (GPS) revolutionized tracking by providing real-time location data with high accuracy. GPS technology is now integrated into most smartphones, vehicles, and specialized tracking devices, making it accessible for developing portable safety alert systems.

2.3 USE OF GSM MODULES FOR COMMUNICATION

GSM (Global System for Mobile Communications) technology plays a vital role in sending and receiving information over long distances using mobile networks. Previous research shows that GSM modules like SIM300, SIM800L, and SIM900 have been widely used in many embedded systems projects for sending SMS and making calls. The integration of GSM modules in safety alert systems enables the transfer of location information through text messages,

ensuring immediate delivery of critical information to emergency contacts.

2.4 EXISTING SAFETY SYSTEMS AND LIMITATIONS

Several commercial personal safety devices and mobile applications have been introduced to help users alert their trusted contacts during emergencies. Mobile apps like SOS alerts and emergency call buttons depend on smartphones and stable internet connections. However, in remote areas where internet connectivity is poor or unavailable, these systems may not function effectively. Hardware-based systems using GPS and GSM modules have been proven to be more reliable as they do not require internet and can work with a basic mobile network.

2.5 RELATED WORKS

Numerous studies and student projects have explored the implementation of GPS and GSM-based alert systems. For example, research papers highlight prototypes developed for women's safety, accident detection in vehicles, and tracking systems for children and elderly people. Most of these works focus on sending the exact coordinates via SMS to a registered contact, enabling quick response and rescue operations. Some advanced systems combine additional features such as voice calling, panic buttons, and integration with police control rooms.

CHAPTER 3

SYSTEM DESIGN

The SOS Alert System is a compact safety device designed using minimal yet effective electronic components to provide emergency communication in critical situations. The heart of the system is the Arduino Nano, a small but powerful microcontroller that manages all the logic and communication tasks. The system is powered using a 3.7V lithium battery, which is compact and rechargeable, making the device portable and easy to use. The NEO-6M GPS module continuously receives signals from satellites and provides real-time location data in the form of latitude and longitude. This data is then processed by the Arduino Nano. The SIM800L GSM module is responsible for sending SMS messages to pre-configured emergency contact numbers. It uses the standard AT command protocol to send the GPS coordinates via SMS. The system is designed to be lightweight, cost-effective, and easy to assemble, especially by students and beginners. It serves as a practical example of embedded systems in real-life emergency applications and can be extended with features like IoT or wearable enclosures for enhanced utility.

3.1 EXISTING SYSTEM

In today's fast-paced world, personal safety has become one of the biggest concerns for individuals, especially women, elderly people, and children. Many systems and mobile applications have been developed to address emergency situations. Existing systems mostly rely on smartphones with inbuilt GPS and internet connectivity. Popular mobile apps allow users to share their live location, send emergency alerts, and even make automatic calls to saved contacts. Some advanced systems are built into cars for accident detection, where an airbag deployment triggers an automatic SOS signal to emergency services.

In the commercial market, there are dedicated SOS alert devices such as smart wearables, wristbands, and keychains with hidden buttons. When pressed, these devices can alert selected contacts through Bluetooth-connected smartphones or send a distress signal using a SIM card. Some vehicles have built-in GPS tracking systems for theft detection and accident alerts. These systems are connected to a central control room, where trained operators monitor and respond to the alerts.

However, most existing safety solutions depend heavily on smartphone applications that need continuous internet connectivity and sufficient battery charge. Many mobile apps also require the user to unlock the phone, open the app, and press a virtual button during an emergency, which may not be practical in stressful situations. Similarly, while vehicle tracking systems work well for cars and bikes, they do not help individuals when they are outside their vehicle or walking alone.

Wearable SOS gadgets available in the market are often costly and may not be affordable for students or low-income individuals. Moreover, some of these devices need regular charging and maintenance, which makes them unreliable if not used properly.

There are also basic GPS trackers with GSM modules used in schools for school buses, pet tracking, and logistics. These are fixed in vehicles or bags and have limited functionalities for human safety during sudden emergencies.

In summary, while existing systems provide multiple options for safety, they still lack a simple, low-cost, easily portable device that works without

depending on internet connectivity and without complicated user operations. This gap creates a strong need for a practical, hardware-based solution like the SOS Alert System Using GPS and GSM Module, which provides reliable alerts through SMS even in remote areas.

3.2 LIMITATIONS OF EXISTING SYSTEM

In today's technology-driven world, personal safety systems are gaining attention, especially for vulnerable groups such as women, children, senior citizens, and people in remote areas. While there are several emergency alert systems already in place, most of these have significant limitations that reduce their effectiveness during real-life emergencies. Understanding the limitations of existing systems helps us justify the need for the proposed solution.

a. Dependence on Mobile Applications

Many current SOS systems are mobile app-based. These applications require the user to open the app, navigate the interface, and press a button. During panic situations such as an attack or medical emergency, the victim may not be in a position to unlock their phone and open an app. Hence, systems that depend on smartphones can fail due to time delay, touch screen malfunction, or user panic.

b. Internet Connectivity Dependency

Most modern SOS alert systems use internet-based platforms like WhatsApp, emergency apps, or location-sharing services. These require a strong mobile internet connection (3G, 4G, or 5G) to send alerts. In many rural areas or disaster zones, internet coverage may be poor or completely unavailable. In such cases, the message never reaches the intended recipient. This makes these systems unreliable in critical situations.

c. High Cost and Complexity

Advanced GPS tracking systems used in vehicles or professional safety

gear often involve costly subscriptions, software licenses, or data plans. Moreover, they may require trained personnel to operate or configure. These cost and complexity factors prevent the adoption of such systems for common people, especially in developing regions or for low-income users.

d. Limited Battery Life

Some existing systems rely on smartphones or rechargeable devices that require frequent charging. If the device runs out of battery during an emergency, the whole purpose of the SOS alert is defeated. Moreover, there's no dedicated power optimization in most applications. In contrast, a dedicated lithium battery-powered system like yours offers better energy efficiency and longer standby time.

e. Lack of GPS Integration in Low-Cost Solutions

Inexpensive emergency alert systems, like basic panic buttons, often do not include location tracking. They may simply trigger a buzzer or send a generic alert message. Without GPS data, the responders cannot pinpoint the exact location of the person in need, wasting valuable response time. This makes low-cost systems incomplete in terms of real-world application.

f. No Visual Feedback or Confirmation

Many systems do not provide any feedback to the user after sending the alert. This leaves the user uncertain whether the message was successfully delivered. A simple LED indicator or screen feedback system is often missing, which can increase anxiety during emergencies. Your project solves this using an LED indicator.

g. Hardware Limitations

Some solutions are purely software-based and do not include external sensors, dedicated modules, or microcontrollers. Such systems may fail if the phone is dropped, damaged, or taken away by an attacker. Dedicated hardware like Arduino, SIM800L, and GPS module gives more control and reliability.

h. Limited to Specific Platforms

Applications may be restricted to Android or iOS and might not work across all devices. Furthermore, system permissions (e.g., location access, background services) might block proper functionality. This platform dependency is a serious limitation, especially for older or basic phones.

3.3 PROPOSED SYSTEM

In the current technological landscape, the need for reliable emergency communication systems is critical. Many existing systems either rely on smartphones or internet connectivity, making them unsuitable in rural areas or during disasters. To overcome these limitations, the proposed project introduces a dedicated SOS GPS Alert System built using affordable and accessible components like the Arduino, SIM800L GSM module, NEO-6M GPS module, and a Lithium battery. This system enables the user to send their exact location as an SMS to predefined emergency contacts without needing internet access or a smartphone.

The device is designed to be portable, standalone, and low-cost, suitable for students, women, travelers, senior citizens, and people in rural areas. It is simple to operate and provides real-time emergency alerts via SMS containing GPS location coordinates. The lithium battery ensures long operational time, even in outdoor or power-out situations.

Once the device is powered on, the GPS module begins searching for satellite signals to determine the device's location. Once it locks onto satellites, it continuously updates the GPS coordinates. When the system is triggered (automatically or manually), the Arduino reads the latest location data and sends an SMS via the SIM800L module.

3.4 FEATURES AND OBJECTIVES

a. Real-Time GPS Tracking

The system uses a NEO-6M GPS module to obtain the user's current latitude and longitude, allowing real-time location sharing via SMS.

b. GSM-Based SMS Alert

The SIM800L GSM module sends the GPS coordinates as a text message to a predefined emergency contact without needing internet access.

c. Standalone System (No Smartphone Needed)

The device works independently without any smartphone or app, making it reliable during emergencies when a mobile phone may not be available.

d. Rechargeable and Portable

The lithium-ion battery makes the device lightweight and portable, ideal for personal safety during travel, outdoor activities, or remote work.

3.5 SYSTEM ARCHITECTURE

The system architecture of the SOS GPS Alert System defines the design and interaction of hardware and software components. It consists of a combination of microcontroller-based control, communication modules (GSM and GPS), a power source, and an alert indicator. Below is a breakdown of the system’s architecture using subheadings.

CHAPTER 4

SYSTEM REQUIREMENT

4.1 COMPONENTS USED

a. Arduino Nano

The Arduino UNO or Nano serves as the microcontroller unit (MCU) that controls the entire system. It reads GPS data, formats the message, sends commands to the GSM module, and manages the LED indicator. It is easy to program using the Arduino IDE and is well-suited for embedded system projects.

b. SIM800L GSM Module

The SIM800L module is responsible for sending SMS messages over the GSM (2G) network. It is controlled via AT commands sent by the Arduino and delivers the emergency alert with the user's GPS location to a predefined mobile number. A stable power supply is essential for its proper operation.

c. NEO-6M GPS Module

This module provides real-time GPS data, including latitude and longitude coordinates. It communicates with the Arduino through serial communication and requires a clear view of the sky to receive signals from GPS satellites. The location data is used to generate a Google Maps link in the alert message.

d. Lithium-Ion Battery (3.7V)

A rechargeable lithium-ion battery powers the entire system, making it portable and suitable for use in areas without access to electricity. It provides sufficient svoltage and current for both the Arduino and GSM module when properly regulated.

e. Jumper Wires and Breadboard

Jumper wires and a breadboard are used to make temporary connections between the components during prototyping. They allow flexible circuit assembly and easy troubleshooting during development and testing.

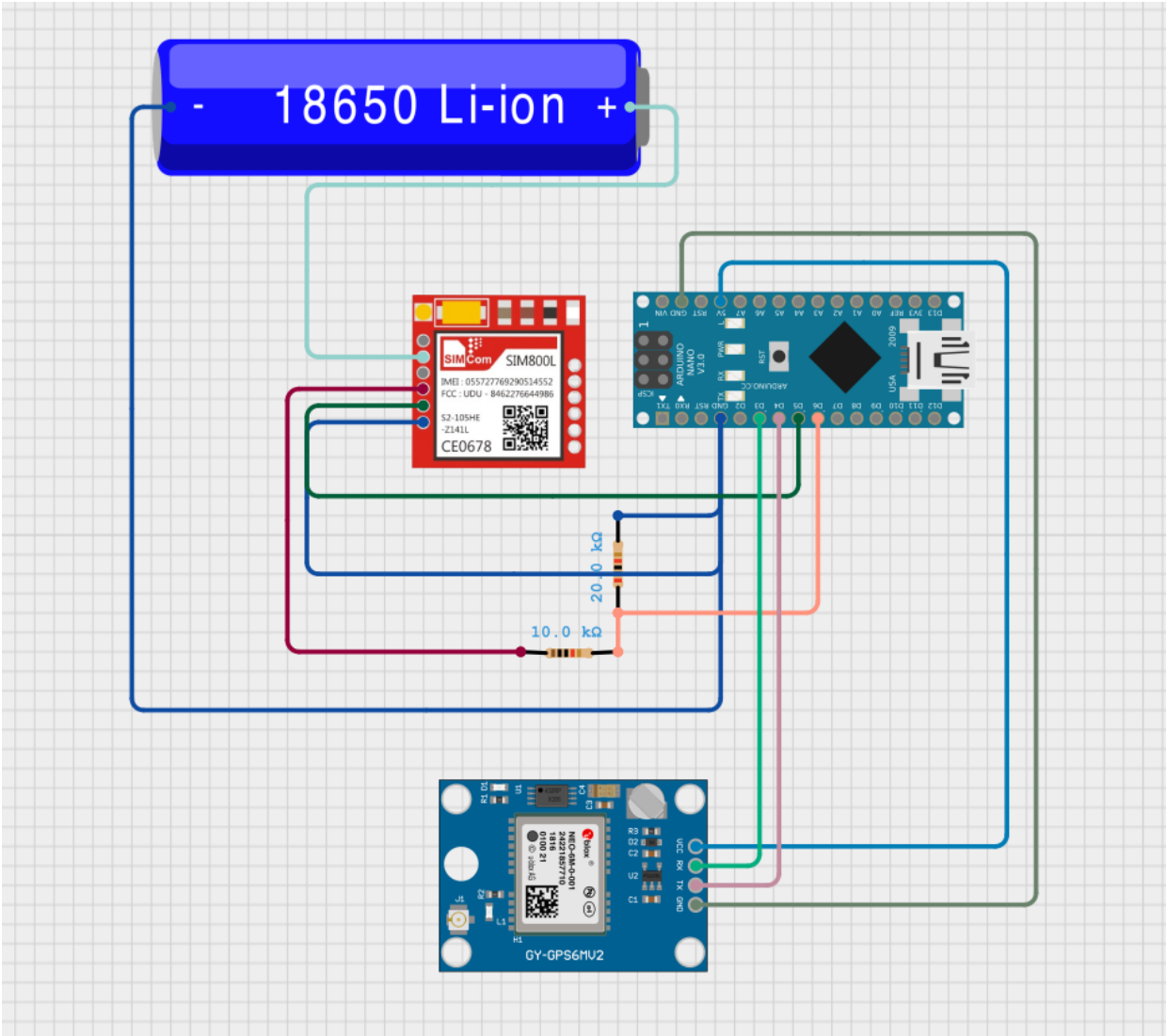

Fig 4.1 Connection diagram

4.2 HARDWARE IMPLEMENTATION

The hardware implementation of the SOS Alert System focuses on building a reliable, low-cost, and compact circuit that can operate independently to send emergency location alerts via SMS. The key components used in this project are Arduino Nano, NEO-6M GPS module, SIM800L GSM module, LED, resistor, jumper wires, and a 3.7V lithium-ion battery.

The Arduino Nano acts as the central controller and is mounted on a breadboard for easy prototyping. It is powered by the 3.7V battery. The NEO-6M GPS module is connected to the Nano through digital pins D3 (RX) and D4

(TX), enabling the Arduino to receive live location coordinates (latitude and longitude).

The SIM800L GSM module is used to transmit the acquired GPS location as an SMS. It is connected to pins D7 (TX) and D8 (RX) of the Nano. The GSM module is powered directly from the battery, and its GND is connected to the system ground to maintain a common reference.

An LED is connected to pin D12 through a current-limiting resistor. It blinks when the message is sent successfully, giving the user visual feedback. All the components are arranged neatly on a breadboard, and jumper wires are used for interconnection.

The entire system is activated as soon as it is powered on. It waits for GPS signal, processes the location, and sends the SMS automatically. No push button or user interaction is required, making the system ideal for emergency use. The hardware connections are simple, portable, and suitable for mini project demonstrations.

a) Arduino Nano **b) SIM800L** **c) NEO 6m GPS**

Fig 4.2 Major Hardware Components

4.3 BLOCK DIAGRAM

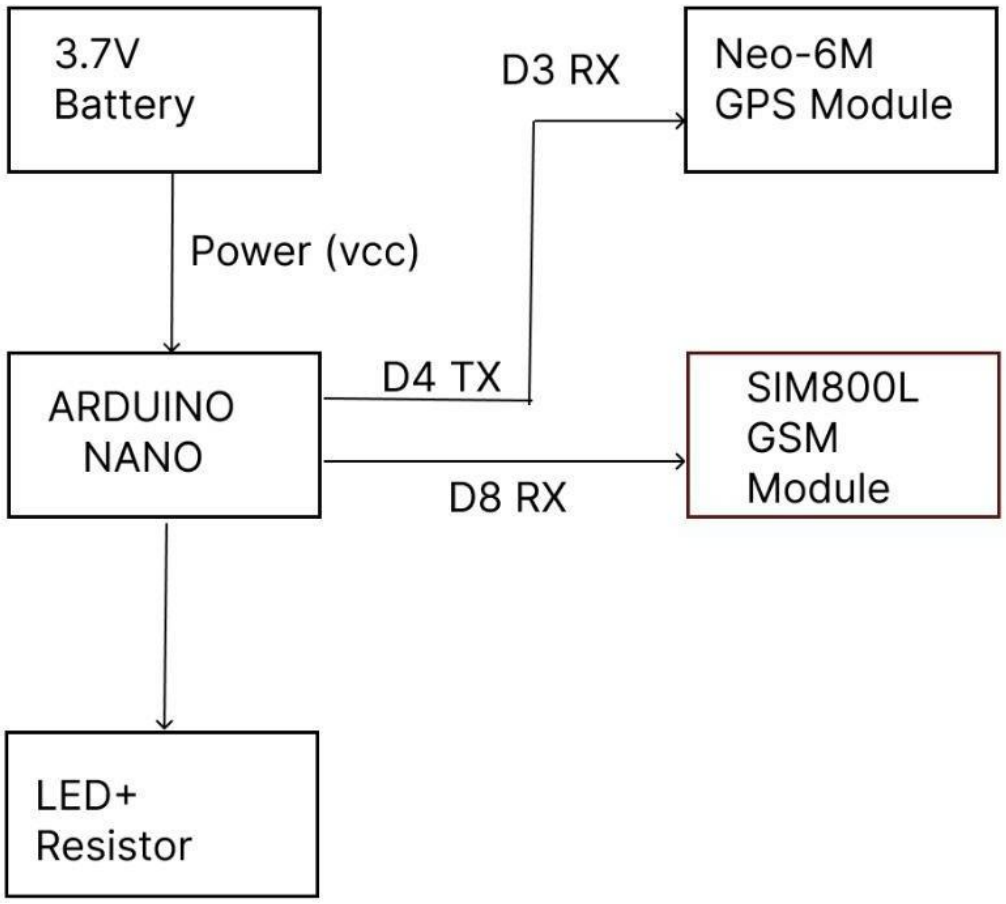

Fig 4.3 Block diagram of SoS system

4.4 SOFTWARE ARCHITECTURE

The software is programmed using the Arduino IDE in C/C++. The code uses libraries such as SoftwareSerial.h to handle serial communication between multiple modules. The software flow is as follows:

- Initialize GPS and GSM modules.
- Continuously read GPS data and extract coordinates.
- Send SMS with the location to a predefined number.
- This logic runs in the loop() function, ensuring the system is always ready

to trigger the alert.

4.5 COMMUNICATION FLOW

- The GPS module communicates with the Arduino using serial communication.
- The GSM module also uses serial (via SoftwareSerial) to receive AT commands and send messages.
- The Arduino manages both modules in sequence to avoid conflict, reading GPS data first, then sending the message.

4.6 POWER ARCHITECTURE

The lithium battery provides portable, rechargeable power. The GPS and GSM modules are sensitive to voltage, so a voltage regulator or capacitor may be used to maintain stable current, especially for the SIM800L during transmission.

CHAPTER 5

RESULT

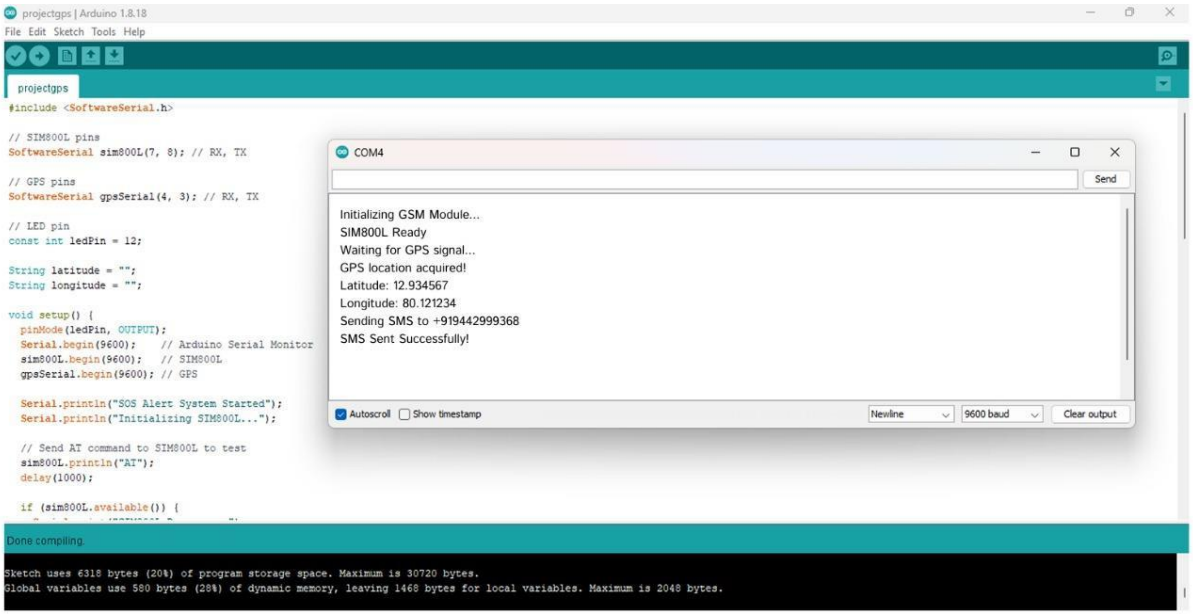

Fig 5.1 Output screen of Arduino IDE

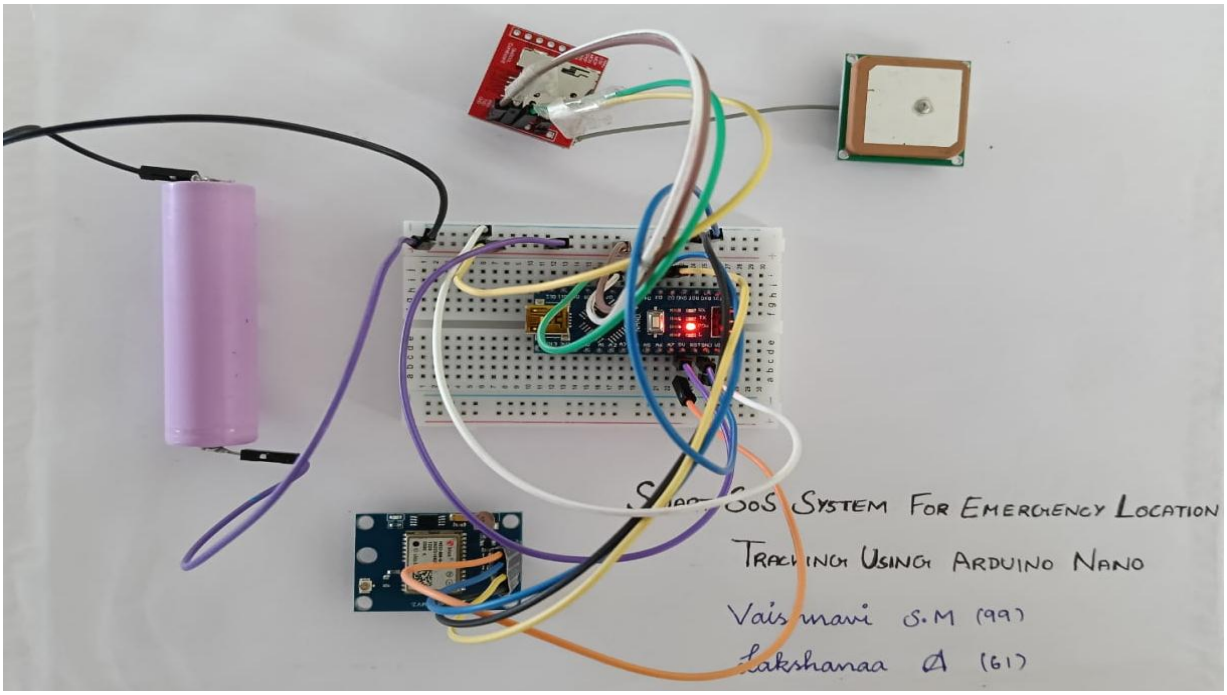

Fig 5.2 SOS System Prototype

CHAPTER 6

CONCLUSION AND FUTURE

Conclusion

The SOS GPS Alert System provides a practical, low-cost, and efficient solution for emergency communication in real time. By integrating the Arduino microcontroller with the SIM800L GSM module and NEO-6M GPS module, the system can send an SOS message containing live GPS coordinates via SMS without requiring internet access or a smartphone. The addition of a lithium-ion battery makes the system portable and reliable, even in outdoor or power-off situations.

This project successfully meets its key objectives: enabling offline operation, ensuring real-time location tracking, and offering a simple, standalone alert mechanism suitable for diverse use cases such as women's safety, elderly care, accident response, and disaster scenarios. The system's LED feedback improves user trust and usability during emergencies.

Through testing, the device proved to be functional and dependable in areas with basic 2G GSM coverage. It demonstrates how embedded systems can be effectively used in real-world safety applications using affordable, open-source components.

Future Scope

While the current system is effective, several enhancements can be considered in future versions to increase its functionality, reliability, and user experience:

a. Panic Button Trigger

Instead of automatic startup or serial triggers, a physical panic button can be added so users can manually send alerts instantly in a crisis.

b. Multiple Contact Numbers

Future versions can be programmed to send the SOS message to multiple recipients (e.g., family, police, friends) for broader support.

c. Location Update at Intervals

The system can be expanded to send continuous location updates every few minutes until help arrives, increasing the chances of real-time tracking.

d. Voice or Audio Alert Option

A small buzzer or pre-recorded voice message could be integrated to attract nearby attention when an alert is sent.

e. Waterproof/Compact Design

The final version can be made weatherproof and fit into a compact casing or wearable format (like a wristband or keychain) for better portability.

f. Fall Detection or Health Monitoring

Advanced versions could integrate accelerometers or health sensors to automatically detect a fall or abnormal heart rate, triggering the alert without user input.

g. IoT Integration

Although current version works offline, future models can support optional cloud connectivity via Wi-Fi or 4G to store alert history or track multiple users.

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