NAVIGATING SAFETY: A GPS - BASED ALARM SYSTEM FOR FISHERMAN

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This is to certify that this project work entitled

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SYNOPSIS

Navigating the boundless expanses of the sea introduces a distinctive challenge for fishermen, characterized by the absence of tangible demarcations. This dynamic environment poses the risk of inadvertent border crossings, where fishermen might unknowingly enter the territorial waters patrolled by foreign navies. Recognizing this potential hazard, the GPS-based alarm system emerges as a crucial component in ensuring maritime safety and averting diplomatic complications.

In this innovative solution, the system constantly monitors the boat's coordinates and establishes predefined values corresponding to international borders. As the boat approaches these critical thresholds, the system promptly triggers an alert through a buzzer, concurrently initiating motor deacceleration. This dual mechanism provides real-time situational awareness to fishermen, empowering them to navigate with precision and avoid unintentional border transgressions.

The absence of physical boundaries in sea ways underscores the significance of a proactive safety measure. This system not only acts as a vigilant guardian against territorial breaches but also addresses the inherent challenges of the existing methods, such as high costs and limited portability. By leveraging the Sky Labs GPS SKG13C module and optimizing the search algorithm, the system achieves remarkable cost efficiency, reducing the overall expense to less than ₹500.

Moreover, the integration of a rechargeable battery with a Type B charging module enhances sustainability and reduces the system's environmental impact. By eliminating the need for a SIM card through the Sky Labs GPS module, the system streamlines functionality while maximizing accessibility. Ultimately, this comprehensive solution represents a significant advancement in maritime safety technology, ensuring that fishermen can navigate the open sea with heightened awareness, security, and efficiency.

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LIST OF ABBREVATIONS

GPS **Global Positioning System**

NMEA **National Marine Electronics Association**

GPRS **General Packet Radio Service**

GSM **Global System for Mobile Communication**

CHAPTER 1

INTRODUCTION

1.1 DESCRIPTION

In the vast expanse of sea, devoid of physical boundaries, fishermen face the unique challenge of unintentionally crossing international borders, potentially encountering foreign navies unknowingly. The proposed GPS-based alarm system addresses this concern by continuously monitoring the boat's coordinates. By setting predefined values corresponding to international borders, the system triggers an alert through a buzzer and initiates motor deacceleration, providing real-time awareness to fishermen when approaching these critical regions. This innovative solution not only enhances safety for fishermen but also mitigates the risk of inadvertent border crossings, ensuring a secure and informed maritime journey.

1.1.1 GPS

The GPS (Global Positioning System) module is a critical component responsible for determining the precise geographical coordinates of the boat's current location. The GPS module, represented by the **TinyGPS** library, communicates with the Arduino through a software serial connection (**mySerial**). This communication allows the Arduino to receive NMEA (National Marine Electronics Association) data from the GPS module.

The **TinyGPS** library is utilized to parse and extract essential information from the NMEA data, specifically latitude and longitude values. These coordinates are then used in conjunction with predefined border coordinates to calculate distances and determine the boat's proximity to the international border.

The GPS module's role is pivotal in providing real-time location data, enabling the implementation of a sophisticated alert system that triggers warnings and motor adjustments when the boat approaches or crosses predefined threshold coordinates. Overall, the GPS module forms the foundation of the project's navigation and safety features by continuously updating the Arduino with accurate position information.

1.2 EXISTING SYSTEM

The existing system utilizes a GPRS/GSM integration approach, employing a SIM808 module with Arduino. This integration extends to environmental sensors, including temperature, humidity, barometric pressure, and an accelerometer/gyroscope for measuring boat movements. Data collected from these sensors is transmitted via the GPRS/GSM module to a remote server or database, allowing for monitoring and analysis.

However, several drawbacks characterize the existing system. The inclusion of GPRS/GSM modules and various sensors can lead to elevated costs. The system's lack of compactness makes it challenging to install on smaller sailboats or in limited spaces. Additionally, there is a deficiency in an integrated alarm system for emergency situations, specifically when the boat approaches the threshold region near the International Border. Continuous data transmission over GPRS/GSM networks can result in high operational costs and potential limitations due to data plan constraints.

1.3 PROBLEM STATEMENT

The maritime domain poses unique challenges for fishermen, particularly in the absence of physical boundaries at sea. The existing safety systems, relying on GPRS/GSM integration and environmental sensors, exhibit limitations that compromise the effectiveness of ensuring fishermen's safety.

The final purpose of this project is to enhance maritime safety for fishermen by proposing a GPS-based alarm system. It seeks to provide real-time alerts and prevent inadvertent border crossings, fostering a more secure and efficient fishing experience on the open sea. The ultimate goal is to address existing system limitations, ensuring accessibility, cost-effectiveness, and heightened awareness for fishermen.

1.4 PROPOSED SYSTEM

Integrating a GPS module with Arduino, our system establishes predefined coordinates corresponding to international borders, triggering real-time alerts through a buzzer and motor deacceleration when the boat nears these critical regions. This cost-effective solution enhances portability, reduces expenses to less than ₹500, and addresses the limitations of existing maritime safety systems for fishermen.

1.5 ORGANIZATION OF THE PROJECT

- Literature review of already existing systems are discussed in chapter 2
- Chapter 3 discusses the overall project and design which tells the brief description of each of the modules in this project.
- Chapter 4 has the implementation and experimental result of the project.
- Chapter 5 deals with the conclusion and future work.
- Finally, chapter 6 deals with the references.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING SYSTEM

The existing system employs a GPRS/GSM integration approach, utilizing the SIM808 module with Arduino. This integration extends to incorporate environmental sensors, including those measuring temperature, humidity, barometric pressure, and an accelerometer/gyroscope for tracking boat movements. Collected data from these sensors is transmitted through the GPRS/GSM module to a remote server or database, enabling continuous monitoring and analysis of the boat's conditions and location.

However, this system has notable drawbacks. The inclusion of GPRS/GSM modules and various sensors contributes to elevated costs, potentially making it financially prohibitive for smaller-scale operations. Furthermore, the system's lack of compactness poses challenges for installation on smaller vessels, limiting its applicability in diverse maritime settings. The absence of an integrated alarm system for emergency situations, particularly when nearing the International Border's threshold region, is a significant limitation. Continuous data transmission over GPRS/GSM networks incurs operational costs and may be subject to data plan constraints, potentially resulting in delays in real-time monitoring.

2.2 PROBLEM STATEMENT

The existing maritime safety system, relying on GPRS/GSM integration and environmental sensors, faces challenges due to high costs, limited adaptability for smaller vessels, a deficiency in emergency alerts near international borders, and potential data transmission issues. These limitations hinder effective and affordable safety measures for fishermen navigating the open sea.

2.3 OBJECTIVE

The existing maritime safety system, relying on GPRS/GSM integration and environmental sensors, faces challenges due to high costs, limited adaptability for smaller vessels, a deficiency in emergency alerts near international borders, and potential data transmission issues. These limitations hinder effective and affordable safety measures for fishermen navigating the open sea.

2.1 Development of Sailboat Monitoring and Locating System using GPRS/GSM and GPS Technology

GPS is a satellite-based navigation system that enables precise location determination and navigation on Earth. It consists of a constellation of satellites orbiting the planet, ground stations, and receivers. The GPS system works by triangulating signals from multiple satellites to calculate the user's exact position, including latitude, longitude, altitude, and precise time information.

Originally developed for military purposes, GPS has become an indispensable technology in various civilian applications. It plays a crucial role in navigation for vehicles, ships, aircraft, and hikers, as well as in location-based services on smartphones. GPS technology relies on the accurate timing of signals transmitted by satellites, allowing GPS receivers to calculate their position with high precision. The integration of GPS in various devices has revolutionized navigation, logistics, and numerous other fields, contributing to increased efficiency and safety in diverse industries.

2.2 Integrated Monitoring System for Sailboats Using GPRS/GSM and GPS Technology

The system introduced is a comprehensive monitoring and locating solution tailored for sailboats, integrating General Packet Radio Service/Global System for Mobile Communications (GPRS/GSM) and Global Positioning System (GPS) technologies. This prototype facilitates the tracking of sailboat locations within a 10 km radius from the Veracruz port, commonly employed by Universidad Veracruzana's crew for wind sailing training. Its primary functionalities involve GPS-based location tracking, environmental

sensors, and data storage using Structured Query Language (SQL) databases. Field tests conducted along coastal routes, spanning 24 km, validated the system's efficacy in continuous location monitoring during sailboat navigation, providing instructors with crucial information for guiding novice sailors effectively and safely from shore.

2.3 Enhancing Fishermen Safety through GPS-GSM Integrated System

The inherent risks for fishermen primarily arise during boat travels, where inadvertent entry into foreign waters poses significant dangers. Addressing this concern, a system leveraging GPS and GSM technologies is proposed. This system aims to proactively prevent such scenarios by continuously tracking boat locations and alerting fishermen in critical proximity situations.

The system's core functionality involves a GPS-GSM integrated module, such as SIM808, where GPS tracks the precise boat location. The GPS receiver provides real-time latitude and longitude coordinates transmitted to a microcontroller. Subsequently, the microcontroller compares these coordinates against predefined values, designating certain thresholds as normal or warning zones. Upon entering the warning zone, indicated by a predefined boundary, the system triggers a buzzer alert, notifying fishermen about nearing the nautical border. Additionally, the system facilitates motor speed control, enhancing safety measures as the boat approaches critical zones.

This innovative system amalgamates GPS and GSM technologies, enabling real-time monitoring of boat positions and providing timely alerts to fishermen. By dynamically controlling the boat's speed and alerting fishermen in proximity to border zones, it ensures heightened safety during fishing expeditions, potentially preventing inadvertent entries into foreign waters and safeguarding the lives of fishermen.

An overall view of all the literature survey papers has been inferred in Table

AUTHOR/TITLE	WORK	ADVANTAGES	DISADVANTAGES
Rosa M. Woo-Garcia, V. Herrera-Nevraumont, E. Osorio-de-la-Rosa, S. E. Vazquez-Valdes, F.Lopez-Huerta Location Monitoring System for sailboats by GPS using GSM/GPRS Technology	A monitoring and locating system for sailboats is developed using the mobile communications general packet radio service/global system for (GPRS/GSM) and global positioning system (GPS) technology.	The system uses a GPS module to obtain the boats coordinates; it has a sensing station: environmental temperature, humidity, barometric pressure, and the angular movement of the ship. A structured query language (SQL) database has been implemented to store data received via AVR-GPRS.	The implemented prototype can track the location of sailboats that do not go out more than 10 km into the sea. System monitoring tests were carried out over a 24-km route onboard a sailboat, obtaining its location during the entire course along the coast of the Atlantic Ocean, Gulf of Mexico
Nidhi Dawda, Ridhee Borad, Aishwarya Dalvi, Niraj Bangera, Varun Mishra Fishermen Nautical Border Alert System using GSM technologies.	The system GSM technologies to track boat locations, establishing predefined zones near international borders. It employs a microcontroller to compare current coordinates with predefined values, triggering warnings through an LCD display and controlling the boat's engine speed based on proximity to the border zones.	Enhanced safety is a key advantage, providing real-time alerts and multiple warning levels before reaching restricted zones. It offers an automated response system, gradually notifying fishermen and controlling the engine to prevent unintentional border crossings.	Reliance on technology and potential technical failures might lead to false alerts or missed warnings. The system's limited manual intervention and lack of direct override options could restrict fishermen's decision-making in critical situations. Additionally, the system's complexity may require specialized knowledge for maintenance and troubleshooting, posing challenges for upkeep.

AUTHOR/TITLE	WORK	ADVANTAGES	DISADVANTAGES
Joel I Miano, Ernesto E. Empig, Alexander R. Gaw, Ofelia S. Mendoza, Danilo C. Adlaon, Sheena B. Cañedo, Roan Duval A. Dangcal, Angelie S. Sumalpong Microcontroller-based Vessel Passenger Tracker using GSM System: An Aid for Search and Rescue Operations	The system, FLOATS, integrates GPS for location tracking, GSM for emergency communication, an Arduino-Nano microcontroller for processing, an inflatable life jacket with a signal light, and an OLED display for rescue updates. It combines theories like Search Theory, Theory of Planned Behavior, and Disaster Preparedness to design a comprehensive solution for locating overboard passengers during maritime distress, aiming to improve safety and expedite search and rescue operations.	FLOATS addresses the safety concerns in the maritime industry by offering a system that swiftly locates overboard passengers during distress, potentially reducing casualties. It amalgamates various technologies and theories, enhancing the efficiency of search and rescue operations. The system's functionality, reliability, and acceptability have been validated through tests and surveys, providing confidence in its effectiveness.	While FLOATS brings advancements in maritime safety, it might face challenges in implementation due to the need for proper training in system usage and maintenance. There could be technological constraints or limitations in extreme weather conditions or remote maritime areas. Additionally, the initial setup costs and integration complexities might be barriers to widespread adoption.
D. Isaac, H. Kingsley Advanced border alert system using GPS and with intelligent Engin control unit	This intelligent design employs a combination of GPS and an ARM7 microprocessor-based Electronic Control Unit to address the plight of Indian fishermen facing arrests due to unknowingly crossing maritime	The system's primary advantage lies in its ability to provide timely alerts to fishermen upon border crossings, aiding in preventing accidental arrests. It offers real-time	Despite its merits, the system may face challenges in implementation due to potential technical complexities associated with integrating GPS, GSM, and an Engine Control Unit. There might also be limitations

	boundaries. Using dynamic vessel location tracking, it alerts fishermen upon crossing borders with an alarm and transmits boat locations to the nearest coast station via GSM. Additionally, it employs an Engine Control Unit to manage engine speed, triggered when nearing maritime boundaries, aiding in preventing unauthorized border crossings.	monitoring capabilities and facilitates control over engine speed through an Electronic Control Unit, potentially deterring illegal activities such as smuggling or intrusions.	in handling diverse maritime conditions or encountering system errors that could affect its accuracy and effectiveness in real-world scenarios. Additionally, while it addresses the issue of arrests, it might not entirely prevent accidental border crossings.
P. Dhivyabharathi, Y. Jeyasingh GPS based Border Alert System using Arduino	This system aims to assist fishermen in navigating within their country's sea borders using GPS and GSM technologies. It utilizes GPS to track the boat's location and GSM to communicate with coastal guard offices. As the boat approaches the restricted zone, the system activates an alarm, gradually reducing the engine speed. If warnings are ignored and the boat enters the restricted area, the engine is automatically shut off, and a message is sent.	Enhanced safety for fishermen is a significant advantage, providing timely warnings and a gradual response mechanism as the boat approaches the restricted zone. The system's integration of GPS and GSM allows for effective communication with coastal guard offices, enabling prompt intervention to prevent border crossings.	The system's reliance on technology, such as GPS and GSM, may be susceptible to technical errors or malfunctions, potentially leading to false alerts or engine shutdowns. Additionally, the system's reliance on automated controls might limit fishermen's autonomy in critical situations. Maintenance and upkeep of the integrated components could require specialized knowledge, posing challenges for implementation and support.

AUTHOR/TITLE	WORK	ADVANTAGES	DISADVANTAGES
Uthayakumar Jothilingam, A. Ravi, Pic Micro Controller based Border Alert and Secured System for Fisherman	The system employs an Embedded Microcontroller PIC IC to enhance fishermen's safety by utilizing GPS coordinates to control the boat's movement. It continuously receives satellite signals for location tracking and, upon detecting border crossings, triggers an emergency switch to alert fishermen and hands over control to the concerned authorities, mitigating border violations.	Improved safety is a significant advantage, as the system utilizes GPS technology to precisely track locations and proactively alerts fishermen when they cross borders. This real-time alert system helps prevent unintentional border violations and enables swift intervention by authorities, potentially reducing fatalities among fishermen.	The system's reliance on automated control may limit fishermen's discretion in emergency situations, potentially affecting their ability to navigate or respond promptly to unforeseen circumstances. Additionally, the system's integration and maintenance complexity might require specialized knowledge for upkeep, posing challenges for deployment and troubleshooting.
J.C. Reynolds, R.P. Denaro, R.M. Kalafus GPS-based vessel position monitoring and display system	The system introduces the first operational GPS/Loran-based vessel monitoring system, merging monitoring workstations, communication solutions, and onboard navigation systems. It serves as a blueprint for expansive systems applicable to hazardous cargo or oil and gas transport across oceans. It emphasizes GPS-based vessel tracking implementation, detailing navigation, position reporting, data communication, and monitoring system applications.	This innovative system integrates GPS and Loran technologies, offering a comprehensive monitoring tool for marine fleet operators. It showcases scalability for hazardous cargo or oil and gas transportation, potentially enhancing safety in maritime logistics. concerns, setting new industry standards.	Despite its innovation, challenges may arise due to technology integration complexities, requiring specialized expertise for deployment and upkeep. Reliability concerns under adverse weather or remote conditions might impact tracking accuracy. High setup costs and infrastructure needs for large-scale deployment could limit widespread adoption.

AUTHOR/TITLE	WORK	ADVANTAGES	DISADVANTAGES
P.SWAPNA GPS-GSM BASED TRACKING SYSTEM FOR SPECIAL USER GROUPS	This system is designed as an anti-theft solution using GSM-GPS technology primarily tailored for special user groups, aiding in tracking buses and assisting blind individuals. It continuously monitors the bus's movement, relaying status reports to blind users upon request. The methodology involves communication between the blind person unit and the bus stop unit through Zigbee, obtaining satellite-based information via GPS from the bus driver unit, and facilitating two-way voice communication for blind individuals to identify the correct bus.	The system provides a tailored solution for special user groups, offering real-time tracking and communication features. It enables blind individuals to request and receive information about bus locations, enhancing their mobility and independence. Additionally, the two-way voice conversation aids in identifying the correct bus for visually impaired individuals.	Possible limitations may arise due to the system's reliance on technology, such as potential technical failures affecting accurate tracking or communication. Dependence on GPS and satellite connectivity might lead to issues in areas with poor signal reception, impacting the system's reliability. Additionally, the complexity of the system could require specialized knowledge for maintenance and troubleshooting, posing challenges for widespread implementation.
Varsha S, Vimala P, Supritha B S, Ranjitha V D GPS AND GSM BASED TRACKING SYSTEM FOR FISHER MAN, SOILDERS, AGED PEOPLE AND GIRLS	The project focuses on developing a tracking device for individuals, particularly for lost fishermen, girls, children, and the elderly. It integrates GPS for real-time location tracking and GSM for transmitting tracked information	The device offers a portable and easily accessible safety solution for vulnerable individuals. It allows real-time tracking and communication with authorities, enabling quick responses in	Potential limitations may include reliance on technology, which could result in technical malfunctions or network issues affecting communication during critical situations. The device's dependency on GPS signals might be hindered in areas with poor signal reception, compromising accurate location tracking. Additionally, the device's effectiveness could be limited if not carried or worn by the individual at all times,

	to authorities. Designed as a wearable safety system, this device, resembling a jacket accessory, features an emergency push button to alert and share the victim's location with pre-defined contacts, aiming to enhance safety during emergencies.	emergencies. By using GPS and GSM technologies, it provides a simple yet effective means to notify and seek help, especially for physically challenged people, thereby enhancing their safety.	affecting its ability to provide timely assistance.
Sindhu S Rao, Saraswathi Devi V G,Lokesh B S BORDER ALERTING SYSTEM FOR FISHERMEN USING GPS MODULE	This system focuses on fishermen's safety by utilizing GPS and GSM technologies to track the boat's location. The GPS module determines the boat's exact coordinates, comparing them continuously with predefined values using a microcontroller. An LCD displays the current location, triggering alerts (buzzer) and controlling the motor's speed when the boat surpasses predefined latitude and longitude coordinates, preventing entry into restricted areas.	The system addresses the critical safety concerns of fishermen, enabling real-time tracking and alerting them when nearing border areas. Its practical implementation at Lingambudhi lake validates its functionality, offering a reliable solution to avoid potentially hazardous situations for fishermen traveling on boats.	While the system provides a safety net, its effectiveness might rely heavily on the accuracy of GPS and GSM modules, potentially causing false alerts due to technical inaccuracies. Additionally, the system's reliance on predefined coordinates may have limitations in areas where precise borders are not clearly defined, possibly leading to ambiguities in alert triggers.

CHAPTER 3

PROJECT DESIGN

3.1 PROJECT DESIGN

3.1.1 ARCHITECTURE OF PROPOSED SYSTEM

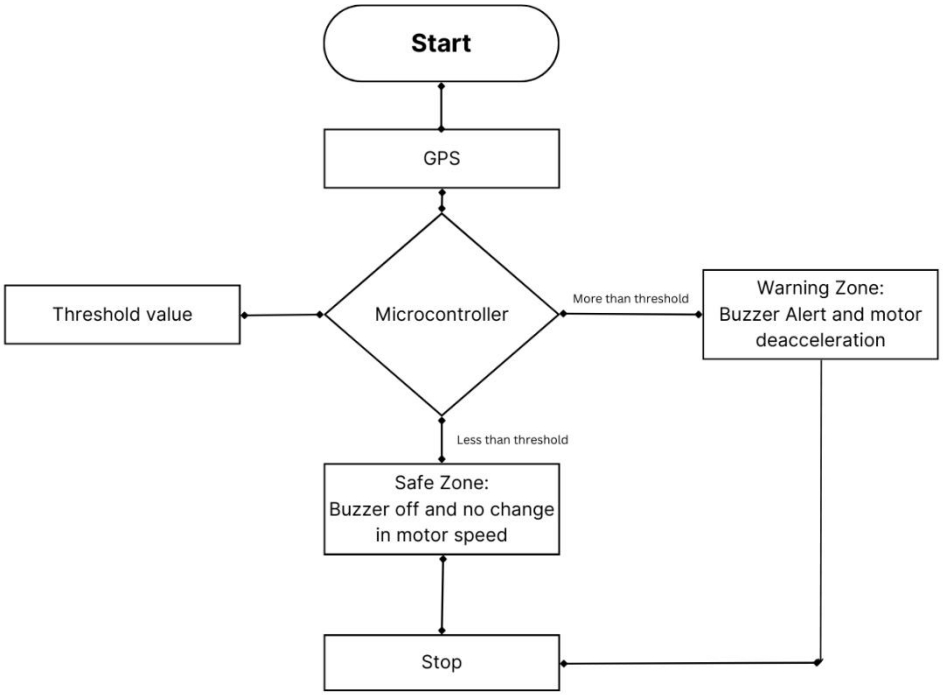

Figure 3.1 FLOWCHART OF PROPOSED SYSTEM

3.2 MODULE DESCRIPTION OF DATA COLLECTION

A set of predefined data specifying the coordinates of the international border, including latitude and longitude, has been acquired through online scraping. This data serves as a critical reference for the proposed GPS-based alarm system, guiding the system to trigger alerts when the boat approaches these specific geographical coordinates. The utilization of scraped data ensures accuracy and reliability in identifying the threshold region near the International Border, enhancing the system's effectiveness in preventing inadvertent border crossings. This pre-gathered information forms an integral component of the project,

providing a foundational framework for real-time monitoring and alerting, thereby contributing to the overall safety and awareness of fishermen navigating the open sea.

3.3 CIRCUIT DIAGRAM

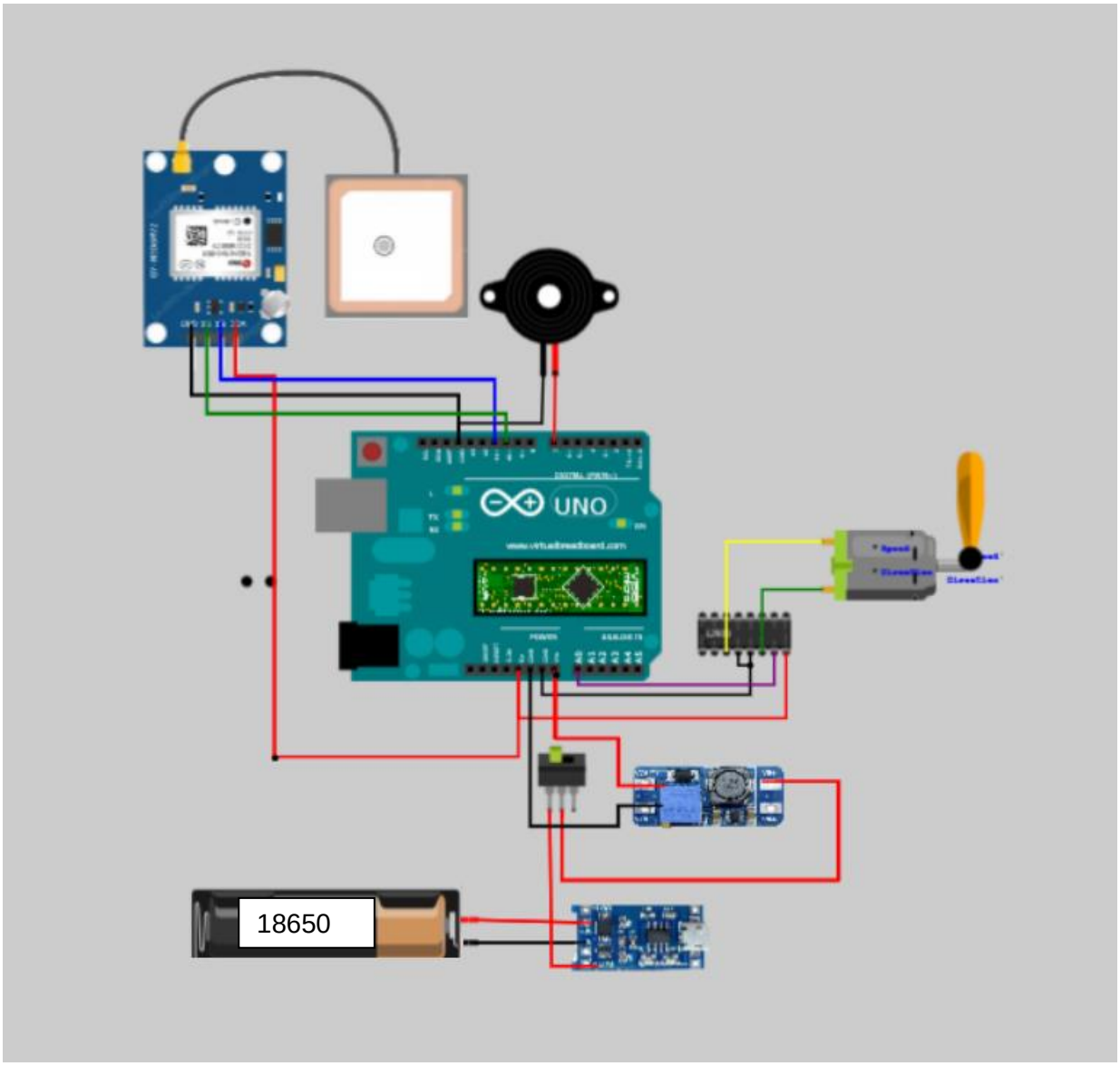

Figure 3.2 CIRCUIT DIAGRAM OF PROPOSED SYSTEM

3.3.1 BATTERY (18650)

The 18650 battery is a common rechargeable lithium-ion battery with a cylindrical shape, measuring 18mm in diameter and 65mm in length, hence its name.

1. **Chemistry:** The 18650 battery employs lithium-ion technology, offering a high energy density, lightweight design, and a relatively long lifespan compared to traditional batteries.
2. **Voltage:** Typically, a single 18650 cell provides a nominal voltage of 3.7 volts. However, for certain applications, multiple cells can be connected in series or parallel to achieve different voltage and capacity requirements.
3. **Capacity:** The capacity of 18650 batteries varies, commonly ranging from 2000mAh to 3500mAh. Higher capacity cells can store more energy, providing longer usage times between charges.
4. **Rechargeable:** One of the significant advantages of 18650 batteries is their rechargeable nature. They can undergo numerous charge-discharge cycles, making them cost-effective and environmentally friendly compared to single-use batteries.
5. **Applications:** 18650 batteries find widespread use in various electronic devices, including laptops, flashlights, electronic cigarettes (vaping), power tools, and electric vehicles. Their popularity stems from their balance of size, capacity, and performance.

3.3.2 MICROCONTROLLER

1. The ATmega328P is a widely used microcontroller in various embedded systems, including the proposed GPS-based alarm system for fishermen **Architecture:** The ATmega328P is based on the Modified Harvard Architecture with 32KB of in-system programmable flash memory. It features 1KB of EEPROM and 2KB of SRAM, providing sufficient resources for program storage and data manipulation.

2. **Clock Speed:** Operating at a clock speed of up to 20 MHz, the microcontroller ensures efficient and responsive execution of instructions, crucial for real-time applications like the GPS-based alarm system.

3. **Peripheral Features:** It includes essential peripherals such as timers/counters, analog-to-digital converters (ADC), USART for serial communication, and GPIO pins for interfacing with external components. These features facilitate the integration of various sensors, GPS modules, and other components in the project.

4. **Low Power Consumption:** With multiple sleep modes and low power consumption features, the ATmega328P is suitable for battery-powered applications, ensuring energy efficiency for prolonged operation.

5. **Programming:** The microcontroller is programmable through the popular Arduino IDE, making it accessible for a broad community of developers. The use of the Arduino platform simplifies code development and facilitates rapid prototyping.

6. **Versatility:** ATmega328P's versatility and compatibility make it suitable for a range of applications, from simple projects to more complex systems, such as the proposed GPS-based alarm system.

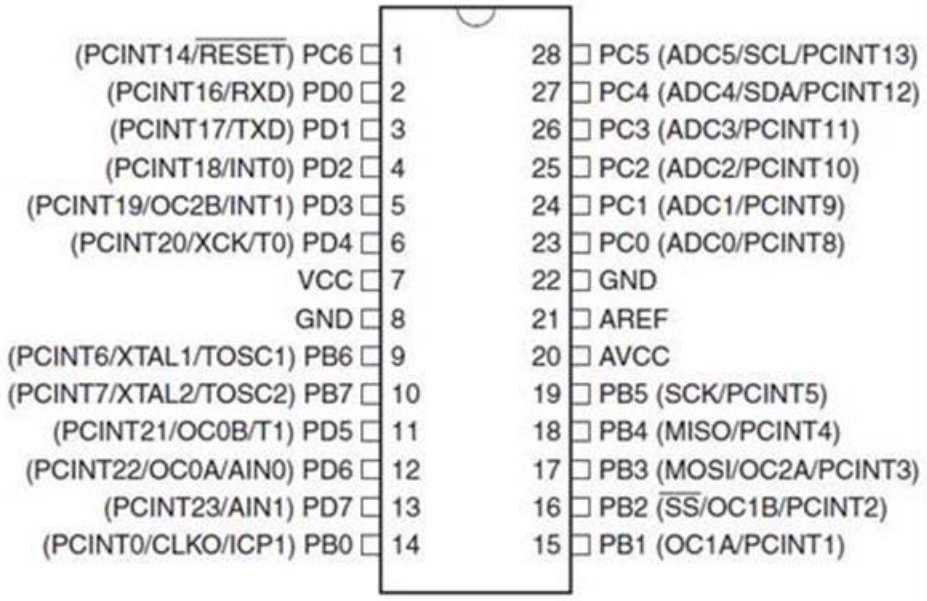

Figure 3.3 ATmega328p Microcontroller

3.3.3 MOTOR DRIVER

The L293D is a popular integrated circuit (IC) widely utilized in electronics and robotics for motor control applications. Specifically designed as a dual H-bridge driver, the L293D enables bidirectional control of DC motors, allowing them to rotate in both forward and reverse directions. Its dual H-bridge configuration consists of four transistors, which facilitate the manipulation of motor polarity, thereby controlling the motor's speed and direction. The IC is compatible with TTL (Transistor-Transistor Logic) and CMOS (Complementary Metal-Oxide-Semiconductor) logic levels, making it easily interfaceable with microcontrollers such as Arduino.

The L293D also features built-in current sensing, providing protection against overcurrent conditions and ensuring the safety of both the connected motors and the IC itself. With its versatility, ease of use, and capability to work with a variety of motor voltages, the L293D remains a popular choice in projects requiring precise and controlled motor movements, contributing to its widespread adoption in hobbyist, educational, and professional applications.

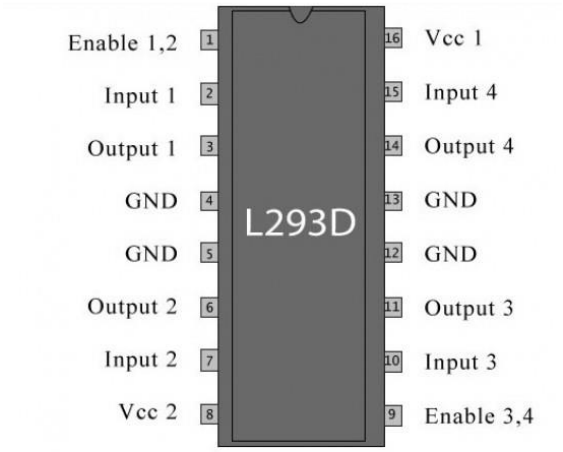

Figure 3.4 Motor driver

3.3.4 GPS

The Global Positioning System (GPS) is a satellite-based navigation system that enables accurate positioning and location tracking on Earth. Developed and maintained by the United States government, GPS consists of a network of orbiting satellites that transmit signals to GPS receivers on the ground. The Skylabs skg-13c model has been used for this project.

1. **Triangulation Principle:** GPS receivers calculate their precise location by triangulating signals received from at least three satellites. The more satellites involved, the more accurate the positioning.
2. **Components:** A typical GPS system consists of satellites, ground control stations, and user devices equipped with GPS receivers. These receivers interpret signals from satellites to determine the user's location.
3. **Accuracy:** GPS technology provides high-precision location data, often with accuracy within a few meters. Differential GPS (DGPS) and Real-Time Kinematic (RTK) techniques further enhance accuracy for specialized applications.

3.3.5 CHARGING MODULE (TP4056)

TP4056 charging module plays a crucial role in ensuring the reliable and efficient power supply for the project's components, particularly the rechargeable batteries. This charging module is integrated into the system to manage the charging of the batteries that power the GPS module, microcontroller (e.g., ATmega328P), and other electronic components.

The TP4056's compact design and compatibility with lithium-ion batteries make it suitable for this application. As the GPS-based system operates in a maritime environment, having a robust and well-managed power supply is essential for continuous and reliable performance. The charging module not only facilitates the recharging of the system's batteries but also incorporates protective features, such as overcharge and over-discharge protection, contributing to the overall safety and longevity of the batteries.

By using the TP4056 charging module in the border alert system, the project ensures that the power source remains optimally charged, allowing the GPS module and associated electronics to function seamlessly. This reliability is particularly crucial for a maritime safety system, where uninterrupted power availability is essential for real-time monitoring and alerting near international borders.

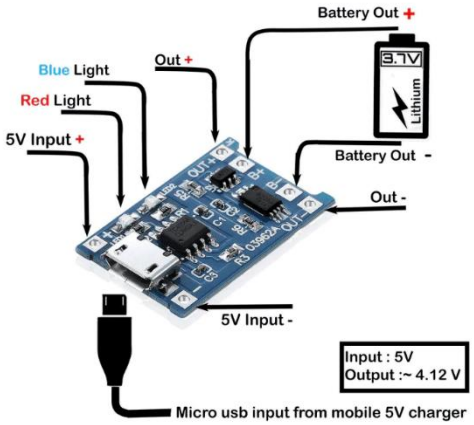

Figure 3.5 Charging module

3.3.6 BOOSTER (MT3608)

The MT3608 is a step-up (boost) voltage regulator module commonly used to efficiently increase and stabilize the output voltage from a lower input voltage. In the

context of the GPS-based border alert system project, the MT3608 may be utilized to ensure a stable power supply for components that require a higher voltage than that provided by the rechargeable batteries.

1. Voltage Boosting: The MT3608 is designed to step up lower input voltages to a higher, more stable output voltage. This is particularly useful when the rechargeable batteries' voltage needs to be boosted to meet the requirements of specific components in the system.

2. Efficiency: The MT3608 is known for its high efficiency, making it suitable for battery-powered projects where maximizing energy utilization is crucial. It helps in extending the overall operational time of the system by efficiently managing power conversion.

3. Adjustable Output: Many MT3608 modules come with an adjustable output voltage feature, allowing flexibility in configuring the desired output voltage based on the requirements of the connected components.

4. Compact Design: The compact form factor of the MT3608 makes it suitable for integration into small electronic projects. In the border alert system, where space may be a consideration, the compact design of the MT3608 is advantageous.

In the GPS-based border alert system project, the MT3608 could potentially be used to regulate the voltage for components that require a higher operating voltage than that provided directly by the rechargeable batteries. This ensures that all electronic components in the system receive the appropriate and stable voltage levels for optimal functionality.

In addressing the operational requirements of the Arduino, which necessitates a minimum voltage of 6 volts, a strategic solution has been implemented in the GPS-based border alert system project. Traditionally, two 18650 batteries, each providing 3.7 volts, would be required to meet this voltage threshold. However, to optimize power management and reduce costs, the MT3608 voltage regulator module has been employed. By stepping up the voltage efficiently, the MT3608 allows the system to operate seamlessly with a single 18650 battery, effectively meeting the Arduino's voltage

specifications. This not only streamlines the power supply configuration but also significantly cuts down on the overall project costs while ensuring the reliable and continuous operation of the entire system.

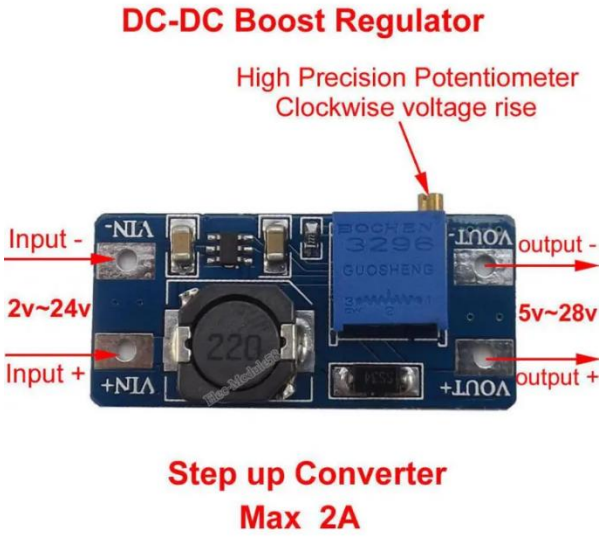

Figure 3.6 Boost Regulator

3.4 HAVERSINE

The Haversine formula is a trigonometric equation used to calculate the shortest distance between two points on the surface of a sphere, given their latitude and longitude coordinates. It is particularly valuable in navigation, geolocation, and various applications involving the measurement of distances on the Earth.

The formula derives its name from the haversine function, which is defined as $hav(\Theta) = \sin^2(\Theta)$. The central concept is based on spherical trigonometry, where the Earth is approximated as a perfect sphere.

The Haversine formula is expressed as:

$$a = sin^2\left(\frac{dlat}{2}\right) + \cos(lat1) * \cos(lat2) * sin^2\left(\frac{dlon}{2}\right)$$

$$c = 2 * atan2\left(\sqrt{a},\ \sqrt{(1-a)}\right)$$

$$d = R * c \text{ (where R is the radius of the Earth, mean radius } = 6371 \text{ km)}$$

where,

$$dlon = lon2 - lon1$$

$$dlat = lat2 - lat1$$

where:

- dlat and dlon are the differences in latitude and longitude, respectively, between the two points.
- lat1 and lat2 are the latitudes of the two points.
- R is the Earth's radius (mean radius = 6,371 kilometers).
- d represents the distance between the two points along the surface of the sphere.

The Haversine formula provides an accurate and straightforward method for calculating distances between locations on Earth, considering the spherical nature of our planet. It is widely employed in geographic information systems (GIS), mapping applications, and any scenario requiring precise distance measurements between given coordinates.

The Haversine formula plays a pivotal role in calculating the distances between the current GPS coordinates of the boat and the predefined coordinates of the international border. As the Earth's surface is not flat, and the project involves maritime navigation, which inherently follows the curvature of the Earth, the Haversine formula provides an accurate method for distance calculations on a spherical surface.

The formula takes into account the latitude and longitude coordinates of two points and computes the great-circle distance between them, considering the Earth as a sphere. This distance calculation is crucial in determining when the boat is approaching the predefined threshold region near the international border.

By utilizing the Haversine formula, the project ensures precision in detecting the boat's proximity to the specified border coordinates. This information is then used to trigger real-time alerts when the boat reaches or crosses the predefined geographical boundaries. The Haversine formula's application enhances the effectiveness of the border alert system, contributing to the safety and awareness of fishermen navigating the open sea.

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CHAPTER 4

SYSTEM SPECIFICATION, IMPLEMENTATION AND RESULT

4.1 SYSTEM REQUIREMENTS

4.1.1 SOFTWARE REQUIREMENTS

Coding Language : C++

Tool : Arduino IDE

4.1.2 HARDWARE REQUIREMENTS

1. Arduino UNO
2. SKY LABS GPS – (skg13)
3. Battery – (18650)
4. Alarm Module
5. Motor Driver Module – (L293D)
6. DC motor
7. Breadboard and Jumper Wires
8. Charging Module – (TP4056)
9. Step up booster – (MT3608)

4.2 IMPLEMENTATION

The implementation of the GPS-based border alert system involves several key components and steps to achieve its objective of enhancing maritime safety.

1. GPS Module Integration:

- The project utilizes the Sky Labs SKG-13C GPS module, interfaced with the Arduino microcontroller using appropriate libraries like "TinyGPS++."

- The GPS module continuously provides real-time latitude and longitude coordinates of the boat's position.

2. Predefined Values and Thresholds:

- Latitude and longitude coordinates corresponding to the international border are predefined and input into the Arduino sketch.

- A threshold distance from the border is established to trigger alerts, enhancing proactive monitoring.

3. Alert Triggering Mechanism:

- The Haversine formula is implemented to calculate the distance between the current GPS coordinates and the predefined border coordinates.

- When the boat approaches the threshold region, the system triggers an alert using a buzzer connected to one of the Arduino's digital pins.

4. Motor Deacceleration:

- Simultaneously, the motor driver module is activated to deaccelerate the boat's motor, ensuring a controlled response to the border proximity.

5. Battery Optimization:

- The MT3608 voltage regulator efficiently steps up the voltage from a single 18650 battery, optimizing power supply and reducing overall project costs.

6. Charging Module Integration:

- The TP4056 charging module manages the recharging of the battery, ensuring a reliable and continuous power source for the system.

7. System Optimization:

- The implementation includes optimizations such as reduced latency in coordinate calculations and the elimination of the need for a SIM card for GPS coordinates.

8. Cost Reduction Measures:

- By utilizing cost-effective components like the MT3608 and minimizing the required number of batteries, the project achieves a total expense reduction to less than ₹500.

The implemented system addresses the challenges of maritime safety, providing real-time alerts and motor control based on GPS coordinates. Through careful integration and optimization, the project ensures affordability, efficiency, and enhanced safety for

fishermen navigating the open sea.

4.3 IMPORTED LIBRARIES

#include <SoftwareSerial.h>

#include <TinyGPS.h>

#include <AFMotor.h>

4.4 CODING

4.4.1 LOCATION DATA

The predefined latitude and longitude coordinates representing the international border are structured in a 2-dimensional array. This array, denoted as "coordinates," encapsulates sets of geographical points in the format [[lat1, long1], [lat2, long2], ...]. Each sub-array within this 2-dimensional array corresponds to a specific location on the Earth's surface, providing a clear and organized representation of the predefined border coordinates. This format is integral to the project's implementation, facilitating seamless integration with the Haversine formula for precise distance calculations and ensuring accurate detection of the boat's proximity to the international border.

4.4.2 CODE

- **LIBRARIES:**
    - **SoftwareSerial:** Used to establish a software serial connection for communication with the GPS module.
    - **TinyGPS:** A library for parsing NMEA data from the GPS module.
    - **AFMotor:** A library for controlling motors using the Adafruit Motor Shield.

```
#include <SoftwareSerial.h>
#include <TinyGPS.h>
#include <AFMotor.h>
SoftwareSerial mySerial(A1, A2);
TinyGPS gps;
```

```
AF_DCMotor motor(4);
const int buzzerPin = A0;
```

- **Locations:** A 2-dimensional array containing predefined latitude and longitude coordinates of the international border.
- **rowCount:** Variable to store the number of rows in the "locations" array.
- **prevLat, prevLon:** Variables to store the previous GPS coordinates.

```
long locations[][2] = {{11017987, 76937093}, {11017987, 76937093}, {11017987, 76937093}, {11017987, 76937093}, };
int rowCount = sizeof(locations) / sizeof(locations[0]);
double prevLat = 0.0, prevLon = 0.0;
```

In the setup() function:

```
void setup() {
  pinMode(buzzerPin, OUTPUT);
  Serial.begin(4800);
  while (!Serial);
  Serial.println("Started");
  mySerial.begin(9600);
}
```

- **Loop Function**:
  - Reads data from the GPS module using SoftwareSerial.
  - Parses GPS data using TinyGPS to obtain latitude and longitude.
  - Checks if GPS data has changed significantly to avoid unnecessary processing.
  - Iterates through the predefined locations and calculates the distance between the current GPS position and each border coordinate using the Haversine formula.
  - If the boat is within a danger zone (distance < 15 meters), triggers an alert using the buzzer and deaccelerates the motor.
  - Updates the motor speed and direction based on the boat's proximity to the border.

```
void loop() {
  if (mySerial.available()) {
    char c = mySerial.read();
    if (gps.encode(c)) {
      long lat, lon;
      gps.get_position(&lat, &lon);

      double currentLat = static_cast<double>(lat) / 1000000.0;
      double currentLon = static_cast<double>(lon) / 1000000.0;

      // Check if GPS data has changed significantly
      if (abs(currentLat - prevLat) > 0.00001 || abs(currentLon - prevLon) > 0.00001) {
        prevLat = currentLat;
        prevLon = currentLon;

        bool inDanger = false;

        for (int i = 0; i < rowCount; i++) {
         double distance = calculateDistance(currentLat, currentLon, locations[i][0] / 1000000.0,
locations[i][1] / 1000000.0);

          if (distance < 15) {
            inDanger = true;
            break;
          }
        }

        if (inDanger) {
          Serial.println("You are in danger");
          analogWrite(buzzerPin, 255);
          motor.setSpeed(30);
          motor.run(FORWARD);
        } else {
```

```
        analogWrite(buzzerPin, 0);
        motor.setSpeed(100);
        motor.run(FORWARD);
      }

    }
   }
  }
}
```

- **calculateDistance Function:**
  - Implements the Haversine formula to calculate the great-circle distance between two sets of latitude and longitude coordinates.

```
double calculateDistance(double lat1, double lon1, double lat2, double lon2) {
  const double EarthRadius = 6371000.0;
  double lat1_rad = radians(lat1);
  double lon1_rad = radians(lon1);
  double lat2_rad = radians(lat2);
  double lon2_rad = radians(lon2);

  double dLat = lat2_rad - lat1_rad;
  double dLon = lon2_rad - lon1_rad;

  double a = sin(dLat / 2.0) * sin(dLat / 2.0) +
             cos(lat1_rad) * cos(lat2_rad) *
             sin(dLon / 2.0) * sin(dLon / 2.0);
  double c = 2.0 * atan2(sqrt(a), sqrt(1 - a));

  return EarthRadius * c;
}
```

4.4 SAMPLE OUTPUT

4.4.1 MODEL

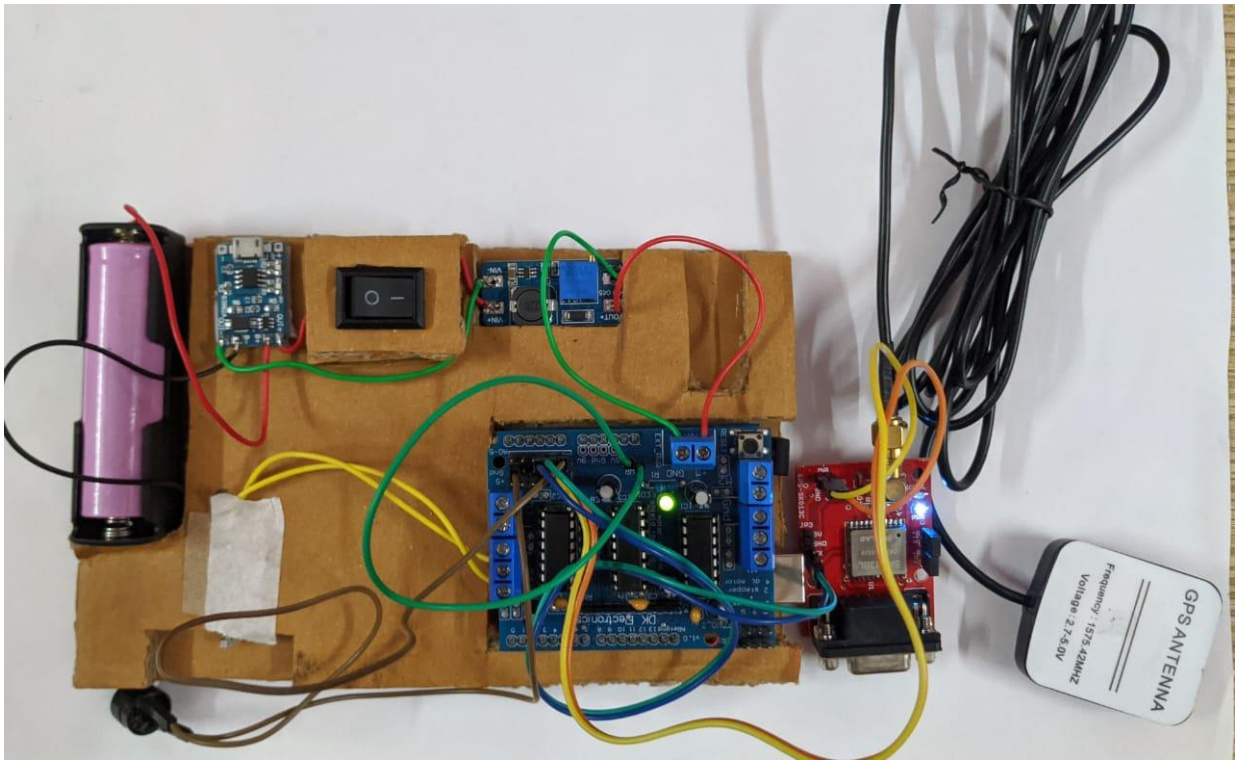

Figure 4.1 MODAL

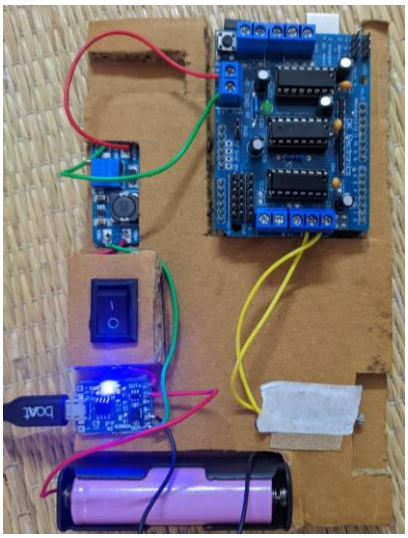

Figure 4.2 When Charging

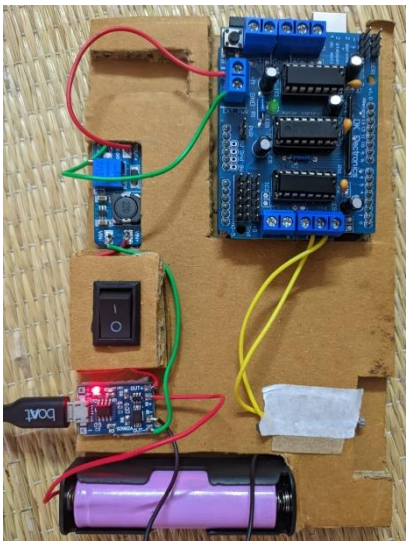

Figure 4.3 Fully Charged

4.4.2 OUTPUT

```
14:33:59.639 -> **********
14:33:59.809 -> Lat:
14:33:59.809 -> 11023610
14:33:59.809 -> Long:
14:33:59.809 -> 76933925
14:33:59.887 -> Distance to location 0 (meters): 63.15
14:33:59.934 -> You are safe
14:33:59.934 -> **********
14:34:00.510 -> Lat:
14:34:00.510 -> 11023608
14:34:00.510 -> Long:
14:34:00.510 -> 76933925
14:34:00.557 -> Distance to location 0 (meters): 63.43
14:34:00.636 -> You are safe
14:34:00.636 -> **********
14:34:00.807 -> Lat:
14:34:00.807 -> 11023608
14:34:00.807 -> Long:
14:34:00.807 -> 76933925
14:34:00.886 -> Distance to location 0 (meters): 63.43
14:34:00.933 -> You are safe
```

Figure 4.4 Safe Zone

```
14:34:20.627 -> **********
14:34:20.799 -> Lat:
14:34:20.799 -> 11023655
14:34:20.799 -> Long:
14:34:20.799 -> 76933968
14:34:20.877 -> Distance to location 0 (meters): 58.11
14:34:20.959 -> You are in danger
14:34:20.959 -> **********
14:34:21.515 -> Lat:
14:34:21.515 -> 11023650
14:34:21.515 -> Long:
14:34:21.515 -> 76933963
14:34:21.562 -> Distance to location 0 (meters): 58.58
14:34:21.657 -> You are in danger
14:34:21.657 -> **********
14:34:21.828 -> Lat:
14:34:21.828 -> 11023650
14:34:21.828 -> Long:
14:34:21.828 -> 76933963
14:34:21.860 -> Distance to location 0 (meters): 58.58
14:34:21.953 -> You are in danger
14:34:21.953 -> **********
```

Figure 4.4 Danger Zone

CHAPTER 5

CONCLUSION

In conclusion, the proposed GPS-based alarm system represents a significant advancement in maritime safety technology. By addressing the limitations of the existing system, including high costs, limited portability, and the absence of an integrated emergency alarm, our solution offers a cost-effective, compact, and efficient alternative. The optimized battery capacity, reduced latency in coordinate comparisons, and elimination of the need for a SIM card further enhance the system's practicality and accessibility. With a total expense reduced to less than ₹500, this project stands poised to contribute to the safety and security of fishermen navigating the open sea, ensuring a more sustainable and efficient maritime experience.

FUTURE WORK

- Integration of Advanced Sensors: Incorporate additional sensors for real-time monitoring of environmental conditions, water quality, and other relevant parameters to provide a comprehensive safety net for fishermen..
- Machine Learning Integration: Implement machine learning algorithms to analyze historical data and improve the system's ability to predict potential safety hazards, providing proactive alerts for fishermen.
- Mobile Application Development: Develop a dedicated mobile application to complement the Web app, offering fishermen a user-friendly interface for real-time monitoring and control of the alarm system.
- User Feedback and Iterative Improvements: Collect feedback from fishermen and stakeholders to identify areas for improvement, ensuring that the system evolves based on practical user experiences and emerging technological advancements.

CHAPTER 6

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