ISSN 2277-2685
IJESR/Jan-Mar. 2025/ Vol-15/Issue-1s/302-308
Sahithi Kancharla *et. al.*, / International Journal of Engineering & Science Research

Border Alert System for Fisherman using GPS and GSM

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Abstract

In day-to- day life we hear news about how many of fishermen being caught and put under custody and even killed across the globe. The sea border between the countries is not easily identifiable, which is the main reason for this cross-border cruelty.

Here we are thought of a solution using embedded system which protects the fishermen by notifying the country border to them by using Global Positioning System (GPS) and Global system for mobile communication (GSM). We use GPS receiver to find the current location of the fishing boat or vessel. Using GPS, we can find the current latitude and longitude values and is sent to the microcontroller unit. Then the controller unit finds the current location by comparing the present latitude and longitudinal values with the predefined value. Then from the result of the comparison, this system aware the fishermen that they are about to reach the nautical border. The area is divided into four zones- normal zone, warning zone, zone near to restricted zone and finally the restricted zone. If the boat is in normal area, then the LCD displays normal zone. Thus, they can make it clear that the boat is in normal area. In case it moves further and reaches the warning zone, the LCD displays warning zone. If the fisherman ignores the warning or fail to see the display and move further, and if the boat enters the zone nearer to the restricted zone the alarm will turn on and the speed of the boat engine automatically gets controlled by 50%. If the fisherman did not take any reaction about the alarm and move further, then the boat will enter into the restricted zone, the alarm continues to beep as before, and once it touches the restricted zone, the boat engine gets off by the control of fuel supply to engine.

1- INTRODUCTION

Fishermen, particularly those operating near international maritime borders, face a significant risk of unknowingly crossing into unauthorized or restricted waters. Such incidents can lead to serious consequences, including arrests, hefty fines, confiscation of equipment, and in extreme cases, political tensions between neighbouring countries. These inadvertent border violations are often a result of the lack of accurate, real-time location tracking and awareness of maritime boundaries, which are not always clearly marked or visible at sea.

With advancements in technology, the use of Global Positioning System (GPS) and Global System for Mobile Communications (GSM) has become a viable solution to ensure that fishermen are constantly aware of their location in relation to international borders. GPS, a satellite-based navigation system, allows users to pinpoint their exact location anywhere on Earth with high accuracy. Meanwhile, GSM provides a reliable means of communication, allowing alerts and messages to be sent in real time when a border breach is imminent.

Despite the availability of these technologies, many small- and medium-scale fishermen, especially in developing regions, lack access to sophisticated navigation systems due to high costs or limited infrastructure. Traditional navigation methods, like using landmarks or rough estimations based on

experience, are not adequate for modern maritime safety requirements.

The Border Alert System leverages both GPS and GSM technologies to provide an affordable, easy-to-use solution for fishermen. This system continuously monitors their location and automatically sends warnings through GSM messages when they approach or cross a designated maritime boundary. By offering real-time alerts, the system helps prevent accidental incursions, ensuring the safety of fishermen and maintaining peaceful relations between neighbouring maritime countries.

2-System Overview and Design

The report covers the basic structure and functioning of the border alert system, including its hardware and software components. It provides a clear explanation of how GPS is used for location tracking and how GSM is used to send alerts. A detailed analysis of the system architecture, including the integration of various components such as the GPS module, GSM module, microcontroller, and user interface, is presented.

Hardware and Software Requirements

The necessary hardware components, including GPS and GSM modules, microcontrollers, and power supply requirements, are discussed in detail. The report also outlines the software needed to run the system, such as location tracking algorithms, communication protocols, and alert generation mechanisms. It explores both the development and implementation aspects of the system.

Working Principle

The report explains the step-by-step working of the system, from detecting the boat's location using GPS signals to generating real-time alerts via GSM when approaching or crossing a border. This section includes the logic behind border detection and the algorithms that ensure the system works efficiently.

System Flow and Algorithm Design

A key part of this report is the flowchart and algorithm design of the system, which shows how the system processes data and responds to location changes. The report details how borders are defined, how the system determines proximity to borders, and how alerts are triggered.

Implementation and Testing

The report covers the implementation of both hardware and software components, along with field testing in real-world environments. It provides insights into the testing process, including the performance metrics used to evaluate system accuracy, reliability, and responsiveness. Results from testing under different conditions are also discussed to validate the effectiveness of the system.

User Interaction and Interface

The user interaction process is detailed, including how the system delivers alerts (e.g., through SMS, buzzer alarms, or visual indicators) and how users (fishermen) can interpret these alerts to adjust their actions. This section highlights the simplicity and user-friendliness of the interface, which is designed for easy use by non-technical users.

Challenges and Limitations

The report examines some of the challenges faced during the development and deployment of the system. These include GPS signal loss in adverse weather conditions, GSM connectivity issues in remote areas, and potential hardware failures. It also identifies the limitations of the system in terms of coverage and scalability, offering insights into areas that require improvement.

3-SYSTEM DESIGN

The Border Alert System for Fishermen is an innovative safety solution designed to prevent accidental violations of international maritime boundaries by providing real-time location tracking and communication capabilities. By integrating Global Positioning System (GPS) technology with Global System for Mobile Communications (GSM),

this system enables fishermen to navigate safely in open waters while receiving timely alerts regarding their proximity to restricted areas.

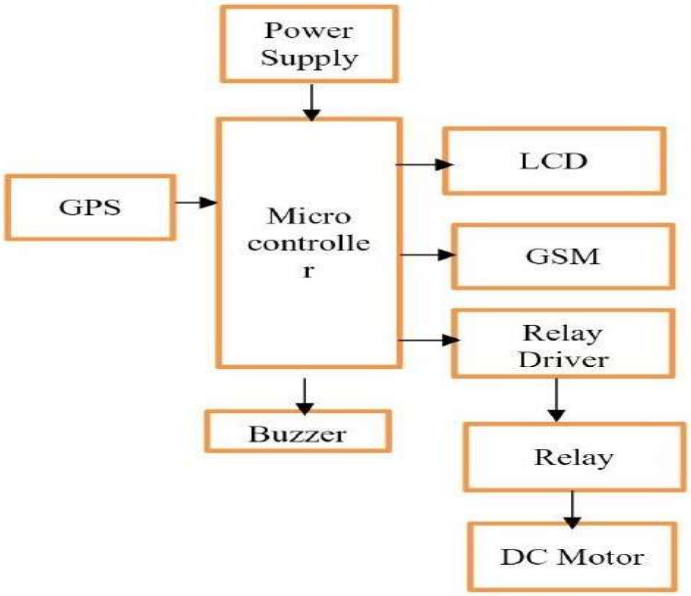

Fig.3. 1. Block Diagram

Key Components of the System

1. GPS Module

The GPS module is responsible for determining the vessel's exact geographical location by receiving signals from a network of satellites. It continuously updates the position of the fishing boat, providing real-time latitude and longitude coordinates. The GPS module serves as the primary source of location data, which is essential for tracking the boat's movement and proximity to international boundaries.

2. GSM Module

The GSM module facilitates communication between the system and the fishermen. It allows the system to send alerts via SMS or audio notifications when the vessel approaches or crosses predefined maritime boundaries. This module plays a critical role in ensuring that fishermen receive immediate warnings, enabling them to take corrective actions.

3. Microcontroller

The microcontroller acts as the central processing unit of the system, coordinating the functions of the GPS and GSM modules. It processes location data received from the GPS module and determines when alerts need to be triggered based on the vessel's position relative to set geofences (virtual boundaries). The microcontroller also manages the communication between the system and the user interface, ensuring smooth operation.

System Architecture

The architecture of the Border Alert System for Fishermen is designed to integrate hardware and software components to create a seamless, efficient, and reliable system for tracking the location of fishing vessels and communicating alerts in real-time. The system architecture consists of three major layers: the Input Layer (sensing and data acquisition), the Processing Layer (data computation

and decision-making), and the Output Layer (communication and user interface).

4-SYSTEM IMPLEMENTATION

4.1 Hardware Implementation

Overview of Components

The hardware implementation begins with the selection of critical components that will function together seamlessly to ensure reliability. Central to the system is the GPS Module (e.g., NEO-6M), which provides real-time location data by calculating the vessel's latitude and longitude. This data is essential for tracking whether the vessel remains within permissible boundaries. The GSM Module (e.g., SIM800L) allows the system to send SMS alerts to predefined emergency contacts whenever the vessel approaches or crosses the border. The Microcontroller (such as Arduino Uno) acts as the central processing unit, integrating data from the GPS and GSM modules and executing the necessary alert logic.

Power Supply and Additional Components

To ensure continuous operation during fishing trips, a Power Supply must be integrated, which can either be a rechargeable battery or a solar power system. Additional components, can be included to provide useful data about the fishing environment, aiding operational decisions. A Display Unit provides real-time status updates, allowing fishermen to monitor their location and alerts easily. Furthermore, Buzzer and LED Indicators serve as local alarms, providing immediate, audible, and visual alerts when the vessel nears the border.

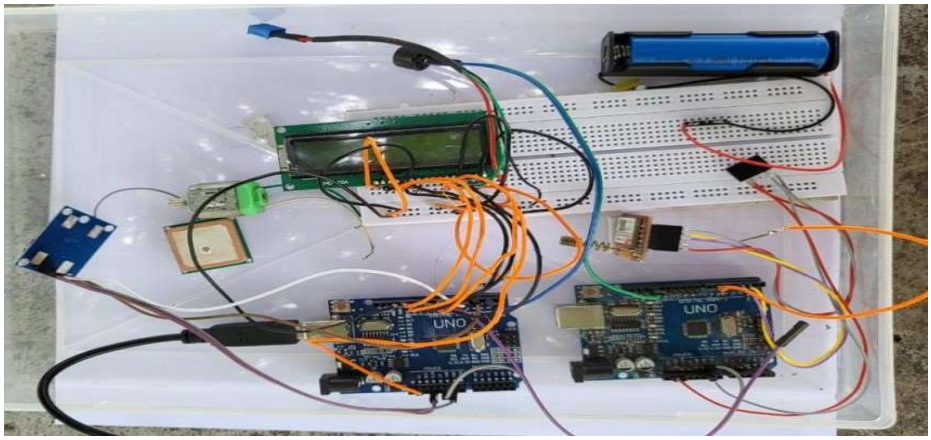

Fig.4. 1.Board Level Circuit Design

Wiring and Assembly

After gathering the necessary components, the next step involves wiring and assembly. Detailed connection diagrams must be developed to illustrate how each component connects to the microcontroller. For example, the GPS module's TX pin connects to the RX pin of the microcontroller, along with power (VCC) and ground (GND). The GSM module follows a similar connection process, interfacing with the microcontroller's serial pins while ensuring voltage compatibility. The display unit can connect via I2C or direct pin connections, depending on the type of display used. Once the wiring is complete, all components must be securely mounted in a waterproof enclosure to protect them from harsh marine conditions. Careful attention should be paid to the GPS module's placement to ensure it has an unobstructed view of the sky for optimal signal reception.

Testing Hardware

Testing the hardware is critical and involves several steps. Initially, each component should be tested individually to verify functionality, assessing GPS signal strength and GSM network connectivity. Once individual components are confirmed to work, integration tests should be conducted to ensure that all modules communicate effectively. This process may involve programming the microcontroller to read data from the GPS and attempt to send SMS alerts via the GSM module. Finally, preliminary field tests should be carried out to evaluate hardware performance under real maritime conditions, allowing for adjustments based on observations.

4.2 Software Implementation

Development Environment Setup

The software implementation involves creating a robust program that enables the system to function as intended. The first step is to set up a suitable development environment, which differs depending on the chosen microcontroller. For instance, Arduino IDE is ideal for programming Arduino boards, while Thonny or other Python-compatible IDEs can be used for Raspberry Pi. Once the development environment is established, necessary libraries must be installed. The `Tiny GPS` library is commonly used for GPS data parsing, while the `GSM` library facilitates SMS communication.

5- Results

Border alert system for fishermen is used to detect the boundary location and warn the fishermen in danger situations. It not only finds the GPS value, but also compares with the stored value in the microcontroller, and makes a decision as to whether the fishermen is in the warning range or not

LCD Results:

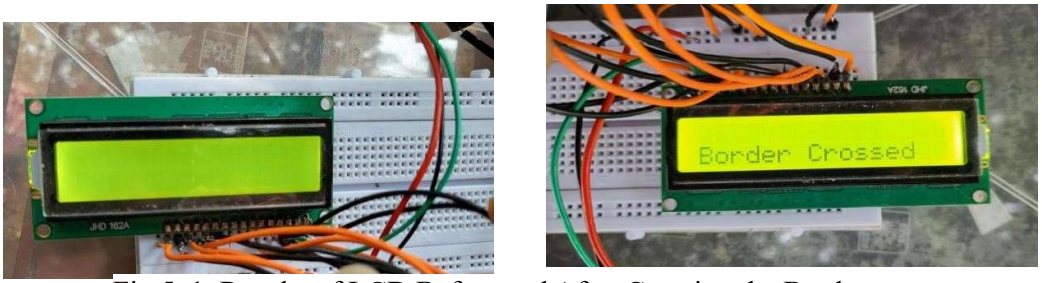

Fig.5. 1. Results of LCD Before and After Crossing the Border

6-ADVANTAGES, DISADVANTAGES AND WORKING

5.3.1 Advantages:

Enhanced Safety

1. Provides real-time alerts for boundary breaches, helping fishermen avoid illegal crossings into restricted waters.
2. Reduces the risk of accidents or collisions by ensuring situational awareness.

User-Friendly Interface

1. Typically designed to be intuitive, making it accessible even for users with limited technical knowledge.
2. Visual and audible alerts ensure that users can quickly respond to notifications.

Remote Monitoring

1. Enables fishermen to monitor their location and the surrounding area even in remote maritime environments.
2. Allows for tracking of multiple vessels, enhancing fleet management capabilities.

5.3.2 Disadvantages:

Dependence on Signal Availability

1. Performance is reliant on GPS and GSM signal strength; poor connectivity can result in missed alerts or inaccurate location data.
2. Limited functionality in remote areas with weak or no cellular coverage.

Battery Life Concernd

1. Continuous use of GPS and GSM can drain battery life, requiring regular recharging or alternative power solutions.
2. Fishermen may need to invest in additional power sources, such as portable chargers or solar panels.

Privacy Concerns

1. Continuous tracking raises potential privacy issues, as location data could be accessed by unauthorized parties.
2. Users may be wary of sharing their location data with third parties.

5.3.3 Applications:

Commercial Fishing

1. Primarily used by commercial fishermen to ensure compliance with fishing boundaries and enhance safety during operations.
2. Helps businesses optimize routes and improve fleet management.

Recreational Fishing

1. Used by recreational fishermen to avoid restricted areas and ensure legal compliance.
2. Provides peace of mind for anglers who fish in unfamiliar waters.

Coastal and Marine Research

1. Useful for researchers tracking fish populations and migratory patterns, aiding in conservation efforts.
2. Helps gather data on fishing practices and their impact on marine ecosystems.

7-CONCLUSION

The implementation and testing of the border alert system for fishermen using GPS and GSM technology have highlighted its significant potential to enhance safety in maritime operations. The system effectively detects boundary breaches, providing timely alerts to fishermen and enabling them to avoid legal complications associated with unintentional crossings into restricted waters. Testing confirmed the accuracy of the GPS module and the reliability of the GSM alerts, with the system demonstrating resilience in various environmental conditions.

User feedback has been overwhelmingly positive, with fishermen finding the system intuitive and easy to operate. Training sessions proved beneficial in familiarizing users with the functionality and features of the system. However, areas for improvement were identified, particularly regarding GSM connectivity in remote locations and the need for enhanced robustness against environmental factors. These insights will inform future iterations of the system, ensuring that it evolves to meet user needs effectively.

Overall, the border alert system stands as a valuable tool for the fishing community, enhancing operational safety and efficiency. Continuous monitoring, regular updates, and incorporating user feedback will be vital for maintaining the system's effectiveness and ensuring that it adapts to the dynamic challenges faced by fishermen at sea. By prioritizing safety and usability, this system has the potential to significantly contribute to the well-being of those who rely on fishing for their livelihoods.

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