

# Design and Development of a Boundary Alert System for Fishermen

Zalak Thakrar<sup>1\*</sup>, Atul Gonsai<sup>2</sup>

## Abstract

*This study presents the design and development of a Boundary Alert System for fishermen, employing the Flutter programming language. The system utilizes International Maritime Boundary Line (IMBL) The maritime border system was initiated and developed by the United Nations Convention of the Law of the Seas (UNCLOS). When a fishing vessel approaches within 500 m of these boundaries, the system triggers visual and auditory alerts for the fishermen and sends text notifications to boat owners. This technology enhances safety and compliance with maritime regulations, contributing to the well-being of fishermen and the sustainability of the fishing industry. The implementation of the Boundary Alert System introduces a proactive approach to maritime safety and regulatory compliance within the fishing industry. By harnessing the capabilities of Flutter and the IMBL, this technology not only ensures the safety of fishermen but also promotes sustainable practices in the fishing industry. The proposed system represents a significant step towards the integration of modern technology to address challenges faced by the maritime community, ultimately contributing to the broader goals of maritime governance and conservation.*

**Keywords:** Boundary alert system, IMBL, international maritime boundary line, Google Maps, fishermen safety, mobile application, maritime border

## INTRODUCTION

Fishing is a critical livelihood for many coastal communities worldwide, but it often involves navigating complex maritime boundaries and regulations. To improve safety and compliance among fishermen, we have developed a Boundary Alert System using Flutter, which leverages International Maritime Boundary Line (IMBL) coordinates to create visual boundaries on Google Maps [1, 2]. When a fishing vessel approaches within 500 m of these boundaries, the system issues visual and auditory alerts to fishermen and sends text notifications to boat owners.

### \*Author for Correspondence

Zalak Thakrar  
E-mail: [Zalak.thakrar@gmail.com](mailto:Zalak.thakrar@gmail.com)

<sup>1</sup>Assistant Professor, Department of Computer Science, Shri V.J. Modha College of Information Technology, Porbandar, Gujarat, India

<sup>2</sup>Professor, Department of Computer Science, Saurashtra University, Rajkot, Gujarat, India

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Fishing is a vital economic activity for many coastal communities worldwide [3]. However, it often involves navigating challenging conditions at sea, which can pose significant risks to fishermen's safety. One common issue that fishermen face is unintentional entry into restricted or dangerous zones, such as marine protected areas, territorial waters of other countries, or hazardous weather zones. To address these challenges and enhance the safety and productivity of fishermen [2], we have developed a Boundary Alert System using the Flutter programming language.

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The Boundary Alert System is designed to provide fishermen with real-time alerts when they approach a predetermined boundary or restricted area. Additionally, it sends notifications to boat owners, allowing them to monitor their vessels' locations and intervene in case of boundary breaches. The system relies on GPS technology to determine the location of the fishing vessel and uses sound alerts and text notifications for communication.

An article published by the Porbandar Observer in India on September 3, 2023, titled "Illegal fishing impacts revenues: Gujarat fisheries," indicates that illegal fishing is affecting the growth of the fishing sector [4]. So, it is very essential to erase these kinds of activities through modern technological developments. As per various pieces of literature, there is a heavy demand for technological advancements in the fishery sector, which this study addresses to a larger extent. From the above discussions, some of the various issues which are constantly faced by the vessels can be listed as follows:

### **Unintentional Border Crossings**

One of the foremost challenges stems from unintentional border crossings, either due to navigational errors or misguidance. Such occurrences not only pose a risk of violating maritime regulations but also escalate the potential for diplomatic disputes. The Boundary Alert System aims to address this concern by providing real-time alerts to fishermen when their vessels approach within 500 m of designated boundaries, thus preventing inadvertent border violations.

### **Piracy Attacks and Security Risks**

Fishermen are often exposed to the grave threat of piracy attacks, which may occur unexpectedly, leading to loss of life, injuries, and damage to property. By incorporating the Boundary Alert System, timely warnings are issued to fishermen as they approach potentially hazardous areas, enabling them to take evasive actions and avoid regions prone to security risks.

### **Unknown Environmental Conditions**

The unpredictable nature of environmental conditions at sea presents a constant challenge for fishermen. Unforeseen changes in weather patterns, sea currents, and other environmental factors can jeopardize the safety of fishing vessels. The developed system enhances situational awareness by integrating real-time weather data, allowing fishermen to navigate with a comprehensive understanding of their surroundings.

### **Unknown Wind Speed and Storms**

Lack of information about wind speed and the potential for sudden storms can expose fishing vessels to perilous conditions. The Boundary Alert System integrates real-time meteorological data to provide accurate information about wind speed, enabling fishermen to anticipate and navigate through adverse weather conditions safely.

### **Oil Spills and Fire Safety**

Oil spills pose a significant threat to maritime safety, not only due to environmental concerns but also because of the increased risk of fires. The system addresses this issue by raising awareness among fishermen about areas with a higher likelihood of encountering oil spills, thereby promoting proactive fire safety measures.

### **Illegal Fishing and Economic Impact**

The study recognizes the adverse effects of illegal fishing on the economic growth of countries and the fishing sector. By implementing the Boundary Alert System, authorities can monitor and curb illegal fishing activities effectively, ensuring sustainable practices and fostering economic growth in the fishing industry.

## LITERATURE REVIEW

This study conducts a survey on several GPS-based techniques for monitoring and warning marine fishermen. Fishermen use navigation as their most crucial tool when at sea. The tracking system makes use of the electronic equipment installed aboard a ship, along with software that enables the user or owner to track the location of the ship using latitude and longitude information. The Global Positioning System (GPS) is a modern navigational tool that is safe to use. Using a GPS receiver, the position and location data can be viewed on an electronic map [5].

Since it is difficult to quickly distinguish the maritime borders of any two countries while fishing, maritime border collisions are one of the major problems in coastal states. The recognition and observation of boats inside a country's border are necessary for maritime domain awareness and border line management. The marine border must be recognized in order to warn fishermen while they are fishing. In this study, we suggest an Automatic Identification System (AIS) that, by alerting the nation's border, might safeguard fisherman. They will receive a VHF notice if they are getting close to the International Maritime Border Line (IMBL). AIS can locate a place using the built-in GPS and send that location to embedded systems, which collect the most recent position by comparing autonomous and longitudinal parameters with the current evaluation. The suggested approach is tested using a case study in the Gulf of Mannar, which forms the maritime border between India and Sri Lanka. It has been discovered that fishermen can be alerted visually and audibly when they are getting close to the nautical border. Then, guardians of the coastline provide support and further assistance to those fishermen. Additionally, this system offers collision avoidance by utilizing AIS and ultrasonic sensors [6].

Due to a lack of ocean boundary awareness and modern warning gadgets on boats, the neighboring country's naval forces are catching and killing fishermen. Maritime security has been a key issue of all coastal communities to safeguard fishermen and support sea borders through boat vessel warning, tracking, and monitoring. Thus, a smart vessel-based marine border warning system would let coast guard officers watch fishermen and inform them if they cross borders. The border warning system protects fishermen and improves ties between coast countries. This technique employs GPS to determine vessel latitude and longitude. This alarm system alerts fisherman by audible and visual methods if they are near to IMBL. During warnings, if the fisherman does not respond and move, the smart vessel should reverse and notify local coast guard officers. Next, the guards may aid the fisherman further. The Gulf of Mannar maritime boundary between India and Sri Lanka is used to verify the proposed approach [7].

The challenges faced by fishermen in coastal areas, particularly the inadvertent crossing of maritime borders leading to arrests and imprisonment, underscore the critical need for heightened awareness. The proposed system addresses this issue by providing an alternate source for avoiding such accidents. By integrating an alarm system to alert fishermen about border areas and implementing an automatic turning mechanism using RF technology, the system serves as a comprehensive solution. Even in instances where the alarm system may fail, the fail-safe feature ensures that the boat can autonomously steer away from potential border violations. This innovative approach not only enhances the safety of fishermen but also contributes to the sustainable and secure practice of their occupation, aligning with the broader goal of fostering a more informed and protected fishing industry [8].

In essence, our application serves as a vital tool for individuals navigating border areas, ensuring a safe path to their destinations. Operating as a centralized system, notifications are relayed to border security forces, acting as servers for all user-operated devices on ships. The application not only tracks device locations but also promptly informs users about potential issues arising from opposing forces at sea. Primarily designed for Tamil fishermen working in border regions, this incident management application includes an automatic alarming system to promptly address concerns. Its user-friendly design, centered around device tracking, makes it accessible even for those with limited literacy, fostering widespread utilization for enhanced safety and conflict avoidance in various situations [9].

In regions with an International Maritime Boundary Line (IMBL), fishermen face persistent security threats and life-endangering situations, especially in countries like India where coastal communities heavily rely on fishing for their livelihoods. Unaware of their country's oceanic boundary limits, fishermen often unintentionally cross borders, risking their lives as they encounter opposing navies. Our study addresses this perilous scenario by leveraging cutting-edge technology, specifically the Global Positioning System (GPS) and Global System for Mobile Communication (GSM), to proactively avoid such accidents and provide early alerts to fishermen about border areas. Beyond enhancing maritime safety, the study highlights the dual application of this technology in detecting natural hazards and obtaining crucial meteorological information, further ensuring the secure navigation of fishermen in the often challenging oceanic environment [10].

## **SYSTEM ARCHITECTURE**

The Boundary Alert System comprises two key components: a mobile application for fishermen and a web-based dashboard for boat owners. The system employs the following technologies and features:

### **Mobile Application (Fishermen)**

The mobile application serves as the primary interface for fishermen and offers the following functionalities:

#### ***IMBL Boundary Display***

The application utilizes IMBL coordinates to draw boundaries on Google Maps, visually representing international maritime boundaries and other restricted areas.

#### ***GPS Tracking***

Continuously tracks the GPS location of the fishing vessel to determine its proximity to boundaries.

#### ***Boundary Alerting***

When the vessel approaches within 500 m of a boundary, the application triggers visual alerts on the mobile device, such as flashing icons and messages. Simultaneously, it emits an audible alert to ensure immediate attention.

#### ***Emergency Button***

In case of emergencies, fishermen can use an emergency button to send distress signals to the boat owner and relevant authorities.

### **Web-Based Dashboard (Boat Owners)**

The web-based dashboard is accessible to boat owners and provides the following features:

#### ***Vessel Monitoring***

Allows boat owners to monitor the real-time location of their vessels on Google Maps, along with the displayed boundaries.

#### ***Boundary Setup***

Boat owners can define and customize boundary zones for their fishing vessels using IMBL coordinates.

#### ***Boundary Breach Alerts***

In the event of a boundary breach, boat owners receive immediate text notifications on their mobile devices. This enables them to take necessary actions to ensure compliance with regulations and safety.

## **IMPLEMENTATION DETAILS**

The Boundary Alert System is implemented using the Flutter framework, known for its cross-platform compatibility and user-friendly interface design. Key implementation details include:

### **IMBL Data Integration**

The system integrates IMBL data, which contains latitude and longitude coordinates for international maritime boundaries, enabling the dynamic display of these boundaries on Google Maps.

### **GPS Integration**

The mobile application utilizes the device's GPS sensor to continuously fetch the vessel's real-time coordinates.

### **Boundary Detection**

The system calculates the distance between the vessel's location and the displayed boundaries. When the distance falls below 500 m, it triggers visual alerts and sound alerts on the mobile device.

### **Text Notifications**

In addition to visual and auditory alerts, the system sends text notifications to the registered boat owner's phone number using a secure API.

### **CONCLUSION**

The Boundary Alert System developed using Flutter, IMBL data, and Google Maps integration enhances the safety and compliance of fishermen operating in complex maritime environments. By providing real-time boundary alerts, visual cues, and sound alerts to fishermen and notifying boat owners of boundary breaches via text messages, this technology significantly contributes to the safety and sustainability of the fishing industry.

Future work may involve further customization options for boundary configurations, integration with weather and ocean condition data, and expansion to include additional safety features. The development of such systems is crucial to protect fishermen, their vessels, and marine ecosystems while ensuring the continued prosperity of fishing communities.

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### **REFERENCES**

1. Binder C. Border disputes through ill-defined borders: maritime territorial conflicts and their impact on security. *Border Politics: Defining Spaces of Governance and Forms of Transgressions*. Cham: Springer; 2017: 33–50.
2. Saravanan K, Aswini S, Kumar R, Son LH. How to prevent maritime border collision for fisheries? - A design of Real-Time Automatic Identification System. *Earth Sci Inform*. 2019 Jun 1; 12(27): 241–52.
3. Karuppasamy S, Ashitha TP, Padmanaban R, Shamsudeen M, Silva JM. A remote sensing approach to monitor potential fishing zone associated with sea surface temperature and chlorophyll concentration. *Indian J Geo Mar Sci*. 2020 Jun; 49(06): 1025–1030.
4. Pramod G. *Illegal, unreported and unregulated marine fish catches in the Indian exclusive economic zone, field report, policy and ecosystem restoration in fisheries*. Vancouver: Fisheries Centre; 2010.
5. Aruli K, Asha J, Nizar SM, Malathi M. A Review on GPS Tracking and Border Alert System for Fishermen. *International Journal of Science Technology & Engineering (IJSTE)*. 2015 Nov; 2(5): 1–3.
6. Townsley M, Leclerc B, Tatham PH. How super controllers prevent crimes: Learning from modern maritime piracy. *Br J Criminol*. 2016 May 1; 56(3): 537–57.

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7. Rajalakshmi NR, Saravanan K. Fisherman communication at deep sea using border alert system. In *Intelligent Computing in Engineering: Select Proceedings of RICE 2019*. Singapore: Springer; 2020; 283–295.
  8. Niveda S. Implementation of Boundary Alert system for Fishermen. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*. 2021 Jun 23; 12(9): 991–5.
  9. Kumar RD, Aldo MS, Joseph JC. Alert system for fishermen crossing border using Android. In *2016 IEEE International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT)*. 2016 Mar 3; 4791–4795.
  10. Ranjith S, Shreyas K, Kumar K, Karthik R. Automatic border alert system for fishermen using GPS and GSM techniques. *Indones J Electr Eng Comput Sci*. 2017 Jul; 7(1): 84–9.