

# Fisherman Navigation and Safety System

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**Abstract:** *The fisherman's crossing the borders and identification of locations in the sea is becoming a difficult task with existing equipment's provide to the fisherman's as a result they cross the borders. In our day-to-day life we hear about many Tamil Fishermen being caught and put under Sri Lankan Naval custody. The sea border between the countries is not easily identifiable, which is the main reason for this offence. Moreover, in cases of imminent natural disasters, failure or delay in notifying concerned personnel to evacuate results in loss of life on a large scale. In this paper we have proposed a method which protects the fishermen by logging their entries and exits in the harbour using embedded system, notifying the country's sea border to them by using Global Positioning System (GPS), GeoFencing and Mobile Systems. We use GPS as a method to track the current location of the fishermen. The GPS current latitude and longitude coordinates are sent to the database where the administrator utilizes it for continuous tracking and monitoring of the user, if in distress using their credentials and last known location, current location predictions can be made. Another benefit being the logging procedures help official authoritative agencies to identify fishermen and their activities for their own safety and security.*

**Keywords:** Navigation, GPS, Geofencing, Mobile System, Security

## I. INTRODUCTION

The fishermen of Tamil Nadu, even today invoke their historical rights and routinely stay into the International Maritime Boundary Line for fishing. From Tamil Nadu about 18,000 boats of different kinds conduct fishing activities along the India-Sri Lanka maritime border but by accidentally crossing the border without knowledge, they are either caught or shot by the Sri Lankan Navy on the basis of Border Law Violation. The seaborder between the countries is not easily identifiable, which is the main reason for this offence. Moreover, in cases of imminent natural disasters, failure or delay in notifying concerned personnel to evacuate the area, results in loss of life and affects the economic incomes on a large scale. Over the years GPS (Global Positioning System) Technology has become an important feature in people's lives. With the availability of such a feature in the hands of the people, it has enabled them to locate themselves on a global scale and get an idea of the nearby surroundings. Earlier, in simple embedded location tracking systems two components were prominent GPS and GSM module.

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This system was designed to send GPS logs to the required recipient via the short message service (SMS) provided by the GSM module. These days with wide spread of GPS embedded mobile devices usage being increased exponentially, the purpose of a separate dedicated embedded system modules such as GPS and GSM for location tracking is no longer used since all these functionalities are now housed in a single mobile device. According to an analysis performed by ABI Research in 2014, 9 out of 10 smart phones are expected to have a GPS chip on them. So it's safe to assume that GPS technology will play a major role in people's daily lives, a similar statement being issued by General Manager of Nokia, Singapore with the statement being "Location based services and experiences will become a fundamental part of mobile phones" Applications for location based tracking for commercial purposes such as food delivery, cab services, transit tracking etc. do exist however similar tracking feature for safety and security are seldom. As mentioned with the widespread smartphone usage, it is safe to assume that even a common man or fishermen in our case can afford a smartphone with decent features such as GPS etc. Since the sophisticated equipment for location tracking in the sea is costlier when compared to mobile phone, we have proposed a system which would track the fishermen's location using their GPS on their mobile phones provided they are within a 10 - 15 mile range from the sea shore along with a dedicated server at the harbour used for authenticating the fishermen for their movement in the sea and back while maintaining a log file for their fishing trip

## II. EXISTING TECHNOLOGY

The existing technology comprises of RADAR/Satellite are based optimized search for vessels near victim vicinity. When a distress message is broadcasted by the victim or any emergency situations are reported to the MRCC, the vessels in the vicinity range of the victim are reported by MRCC (Maritime Rescue Coordination Centre). It is a Government entity which has the RADAR/Satellite position of all sea vessels and hence they intimate the nearest vessel/ship to aid the search and rescue. The equipment's which are used for distress signalling like EPIRB (Emergency Position Indicating Radio Beacon), SART (Search and Rescue Transponder) are a standard for Global Maritime Distress and Safety System (GMDSS) which are available on high end or top notch ships but these equipment's are not affordable by mere fishermen.

This existing technology has few drawbacks such as

## Lack of feasibility

The existing technologies used are available only on Ships and Sea vessels of top notch quality or stature or are available only with Official Authorities. However these technologies are not easy affordable by mere fishermen since the cost of these safety equipment's are very costly

## Activated only in emergencies

Safety equipment's which are used for signalling like Emergency Positioning Indicating Radio Beacon, Emergency Locator Transmitter, Personal Locator Beacon, Search and Research Transponder are activated only during emergency protocols since they are search and rescue equipment and not real time tracking devices. Hence, it's difficult to ensure the safety of the fishermen

## No logging data of personnel in harbour

Here is no logging information regarding the fishermen in sea (or those who are about to leave the harbour) with the official authorities, due to which it becomes difficult for the authorities to identify the fishermen in crisis (victim). With the proper logging information of the fishermen and their activities such as entering or exiting the harbour, it is easier to log their flow in the sea and identify the missing fishermen, if needed or for any other safety reasons

## Difficulty in broadcast communications

It is difficult for a common fisherman to communicate with authorities in times of distress due to lack of broadcast radio communications or any other form of communication. The sophisticated equipment's of communication are not feasible for the common fisherman as already mentioned, hence it becomes impossible for them to send a distress signal to the authorities.

## III. EXISTING SOLUTION

In the paper with title "GPS based tracking system for transit objects" by Dhinakaran K, Srinath S, Sriram S, Venkateshwar R provided a solution that proposes a tracking system which could aid the safety of women and physically challenged people while traveling from one place to another. A list of desired contacts would be intimated when the user is found to go in an undesired course of route. The user's uses a mobile application that broadcasts their position to their desired contacts and intimates the user location at regular intervals. In paper title "design and implementation of a gps-enabled mobile wireless sensor network for livestock herd tracking in mongolian nomadic herding" by sung-gichoi, ganzorigchimeddorj, baljinnymaltankhuyag, sarantuyadunkhorol provided a solution describes the designing and implementation of a wireless sensor network system which is gps enabled, used for tracking the location of the herd in nomadic herding. The proposed system contains a mobile main node which is mounted on the herd's leader and keeps track of the presence of its members by communicating with the wireless sensor module which is present with each member and this network is graphically represented on a web browser using google maps api.

In the paper title "geofencing for fleet and freight management" by Fabrice Reclus, Kristendrouard provides the

solution deals with a virtual geographic fencing technology in which tracking and tracing systems are used for enforcing heavy good vehicles (HGV) regulations such as height and weight restrictions for specific routes such as tunnels, bridges, transport restrictions etc. When the vehicle exits or enters the geographical fence the event occurred is sent to the respective control centre. Applications of this system include defense and security, traveling and logistics, fleet and freight management, proximity to the point of interest and more.

In the paper title "overview and an approach for qr-code based messaging and file sharing on android platform in view of security" by Altaf T Shah, Vikram Singh R Parihar provides the solution discusses the need for a new competent messaging and file sharing techniques in android smart phones due to an increase in demands of such devices. The author(s) also give an overview of the existing techniques of secure messaging and file sharing in such devices using internet / data through qr (quick response) code for hiding and integrity purposes and have also suggested their approach which incorporates rsa algorithm for encryption, md5 algorithm for integrity check while reducing the use of mobile data using qr (quick response) code for sharing messages or files over the internet.

In the paper title "a novel approach of geofencing and geotagging system based sea border identification using embedded system" by K. Prabhakaran, N. Rajkumar, G. Punita, Sabanaasmi, Paulchamy provides the solution majorly focuses on avoiding the unintentional crossing or navigation beyond the international sea border. This paper proposes a system that has two units: control and guiding unit. The guiding unit is an embedded system with a gps module which utilizes a gsm interface transmitter that sends messages to the shore's base station generating an alarm to alert that either the fisherman has crossed the border or it's an emergency broadcast and might require further assistance. Moreover the signal is also processed locally and the alert is given to the user in a form of voice synthesized and the message given through speaker in the local language. The control unit is placed on the lighthouse for communicating with the guiding unit. This unit can also be used for transmitting emergency broadcast signals for the fishermen informing them about whether conditions such as rains, cyclone, tsunami or for evacuating and restricting certain areas for confidential purposes.

## IV. SYSTEM DESIGN

The figure 1 describes the system design flow, the whole system comprises of three modules. They are:

- **Client Module**, which is the smart phone application at the fishermen / users' end.
- **Server module**, a standalone server made from Raspberry Pi for authentication and security purposes.
- **Administrator's system module**, to monitor and control the client's activity.

Accessed by the Official Authorities.

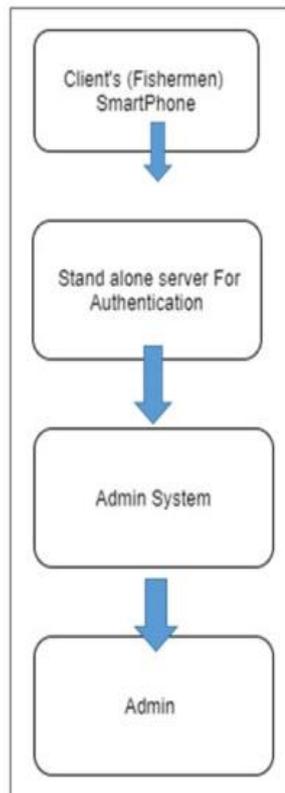


Fig. 1 System Design flow

### Client Application

This is the client application which helps the clients to receive alerts when they reach the borders of international waters with the help of geofencing while simultaneously sharing their GPS coordinates to the administrator by continuously updating the values in the real-time database at a specific time interval. The application also gives warning sound alerts from the phone's speaker if the user / fisherman is about to approach or has crossed the sea border. The client application uses the phone's camera as a QR code scanner which scans the QR code generated by the Pi Server and if the code matches with the IMEI of the registered device then the person is authorized to enter the sea or exit the previous fishing activity.

### Server Module

A standalone server is made to ensure authorized entry and exit in the harbour and sea waters. This server is built using a Raspberry Pi connected to the firebase real-time database which generates a QR code of the IMEI number of the client's handset with the help of a pin allotted to the handset while registering in application. The Pi accepts the user's 5 digit pin and if the pin matches with the pin registered in the database, it will return a QR code representing the encoded IMEI number which will be further used for scanning and authentication.

### Administrator System Module

The Administrator system module has control over all the systems. It utilizes a web interface with Google Maps API to track and monitor the location of each fisherman and also maintain a real time database for observing their travel logging time. Each time a fisherman enters or exits the harbour their data is logged in the real-time database

thereby easing our task of identifying the missing fishermen during emergency search and rescue operations (if any) and provide the victim's personal data such as name, age etc along with their last known location. The administrator system module also consists of a separate page which contains a list of joining requests for each fisherman who has registered. This gives the administrator the authority to validate and verify the identity of the fishermen by analysing their personal identification documents (AADHAR) submitted during the registration process and can grant them the access to use the application if the submitted documents are found to be genuine. When this procedure is completed, the User's Private Pin will be generated and given to the user. The pin will be generated if and only if the administrator approves their joining request.

### V. WORKING PRINCIPLE

The methodology which we are proposing in this paper utilizes feasible hardware and software and also requires minimum user intervention with the application. The User Private Pin generates the necessary specific QR code for authentication to start or end their off-shore. After entering the User Private Pin, a QR code is generated, when the QR code is scanned with the registered device it returns a successful authentication. After completing the logging procedure, if it is a login procedure (start trip) then the application initiates the periodic GPS tracking process and stores the GPS coordinates of the user (fishermen) in the real time database which are utilized to plot their presence offshore on administrator web interface, and also checking the conditions of the geofence whether the fishermen are within the geofence or are approaching the fence end, if it's the latter case then it implies that they might cross the international border. So in such a scenario the user will be intimated about their location and their proximity to the international sea border and alerting them to change their course. The geofence radius is purposefully set a 5 miles lesser than the actual radius of the border's fence (a point of the actual sea border which lies on the circumference of this fence). Since exiting this actual fence would be violating the sea border law hence it is better to restrict the user / fishermen before they approach the actual border itself. If the fishermen are in distress we can predict where the fishermen is or will be and with the log details we can identify the victim. The system overall monitors their fishing schedules, and ensures that they do not enter international waters or cross the international borders and also provides a means of broadcasting emergency message related to weather warnings such as rains, storms etc or for intimating about restricted areas. The figure 2 provides the registration forms and figure 3 provides the authentication and geofence model

Registration (1 of 2)

First Name:  
First Name

Last Name:  
Last Name

Phone No:  
Phone No

Aadhar Number:  
Aadhar No

Address  
Address

UPLOAD YOUR AADHAR CARD PHOTO

UPLOAD YOUR PHOTO

Registration (2 of 2)

Preferred Email ID:  
your\_choice\_email\_id@friends.co

Password  
Password

Confirm Password:  
Confirm Password

REGISTER

Fig. 2 Registration forms

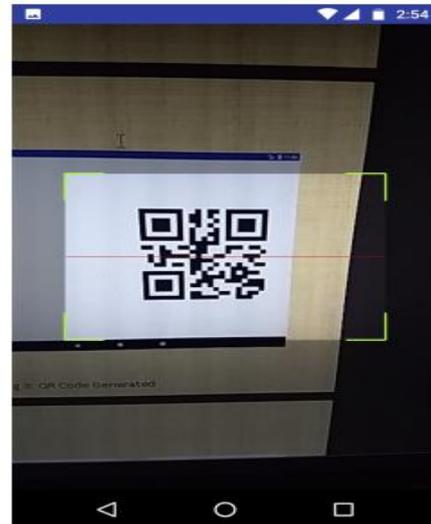
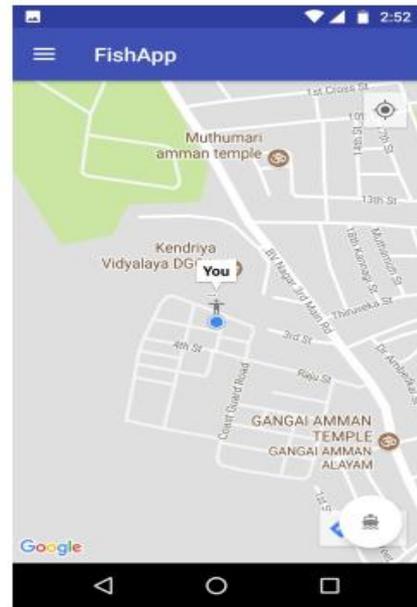


Fig. 3 Authentication and Geofence Model

## VI. FUTURE ENHANCEMENTS

- Implementing appropriate Machine Learning algorithms to teach a system the daily fishing patterns of all the domestic vessel to identify irregularities thereby classifying between native and non-native vessels activities.
- Provide an easier interaction interface between the fishermen and the appropriate government agencies. i.e; Customer Support Enhancements.
- Native Language Support for both application texts as well as vocal warning alerts.
- Use of Facial Recognition along with the User's Private Pin and QR Code Scanning procedure to enhance security measures.
- Provide easier ways of broadcasting SOS messages from client side to the administrator and appropriate agencies for assistance through the application.

## VII. CONCLUSION

We can state that with the existing technology it is difficult to identify, track and locate a fishing boat or any domestic vessel offshore by the means of RADAR / Satellite based optimized search for vessels near victim vicinity, or by sending distress signals such as Emergency Positioning Indicating Radio Beacon (EPIRB), Search and Research Transponder (SART) since these methods are proven to be costly and hence it is nearly impossible for the government to completely monitor the coast line and track each and every position of the fishermen going into the sea. With our proposed model, we can track the location of the boats up to 10 - 15 miles from off coastline by simply tracking the GPS location of their smart phones which can further be extended by using signal repeaters, almost doubling the range. This method is feasible and cost effective because of the abundant use of smart phones with GPS based location services enabled in them. With our system we can ensure to easily track the number of people entering the sea and coming back to the shore with the date and time log of entering and exiting the harbour, hence it is easy to identify the missing native personnel's or illegal immigrant's activities. The entire security is based on User's Private Pin which is unique to each user, once authorized it generates a personal QR code on the server which activates or ends the trip only when scanned using the application with the registered handset.

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