



DESIGN OF SMART TRACKING SYSTEM USING MICROCONTROLLER

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ABSTRACT

Smart Tracking Vehicle (STV) can be considered as a special Tracking Vehicle because it is used by fishermen, Boat man/users who have special needs. Using the Smart Tracking Vehicle the fisherman can use their boats independently. Security is one of main factor for the country, increasing tensions between Indian and Sri Lanka due to the maritime border issues as fishermen from Tamil Nadu are being abducted by the Sri Lankan navy for crossing the border which is unintentional most of the time. This paper presents an add-on smart tracking of the system to help fishermen to use the vehicle/boat independently and safely. The system integrates microcontroller unit with GPS and GSM, mobile phone and an alarm system. The tested prototype uses Arduino microcontroller, interfaced with GPS tracking unit and GSM mobile communication system. The system is extendable and more facilities for fisherman can be added. The GPS tracking unit provides the location of the boat and data are acquired by an embedded system microcontroller kit and displayed on a Liquid Crystal Display (LCD). Data are also sent to the authority person and via GSM module for monitoring. In emergency cases, alarm signal is triggered. Moreover, a SMS messages are sent to the people in charge of monitoring the user. The system was tested and validated.

Keywords: fisherman safety, embedded system, location detection, microprocessor unit, smart boat.

1. INTRODUCTION

One major reason for the proposed system is mainly due to the knowledge of the international maritime border by the fishermen and they cross the border due to rough weather conditions, more fish catchment. Whenever the fishermen are being abducted by Sri Lankan navy, the families of the fishermen undergo lot of turmoil as the fishermen's are released after many ordeals. As part of the proposal a GPS monitor will be placed in the boat to support and alert the fishermen. GPS will be programmed with longitude & latitude which will help the fishermen in identifying the Indian maritime territory.

This GPS will be synchronized with the Coastal guard control center which will alert the coast guard whenever any of the boats near the international border and will help them to guide the boats back to Indian Territory. Also a reverse motor will be placed in the boat and will be reversed if the fisherman does not hear the alert sound. Many researchers have suggested more advanced solutions, which might be categorized under the title "smart systems". Those systems are based on several aspects, namely human-machine interface, navigation methods and other smart systems like safety driving systems [2, 5]. Fishermen usually have safety complaints in border crossing.

2. RELATED WORKS

There is a border issue between Srilankan and Tamilnadu and the numbers of issues have been occurred for fishermen. However, obtaining the Maritime International Border between India and Sri Lanka near the Rameswaram coast of Tamilnadu is very close resulting in abduction of fishermen from Tamilnadu. Also the island of Katchatheevu is major concern where the Tamilnadu fishermen used to fish and dry their nets on the island.

There were no issues for the fishermen to go around the Katchatheevu Island till the 2009 Civil War in Sri Lanka. But post the war between Sri Lankan government and LTTE in 2009, the Sri Lankan government strengthened its security at maritime boundaries. When Indian fishermen crossed boundaries, arrests followed and talks for retrieval of Katchatheevu followed suit in Tamil Nadu.

Even though the island was ceded to Sri Lanka in 1974, the agreement allows Indian fishermen to fish around the Katchatheevu and to dry their nets on the island. But the Sri Lankan government claims that depletion of marine resources on its waters has affected the livelihood of fishermen. Lankan Navy continues to arrest any fisherman who comes near the maritime international border. The territorial limits on the sea are determined. The maritime boundaries are determined in accordance with the United Nations Convention on the Law of the Sea (UNCLOS), also called the "Law of Sea Treaty", which is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), and took place between 1973 and 1982. 1 Nautical Mile is defined as 1852 Metres. Distance between Tamilnadu and Sri Lanka is 581.5 Nautical miles/ 1077km/ 669.2 miles. Therefore, it is not always safe to use a boat independently as fishermen are subjected to critical situation in border regions. Therefore, an add-on tracking system is needed to help the fishermen in borders. Thus, this paper proposed a tracking system to address this matter.

Normally, the tracking systems use GSM-SMS protocols, smart microcontroller kit, GPS positioning system, and triggering alarm. In fact, the most recent systems have shifted toward computer and smart phones-based applications [1, 3, 6, 7]. The structure of most of these systems includes a smart phone, which



communicates with a controller [4, 5]. In this paper, a smart monitoring system is proposed that combines smart controller Arduino along with GPS and GSM technologies to provide safety of the fishermen.

3. SYSTEM ARCHITECTURE

In this work, a smart controller unit is proposed to track the boat. Arduino acts as the main controller in the system where the entire control coding is done. Through Arduino, the system is fully controlled and integrated with GPS to identify and share the exact location of the boat. Also the coding is done in such a way that location of the boat is sent through signals. And even when the system is nearer to the specified region alarm is triggered and motor is configured to get reversed automatically in order to not reach the boundary. Figure-1 shows the architecture of the smart tracking system.

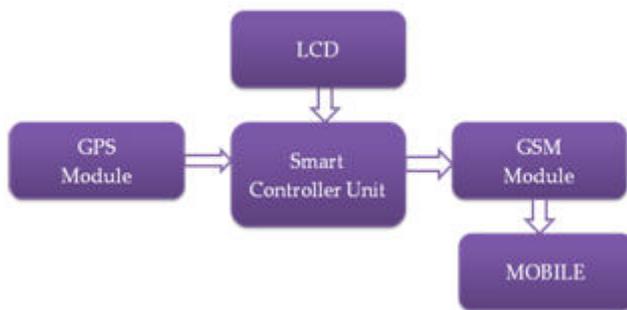


Figure-1. Smart tracking system architecture.

A. Global Positioning System (GPS)

The GPS tracking device is a, normally carried by a moving vehicle or a person, that uses the Global Positioning System to determine and track its precise location, and hence that of its carrier, at intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a centre-location database, using a cellular or satellite modem embedded in the unit. This GPS will be synchronized with the Coastal guard control center which will alert the coast guard whenever any of the boats near the international border and will help them to guide the boats back to Indian Territory. Also a reverse motor will be placed in the boat and will be automatically reversed if the fisherman does not hear the alert sound.

B. Arduino and its features

- Arduino [1] is a single-board microcontrollers for building digital devices and interactive objects that can sense and control objects in the physical and digital world.
- This microcontroller kit consists of ATmega328 with 14 digital I/O pins and 6 analog pins along with an operating voltage of 5V. The pin diagram has been shown in Figure-2.

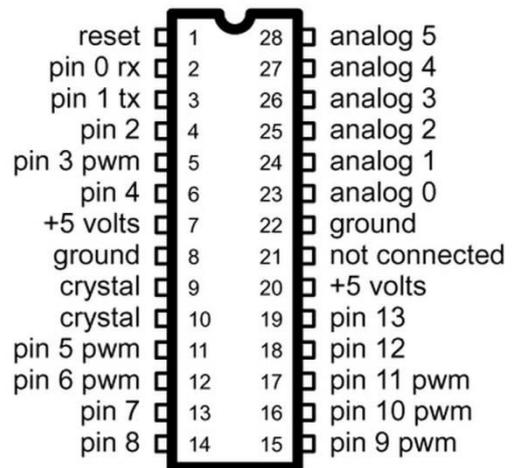


Figure-2. Pin diagram of Arduino MC.

C. Flowchart

The flowchart shown in Figure-3 explains the workflow of the smart tracking system. Initially, GPS will be tracking the location of the sea boundaries from the Srilankan and Tamilnadu maritime border detection.

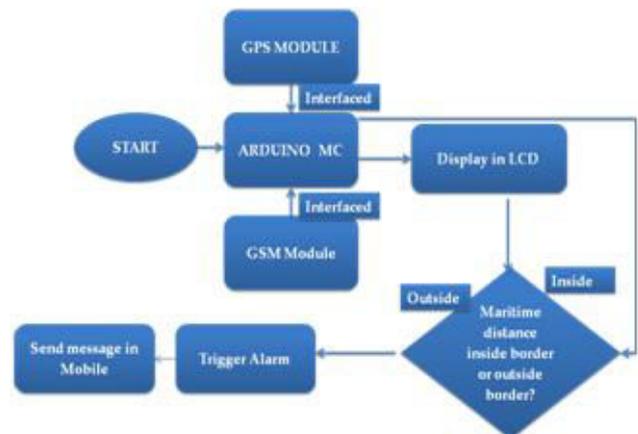


Figure-3. Smart Tracking System - Flowchart.

The tracked location along with the latitude and longitude position gives the data to arduino mc and the values will be displayed in the LCD screen. The arduino mc kit helps to pass the data to GSM module for communication to the authoritative persons at the maritime border security alerts.

D. GSM

Through the GSM [7], the persons are able to get the message in their mobile, and if the fisherman boat crosses the maritime boundary in the sea, with the nautical miles calculated from the shore towards the boundary which helps to find the exact location of the border and gives a trigger alarm to the fisherman who is inside the boat. Navy continues to arrest any fisherman who comes near the maritime international border. The territorial limits on the sea are determined by Nautical Mile which is defined as 1852 Metres. Distance between Tamilnadu and



Sri Lanka is 581.5 Nautical miles/ 1077km/ 669.2 miles. Therefore, tracking system is needed to help the fishermen in borders.

In this paper, a smart monitoring system is proposed that combines smart controller Arduino along with GPS and GSM technologies to provide safety of the fishermen.

4. EXPERIMENTS AND RESULTS

The model of a boat is designed so that in the prototype the smart tracking module of the vehicle is in built by using the microcontroller kit along with the GSM module and GPS tracking device in addition to get a triggering alarm uses a buzzer and communicated through mobile system. Moreover, the latitude and longitude positions are diagnosed and shown on the LCD display integrated into the prototype model to know the exact location of boat, whether the vehicle is inside the maritime border location or has crossed the international boundary. Figure-4 shows the overview of the smart tracking system.

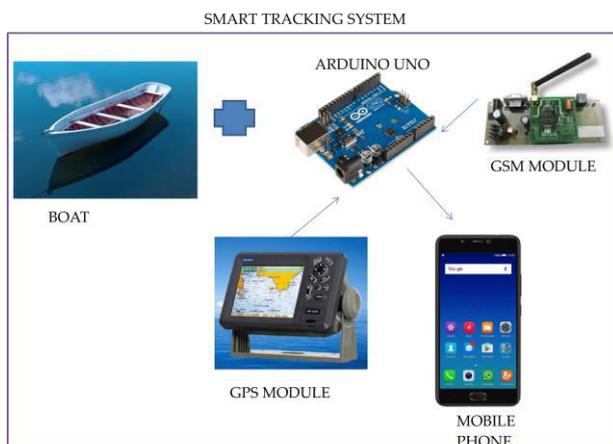


Figure-4. Smart Tracking System - Overview.

A. GPS

The Global Positioning System (GPS) is a space-based radio navigation system. The GPS provides critical positioning capabilities to military, civil, and commercial users around the world. It's based on the concept on time and the known position of GPS specialized satellites. These satellites continuously transmit data about their current time and position.

The smart controller unit the coding part is done in Arduino. Software Serial Library is used to allow serial communication on pin 10 and 11.

```
//SoftwareSerial gps(10,11); // RX, TX
```

After initializing the serial communication, LCD, GSM & GPS module is initialized using setup function.

Function *void get_gps()* has been used to extract the coordinates from the received string.



Figure-5. Maritime distance.

This smart vehicle tracking vehicle, gives indication to the fisherman in the boats and to the authoritative personnel, if the boat crosses the international maritime boundary. This way the peoples and their families who are getting into trouble, when they are caught by the srilankan navy peoples for crossing the border. This smart device will help fishermen to know the location and safeguard themselves from entering into the restricted zone.

B. Smart controller coding in Arduino

Function *void gpsEvent()* is used for receiving GPS data into the Arduino.



Figure-6. LCD Display.

Function *void serialEvent()* is used for receiving message from GSM and comparing the received message with predefined message to track the boat.

```
init_sms();
send_data("Vehicle Tracking Alert:");
send_data("Your Vehicle Current Location is:");
Serial.print("Latitude:");
send_data(latitude);
Serial.print("Longitude:");
send_data(longitude);
send_data("Please take some action soon");
send_sms();
```

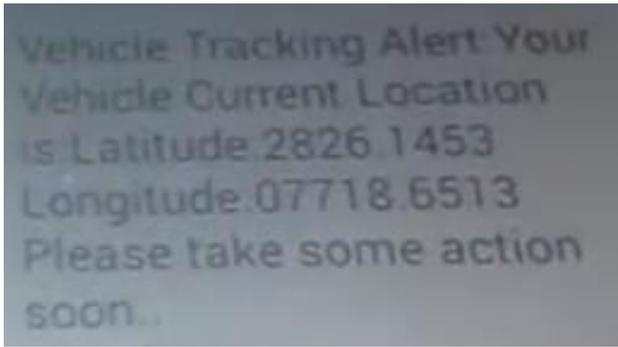


Figure-7. SMS in mobile.

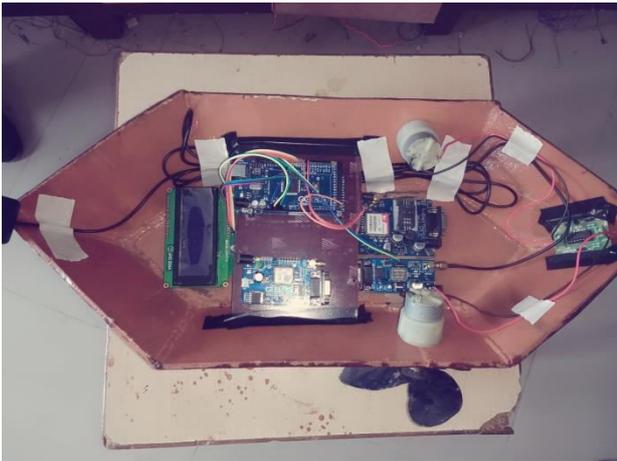


Figure-8. The installation of Smart Tracking System.

Figure-8 shows the installation of smart tracking system and the Figure-9 shows the results of the system.



Figure-9. Results of Smart Tracking System.

The SCU (Smart Controller Unit) continuously checks the GPS location information. The reading results are shown on the LCD. The system will trigger an alarming sound if the condition of the latitude and the longitude location are outside the range of the border. SMS will be sent to the designated people in charge using the mobile phone App at the same time.

5. CONCLUSIONS

An advanced tracking system for fishermen/boat user is proposed in this study can easily identify the national sea borders and therefore prevents them from entering their area. The smart tracking system can be installed to any boat to ensure the user's independence and safe mobility. The system integrates an Android smart phone App, an embedded MCU and GPS navigator. The system uses a Bluetooth technology connection to exchange commands and data between the smart phone and MCU module. The tracking add-on device is attached to the boat in a visible way for the user. Through the commands, the MCU can easily identify the location of the boat and if it goes beyond the maritime border, the alarm is triggered.

The system provides high accuracy and high precision values of the Latitude and Longitude. The novelty of this model, GPS device is used to track the border and make the boat move backwards. This system will not only alert the coastal guard & fishermen but also helps is rerouting the boat backwards. Also this provides additional advantage for coastal guard in tracking the boat even during any emergencies due to unforeseen rough conditions and weather. Hence it establishes good relationship with the neighboring countries along with saving lives.

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