SATELLITE AND VHF ENABLED ASSISTANCE FOR MARINE NAVIGATION

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In any country's Coast line, fishing is one of the most important occupations of the people. When the fishermen go out to sea for fishing, they cannot visually distinguish between their country's border, the international water boundary and the other country's border. When they tread into the other country's border unknowingly, they get arrested for trespassing and are thus jailed. This is a major issue existing till date. This Paper aims mainly to meet the safety needs of fishermen who cannot afford highly priced systems for navigation and communication. Currently, there are no affordable systems that provides border alerting for the fishermen at sea. Using VHF technology, we are providing a solution for this. We are also implementing a system which can be used by the fishermen to send out an SOS message with their GPS co-ordinates when they are under danger / distress using Lora technology. We have included additional features such as audio and visual indicators to alert the fishermen when he is crossing the country's border. Also, sudden weather changes are immediately alerted to the fishermen using VHF technology. We have made use of the PIC microcontrollers as the core of the system &Lora for wireless communication.

I. INTRODUCTION

Considering the problem faced by our fishermen and to provide a cost effective solution, we designed Satellite and VHF Enabled Assistance for Marine Navigation.

The three main features are:
1. Border Determination
2. Distress message communication
3. Sudden weather change alerting

Unlike on land, visually distinguishing the border of a country at sea is impossible .We have seen many cases wherein the fishermen are found "trespassing" into other country's border and as a result are jailed. Unfortunately, these fishermen fail to realize they are in the other country's border and thus get caught .This is one of the most tragic phenomenon seen (for example: between India and Srilanka & India and Pakistan).

As of today, there is no system available (that is affordable and portable) for the fishermen that can help him in alerting him if he is venturing out of the country's border at sea. Thus we aim to create a robust system that not only gives both audio and visual alerts when the fishermen crosses out of the country's border, but we also plan to implement a system where in the fishermen can send an "SOS" signal when he is in trouble at sea, immediately at the push of a button .We are implementing a system wherein we can transmit sudden weather change information to the fishermen at sea so that they can come back to shore immediately.

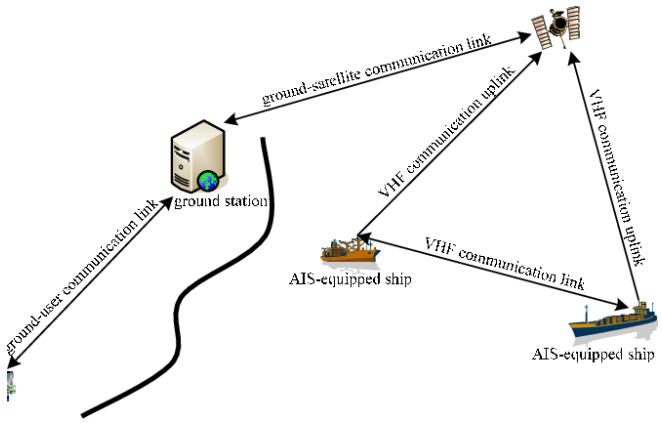


Figure 1.1 ***Satellite-based AIS architecture***

A. CRUCIAL CONTRIBUTION

The use of satellite-based VHF communications for marine navigation has made significant cultural contributions to the maritime industry. Here are some examples:

Improved Safety: By providing real-time information on vessel positions and weather conditions, satellite-based VHF communications have helped to improve safety in the maritime industry. This has cultural contributions to the lives of seafarers who are now able to work in safer conditions.

More Efficient Navigation: With the use of satellite-based VHF communications, ships can communicate with each other and with shore-based stations more efficiently. This has led to more efficient navigation, reducing travel times and lowering costs. This cultural contribution has had a positive impact on the maritime industry as a whole.

Improved Maritime Security: The use of satellite-based VHF communications has also contributed to improved maritime security. With better tracking and identification of vessels, authorities can respond more quickly to potential security threats. This cultural contribution has helped to protect seafarers and the shipping industry from piracy and other security risks.

Increased Global Trade: By improving navigation and reducing travel times, satellite-based VHF communications have contributed to increased global trade. This cultural contribution has helped to facilitate the exchange of goods and services between countries, fostering economic growth and cultural exchange.

In summary, the use of satellite-based VHF communications has made significant cultural contributions to the maritime industry, improving safety, navigation efficiency, maritime security, and global trade.

II. Literature Review

In this section, we briefly understand the basic of satellite and VHF enabled assistance for marine navigation and the most recent work done in this field. A GPS-based wireless ad hoc network is proposed for marine Monitoring ,search, and rescue applications in Vietnam. The network routing protocol and algorithm are evaluated using Network Simulator 2 software. The results indicate a success rate of packages transmission higher than 85% and show the great potential of the proposed concept. Keywords-Ad hoc network, marine monitoring and searching ,Global Positioning System (GPS).A GPS receiver which receives signal from the satellite and gives the current position of the boat. The proposed system is used to detect the border of the country through the specified longitude and latitude of the position, not only between Sri Lanka and India but all over the world. The particular layer level i.e. border can be predefined and this can be stored in microcontroller memory. The current value is compared with predefined values and if the se values are same, immediately the particular operation will be done i.e., the microcontroller gives instruction to the alarm to buzzer. It also uses a message transmitter to send message to the base station which monitors the boats in the sea. The system provides an indication to both fisherman and to coastal guard. Thus it saves the lives of the fisherman and alerts the base station to provide help. The system is used to detect the maritime boundary of the country where the long time dispute between Sri Lanka and India still exists. This mainly happens when fisherman crosses maritime border of neighbouring country as he is not aware of the limits in sea. The proposed system uses a GPS receiver which receives signals from the satellite and gives the current position of the boat. With already known details of the latitude and longitude of the maritime boundary, the microcontroller calculates the current position and stored boundary positions and indicates the fisherman that he has crossed the boundary by an alarm system. It also uses a message transmitter to send message to the base station which monitors the boats in the sea. This system provides an indication to both fisherman and to coastal guard. Thus the system saves the lives of the fisherman or reduces the damages caused to them by Lankan coast guards. Additionally, sensors for iceberg detection and tsunami prediction have been included. A report for weather can also be obtained through temperature and humidity sensor. The system is mainly for fishermen are used to detect the maritime boundary

A. In their paper, "Global Navigation Satellite System for Marine Navigation," researchers S. S. Shaw and G. K. Shyamala discuss the potential of satellite-based navigation systems in the marine industry. The authors highlight the benefits of using a satellite-enabled VHF radio system, including improved accuracy, availability, and reliability.

B. .In the article "VHF Radio Navigation in Coastal Waters," author J. H. Sanders explores the use of VHF radio navigation in coastal waters. The author notes that VHF radio navigation is an essential tool for coastal pilots and discusses the limitations of traditional radio navigation systems.

C. The paper "Marine Navigation with GPS and DGPS," by L. Wang and R. Shen, compares the accuracy of GPS and DGPS (differential GPS) systems in marine navigation. The authors find that DGPS is more accurate than GPS in marine navigation and that the use of DGPS has significantly reduced the risk of collisions and groundings.

D. In their study, "The Role of AIS in Maritime Navigation," researchers Y. Wang and S. Mao investigate the benefits of using Automatic Identification System (AIS) in marine navigation. The authors highlight the usefulness of AIS in providing vessel identification, location, and speed information.

E. The article "The Future of Maritime Navigation," by J. R. Montgomery, discusses the future of maritime navigation and the impact of satellite-enabled navigation systems. The author predicts that satellite-based navigation systems will become the primary means of marine navigation, and that future advancements in technology will continue to improve navigation safety and efficiency.

Overall, the literature on satellite-enabled VHF marine navigation highlights the numerous benefits of using this technology in the

marine industry. The research suggests that satellite-enabled VHF radio systems are more accurate, reliable, and available than traditional radio navigation systems, and that the use of satellite-based navigation systems will continue to grow in the future.

Table 2. 1

Comparison Table of Different approaches

PAPER TITLE	AUTHOR NAME	Focus of the Paper
Satellite navigation for marine applications	C.M. Rizos, L. Hockings, and A. Moore	Overview of satellite navigation systems and their use in marine navigation
VHF communication for marine navigation	M. Talaee and A. R. M. Ali	Use of VHF communication systems for marine navigation
Integration of satellite and VHF technologies for marine navigation	by G. Q. Zhang and H. Li	Integration of satellite and VHF technologies for marine navigation
Assisted marine navigation using satellite and VHF technologies	by J. C. Haag and J. A. Shaw	Use of satellite and VHF technologies for assisted marine navigation

III. PROPOSED APPROACH

As mentioned earlier, this paper aims to incorporate three main problems faced by our fishermen. They are: Border determination, distress message communication and instant weather updates. Thus, by incorporating all of these features on to a single system, we aim to create a robust and cost effective system forthe fishermen to use..

A. Global Navigation Satellite System (GNSS): This approach involves using a network of satellites to provide accurate positioning, navigation, and timing information. Systems like GPS, GLONASS, and Galileo are examples of GNSS systems that are commonly used in marine navigation.

B. Automatic Identification System (AIS): AIS is a radio-based system that allows vessels to exchange information with other vessels and shore-based stations. AIS provides vessel identification, location, and speed information, which can be used to improve navigation safety and efficiency.

C. Differential Global Positioning System (DGPS): DGPS is a system that uses a network of ground-based stations to correct GPS signals, resulting in improved positioning accuracy. DGPS is commonly used in marine navigation to improve the accuracy of vessel position information.

D. Electronic Chart Display and Information System (ECDIS): ECDIS is a computer-based navigation system that uses electronic charts to display vessel position, speed, and other information. ECDIS can be integrated with other navigation systems, such as AIS and GNSS, to provide a comprehensive navigation solution.

E. Real-time kinematic (RTK) positioning: RTK is a GPS-based positioning technique that provides highly accurate positioning information in real-time. RTK can be used in marine navigation to improve the accuracy of vessel position information, particularly in areas with challenging navigation conditions.

F. Radio direction-finding (RDF): RDF is a technique that uses radio signals to determine the direction of a signal source. RDF can be used in marine navigation to locate other vessels or navigation aids, such as buoys and beacons.

These approaches can be used individually or in combination to provide a comprehensive satellite-enabled VHF marine navigation solution. The choice of approach depends on various factors, including the navigation requirements, the vessel type, and the operating environment.

IV. METHODOLOGY

A. BLOCK DIAGRAM

Fig 4.1: BASE STATION

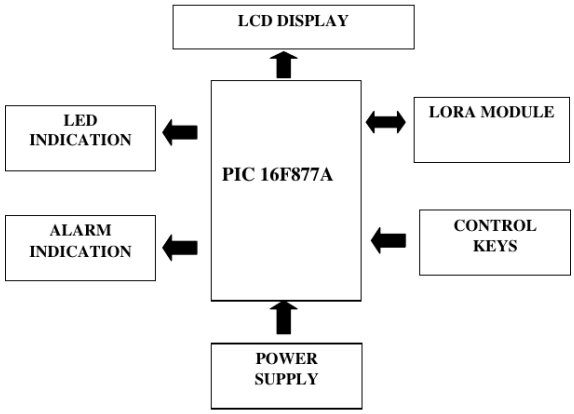
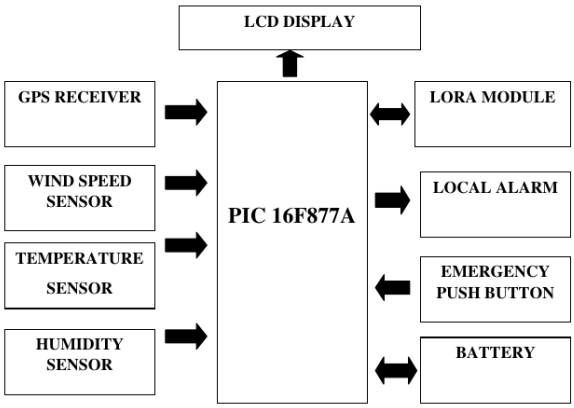


Fig 4.2: BOAT SYSTEM



4.1 BLOCK EXPLANATION

4.1.1 BASE STATION

- This is the schematic of the device in the base station on the shore.
- The base station consists of the 2 channel duplexers.
- The digital channel is used to decode the location of the boat when requested
- under distress condition. i.e., receive the SOS messages via Lora.
- The analogue channel is set for the predefined weather forecast messages. This

unit is used to broadcast the signal (info. About sudden weather changes) to all the boats with burst communication system .The VHF towers are used to distinguish the three borders. Three such towers are used. They are VHF transmitters. VHF transmitters are electronic devices that create continuously varying electric current, encode sine waves, and broadcast radio waves .VHF transmitters use oscillators to create sine waves, the simplest and smoothest form of continuously varying waves, which contain some information like data, audio ,etc. Here, we make use of data as the message signal that is used with carrier to get the FM signal .Modulators encode these sine waves and antennas broadcast them as radio signals.
There are several ways to encode or modulate this information, including amplitude modulation (AM) and frequency modulation (FM).Tower A is used to indicate the fishermen's country border, Tower B is used to indicate the International water border and Tower C is used to indicate the other country's border .The VHF transmitter is built around the ASIC (Application Specific Integrated Circuit) and common passive and active components, which are very easy to obtain from the material shelf. The circuit works on Very High Frequency bandwidth wide covering range. The above figure illustrates the border concept described in this paper .The VHF tower-A will be placed on the shore of the fishermen's country. The tower-B will be placed at the border of the international water boundary and tower-C will be placed at the border of the other country's boundary.

4.1.2 BOAT

- The VHF receiver is used to receive the "sudden weather change alerts" from
- the Base station.
- Lora is used to transmit the SOS message from boat to base station and other
- boats.
- The latitude & longitude coordinates are obtained using the GPS receiver.
- Push button is used to activate the "distress SOS" communication.
- The antennas used are simple wire antennas.
- Both weather alert and SOS activation messages are displayed on respective

16x2 LCD modules. Two separate modules are used for the two different
microcontrollers.

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V. RESULTS

Satellite and VHF enabled assistance can be very helpful for marine navigation. Here are some potential benefits of each:

Satellite navigation systems like GPS (Global Positioning System) can provide highly accurate and reliable location information, which is essential for safe navigation at sea. With GPS, mariners can determine their position, course, and speed with a high degree of accuracy, even in challenging weather or sea conditions.

VHF (Very High Frequency) radios are another important tool for marine navigation. VHF radios allow mariners to communicate with other vessels, as well as with shore-based facilities and emergency services. This can be crucial in emergency situations, as well as for general navigation and traffic coordination.

Combining satellite and VHF technologies can provide even greater benefits for marine navigation. For example, many modern marine navigation systems integrate GPS and VHF data to provide real-time information on vessel traffic, weather conditions, and other factors that may affect navigation. This can help mariners make informed decisions and avoid potential hazards.

Overall, satellite and VHF enabled assistance can play an important role in ensuring safe and efficient navigation at sea. However, it's important for mariners to use these tools in conjunction with other navigation techniques, such as visual observation, chart reading, and traditional navigation skills.

VI. CONCLUSION

We conclude that we were able to successfully incorporate all the three features
mentioned in this paper into our prototype model .

- Main application is for our fishermen who unknowingly thread in to international borders and get arrested by authorities of the other country for trespassing. The system guides them such that they are aware of the nation's boundary and when they have crossed it.
- Also, with the incorporation of the alert / warning & distress systems, the fishermen can be assisted at times of disaster. Thus an overall robust and cost effective

system is developed that can be used by them when they venture into the sea every day to meet their livelihood.

VII. REFERENCES

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These references provide information on the use of satellite navigation, VHF communications, and other electronic aids to navigation for mariners. They also discuss the importance of using these tools in conjunction with traditional navigation techniques and best practices for safe navigation at sea.