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S.E.A.M.A.N.
(Satellite and RF Enabled Assistance for Marine Navigation)

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Abstract— **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 RF 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 zigbee 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 RF technology. We have made use of the ARM7 and 8051 microcontrollers as the core of the system & zigbee for wireless communication.

Index Terms*— *ARM7microcontroller, audio & visual indicators, fishermen, P89V51RD2 microcontroller, RF technology, zigbee.

I. INTRODUCTION

Considering the problem faced by our fishermen and to provide a cost effective solution, we designed S.E.A.M.A.N. (S.E.A.M.A.N. stands for: Satellite and RF 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 also 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.

II. EXISTING SYSTEM

GPS navigators are the best solution to determine one's position. But, due to their high price, our fishermen cannot afford them. Other option includes using buoys along the country's entire water boundary.

This is a costly process and ocean current and waves can easily disturb their positions. Another instance is that coast guards roam around the border and alert the fishermen whenever they tread near the border.

Currently there is no system available exclusively for our fishermen to get updates on sudden weather changes or natural calamities like hurricane or tsunami alerts or a system they can use to send out distress messages with their coordinates when they are in need of assistance or help.

III. PROPOSED SYSTEM

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 for the fishermen to use.

IV. METHODOLOGY

1. Border Determination

Method 1:

To determine the location of any object on earth, we use GPS coordinates. There are 24 GPS satellites revolving around the earth at all times. By synchronizing with at least 3

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of them we can obtain the object's exact latitude and longitude values and thus its location on earth.

Method 2:

We can make use of Radio Frequency (RF) towers to map the borders. We have made use of FM radio transmitter. Three such towers are used to distinguish three border areas: own country's border, The International water border and the other country's border.

Each FM transmitter has a fixed carrier frequency of 147MHz. Each transmitter is given a different message frequency. The message is frequency modulated with the carrier to get the FM signal. Thus, three different FM signals are obtained for three different boundaries.

2. Distress message communication

When the fishermen are in distress (example: their boat is sinking) they need immediate help. Currently there is no system existing to achieve this. We have incorporated an "SOS distress system" wherein the fishermen, when in distress have to just push a button. This action will send out a distress message using wireless zigbee communication to all nearby boats and also to the base station. The distress message will contain a predefined message and the latitude and longitude co-ordinates of the boat when the button was pressed. The coordinates will be obtained using a GPS receiver present on the boat.

3. *Sudden weather change alerting*

Suppose the fishermen have gone out for fishing, and the base station receives (say) a Tsunami alert. This information needs to be immediately sent to the fishermen at sea. Currently there is no such system that meets this demand. We have used RF technology to transmit these "weather update" messages to the fishermen.

We have used an audio indicator on the boat to inform him whenever an update is received. Thus he can come back to shore safely

V. SYSTEM BLOCK DIAGRAMS

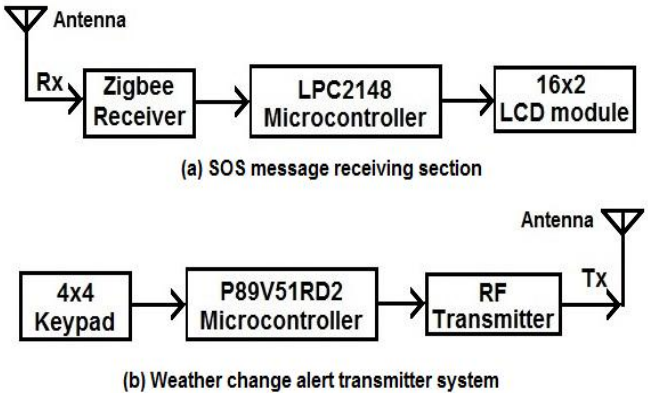

Fig 1: *The base station setup*

- This is the schematic of the SEAMAN device in the base station on the shore.
- SEAMAN works on dual channel system: the **analog channel** and the **digital channel**.
- 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 zigbee.
- The analog 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.

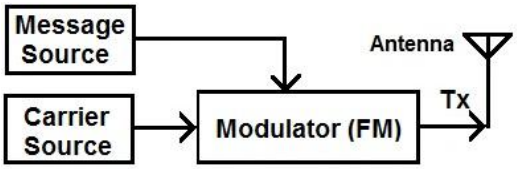

Fig 2: *The RF tower setup*

The RF towers are used to distinguish the three borders. Three such towers are used. They are RF transmitters. RF transmitters are electronic devices that create continuously varying electric current, encode sine waves, and broadcast radio waves. RF 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 RF tower consists of a 3volts power supply (batteries).

The RF 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 band with wide covering range. The Carrier frequency is 147 MHz and Data frequencies are 17 MHz, 19 MHz, 22 MHz & 25 MHz.

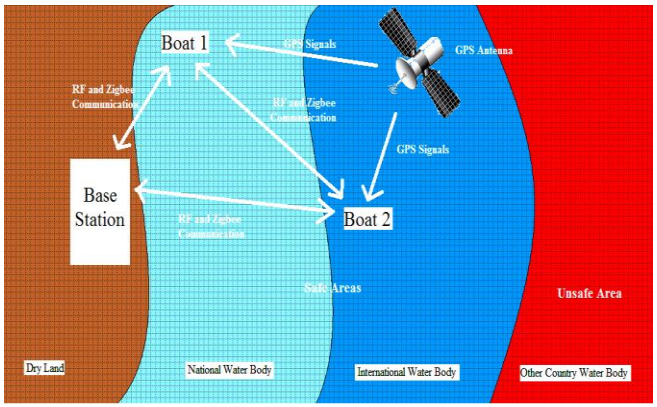

Fig 3: *Illustration of the three border concept*

- The above figure illustrates the three border concept described in this paper.
- The RF 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.

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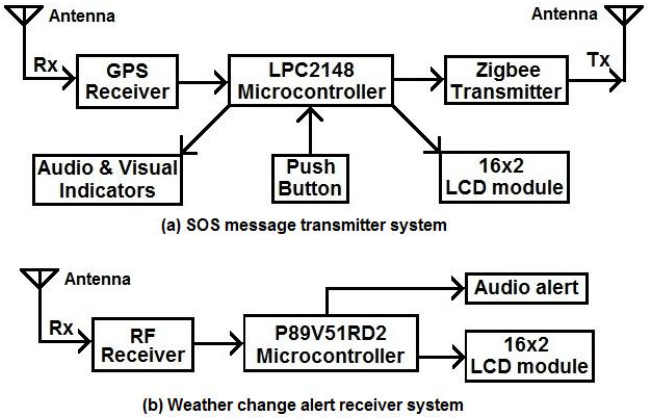

Fig 4: *The boat setup*

- This is the schematic of the SEAMAN device in the boat of the fishermen.
- The RF receiver is used to receive the "sudden weather change alerts" from the Base station.
- Zigbee 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.

Power Supply:

The Base station is powered up with 12V DC input that is obtained from rectifying and regulating 230v AC voltage. The boat setup is powered up by a 12v, 1.3Ah lithium-polymer battery. The RF towers are powered up by 3.3v DC input obtained by using two 1.5v AA batteries.

VI. SOFTWARE DISCRIPTION

We have made use of three different microcontrollers in our system; they are the NXP's P89V51RD2 microcontroller, LPC1768 and LPC2148 ARM7 microcontroller.

Programming is done in embedded-C language. Compiler used is Keil microvision-3 for 8051 controller and Keil microvision-4 for LPC2148 & LPC1768 controller. The compiled programs are downloaded onto the microcontrollers using RS232 interface for 8051 and JTAG port interface for LPC2148 and LPC1768 using flashmagic for 8051and JTAG downloader software for ARM7 controllers respectively.

Separate flow charts are used to describe the program flow for the three features of the project.

The flow charts are as below:

[1] Border determination and alerting

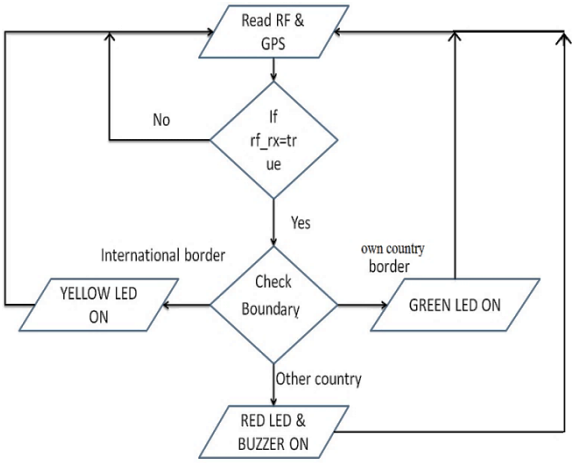

Fig 5: *Border determination and alerting flow chart*

[2] Sudden weather change alerting

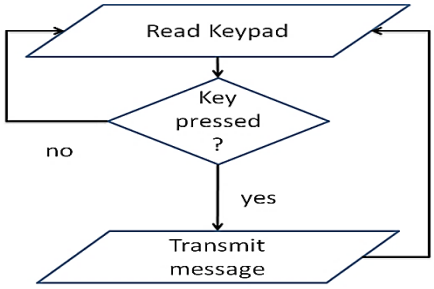

Fig 6: *Weather alert transmission*

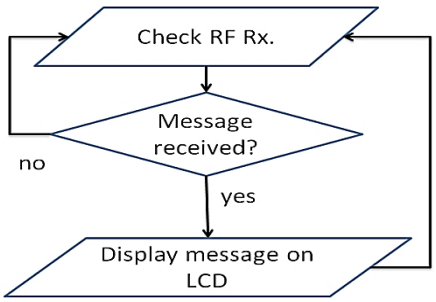

Fig 7: *Weather alert Reception*

[3] Distress SOS alerting

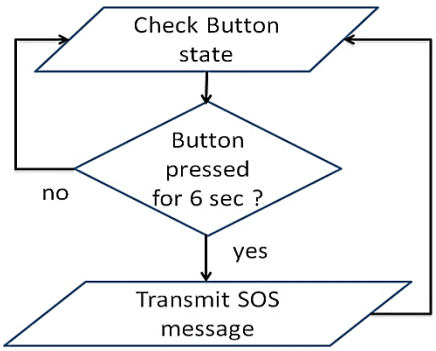

Fig 8: *SOS distress message transmission*

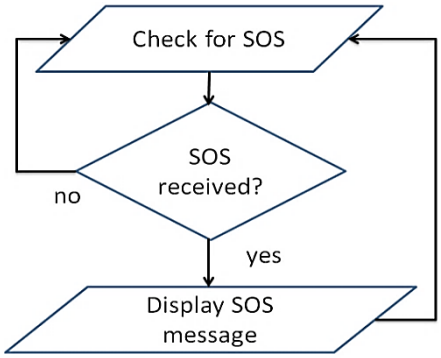

Fig 9: *SOS distress message reception*

VII. RESULTS

The concepts discussed in this paper were successfully developed into a working prototype. We were successfully able to implement all three features as follows:

The "border determination" system was implemented successfully using three RF transmitter towers, an RF receiver and decoder, an ARM (LPC2148) controller and three LED's and a buzzer as follows: the three RF towers were placed in three different areas to illustrate three boundary regions. Whenever the boat setup was near tower-A, a green LED was switched ON indicating that the boat was inside the fishermen's own country border. Whenever the boat setup was placed near tower-B, the green LED was switched off and a yellow LED was switched ON, indicating that the boat was near the international water border. When the boat setup came near tower-C, yellow LED was OFF and a red LED was switched ON and a buzzer was sounded indicating that the boat was near the other country's border i.e. danger area.

Coming to the "distress messaging" system, we were successfully able to implement it using an ARM (LPC1768) controller, a GPS receiver, a switch and a Zigbee module. When the switch was turned on, the "distress messaging" system was activated. The boat's current GPS coordinates were obtained from the GPS receiver and was sent out to a nearby boat setup (boat #2) and the base station along with a predefined message using Zigbee. As soon as the message was delivered, the success message was displayed on a16x2 LCD on the boat. Also, the SOS message was displayed on LCD modules placed on the base station as well as that in boat #2.

Finally, the "sudden weather change alerting" system was successfully implemented using 8051 (P89V51RD2) controller, an RF transmitter and receiver pair and a hex-keypad input as follows: at the base station, the designated key on the keypad (say key3 = tsunami alert) is pressed. This message is transmitted to the boat setup and is received and decoded by the RF receiver and the message is displayed on a 16x2 LCD module. Thus the fishermen are alerted of the sudden weather changes so that they can come back to the shore safely.

VIII. CONCLUSION

We conclude that we were able to successfully incorporate all the three features mentioned in this paper into our prototype model "S.E.A.M.A.N."

- Main application is for our fishermen who unknowingly thread into 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.

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