RF Based Fishing Vessel Surveillance System: An Integrated Approach

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***ABSTRACT*- Surveillance is a key factor to ensure safety in various fields , here motivity of fishing boats in ocean/sea are monitored for illegal intrusion in other nations boundary. Hence an effective scheme is designed to overcome this threat with Global positioning system (GPS) which provides dynamic location of fishing vessel in water and microcontroller which competes on GPS and predefined boundary locations to determine whether the boat have crossed the border or not. If so the fisherman is alerted and the message is transmitted to nearby coast guard ships through RF signals at VHF (30-300MHz) range which covers wide area. On adumbrated the patrolling units can alert the fisherman from their position or if necessary the entire movement of the fishing vessel could be controlled remotely for trespassing. This measures fixes the cross boundary fishing problems between nations as the fisherman's are unaware about their position in water.**

Keywords: Vessel , GPS, VHF, Auto-Steering, IMBL

I. INTRODUCTION

Wireless communication is one of the most important communication system at sea. But lack of knowledge in radio channel characteristics limits the development of various wireless communication techniques for maritime applications .The problem arises when fisherman crosses the international boundary of their country, thus many people are arrested in some cases it may even lead to death. From the fishermen's opinion, erring occurs unknowingly, because of ignorance on maritime boundaries. Sometimes times drift is because of strong currents or engine failure, though some cross boundary intentionally. Thus to overcome this a secure surveillance and control system is required. In order to carry out these tasks, long distance communications is essential between the sea vessels .This communication must be reliable at all times and it must withstand all climatic changes happens in a sea environment .To establish communication at sea many approaches are used at present, but the criteria is whether the communication is reliable, robust and secure at all times. In TRITON[1] model, the coverage at sea is achieved through setting up a mesh or adhoc network[2] between the fishing boats. The transceiver unit present in each fishing boat act as signal repeater/regenerator until it reaches the sink /base station in water or in land. Here the communication fails if the intermediate boats are not present at a particular distance from the transmitting boat. Main drawback in GSM is communication breaks between the sea vessels, if the link provided by the network provider fails then message cannot be transmitted. We cannot expect proper signal strength in the mid of the sea [3]. Where the popular satellite phones are expensive to install in fishing boats, moreover they are meant for talking purpose hence activities can't be monitored by coastguards. Individual monitoring of all vessels through RADAR is practically not possible.

Thus in this proposed method is to achieve reliable communication at sea through RF communication. In this system, GPS module updates the dynamic locations of the boat. The controller unit which compares the GPS location value ranges with fixed IMBL. If the fishing boat approaches near to the IMBL , controller unit alerts the fisherman about their location, hence they can change their movement position. In some cases the fisherman intends to cross the IMBL for owning more sea resources, this intention has to be restricted. Hence to avoid these activities the position of the boat can be notified to roaming coast guards through RF transmission at VHF range. Since the existing maritime band radio operates in this frequency range. Thus as soon as the coast guard knows the fishing boat's illegal motivity, they can communicate with that boat driver for bow out. In certain cases the fishing boat's movement has to be confined so control commands are transmitted wirelessly by coastguard ships.

II. BLOCK DIAGRAM

The setup is constructed as shown in block diagram (fig.1) with various units which are described below.

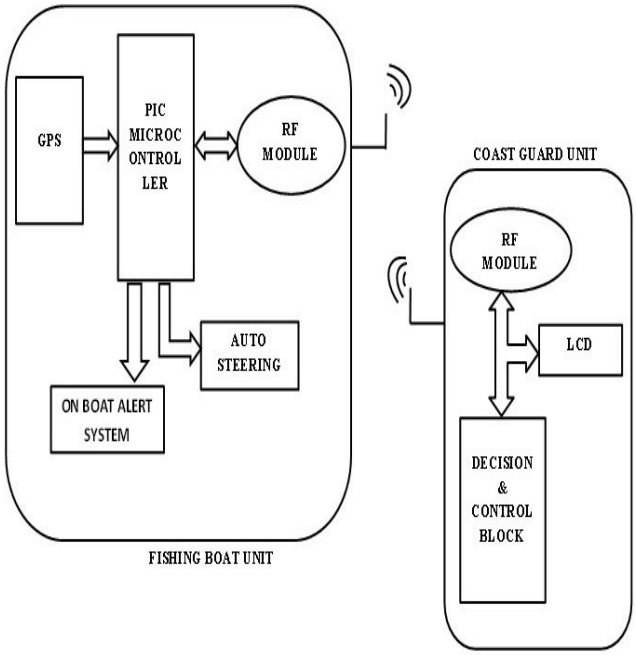

Fig.1.Block diagram

2.1 GPS

It gives the exact position of latitude and longitude anywhere on earth. Values are provided by 24 satellites comparatively for 24x7 and in all weather conditions. Hence this module is used in our paper which provides a position of fishing boat at all instances. With this geographical locations motivity of the boat can be continuously updated where no license is required to use this facility.

2.2 PIC

The PIC is a RISC processor with features of low-power consumption and high performance. PIC 16F877 is an 8-bit controller used in this proposed system which compares the values from GPS and internally stored IMBL location. When necessary arises based on the criteria either alarm or wireless communication is being processed. It also activates the Auto-steering mode based on the wireless commands received from the control center.

2.3 Wireless module

At sea wired communication is not feasible hence we opt for wireless transmission [4] also this communication must be reliable, robust and connectable at all weather conditions .Thus RF waves can be used for transmission and receptions of signals.

2.3.1 Radio Frequency (RF)

All wireless communications are carried out in the form of radio waves. At present the maritime band radio is one of the communicating methodology at sea. Walky talky in sea operates in this band in VHF range which is experimented. Our idea is if the information transmitted at this range it reaches the civilian coast guard ships. This method overcomes the traditional GSM transmission which may fail at critical situations

2.4 MARITIME BAND RADIO

It operates in the megahertz frequency range which has specifically designated channels for specific purposes. Alphabet ‘A’ shows simplex transmission mode from ship station generally used only in the United States which varies from international operations on those channels . Hence "International - U.S." switches are present in some channel.‘B’ denotes coast station transmission channel in duplex mode. Boaters can use noncommercial channels. For calling other stations and distress channel16 can be used. On peril of collision channe13 can be used[6]. Other existing frequency ranges can be viewed in reference[7].

2.5 Control Module

On coast guard's senses about the trespassing of fishing boat, the movement of the boat can be controlled through wireless commands .Hence to transmit commands again RF waves are used on another VHF range. As the command reaches the fishing boat Auto steering mode is activated

2.5.1 Auto-steering mode

Movement of boat depends on the rotation of installed turbine blades and Steering movement. Stepper motor can be attached to boat's steering wheel located at the top of rudder stock. To send and receive real-time commands, wireless intelligent device is fixed which comprises of both motor driver IC and RF transceiver block. With the clock and anti-clockwise rotations of stepper motor [5], the steering can be controlled. Also the rotors movement is controlled alternatively so that left and right turnings can be achieved. Based on fishing boat either the steering rotation or rotor rotation control is decided on implementation.

2.5.2 Driver IC L293D

It provides a wide supply voltage which ranges around 4.5 V to 36V. It has features like separate input for logic supply and thermal shutdown with internal ESD protection, also has inputs with high noise immunity. This IC drives the motor with its synchronous voltage to represents the movement of vessel.

III. SYSTEM FLOW

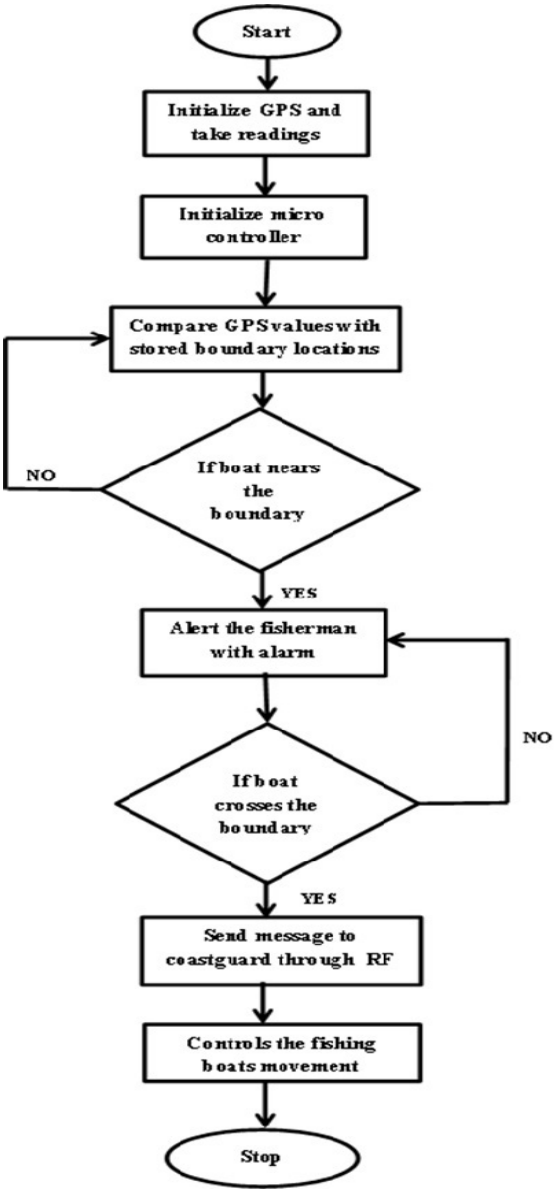

Fig.2 System Flow

IV. INSTALLATION LOGIC

In First phase, Microcontroller receives the data from the GPS receiver through UART. Received data contains details of latitude and longitude. The current positions are compared with already stored latitude and longitude of country's boundary locations. Received values from GPS is stored at L1 (latitude), L2 (longitude). The latitude L1 is compared with stored latitudes. If latitudes match, then adjacent IMBL latitudes and longitudes(X1,Y1 and X2,Y2) are retrieved from memory .With algorithm, position of the vessel with respect to boundary is found

diff_lat=lat(fixed)−lat(current)

diff_long=long(fixed)−long(current)

a=[sin²(diff_lat/2)+cos(lat(current)].cos(lat(fixed)).sin²(diff_long/2)

C=2.atan2({a}^(½){1-a}^(½))

Distance = R*C

Where, R is earth's radius (mean radius=6,371km)

Case1: The vessel is approaching the IMBL but inside the country's border, the microcontroller activates the alarm and performs manipulation with new values

Case2:The vessel has crossed borders, .microcontroller activates the alarm also it sends information to coast guard vessels through RF communication in VHF range.

In Second Phase, on receiving information about trespassing by coast guard the fishing vessel can be controlled remotely through RF. Control on stepper motor rotation alters the boat's steering also alternative power up of turbines moves vessel in right and left directions. Hence with this feature the vessel can be dragged into country's boundary

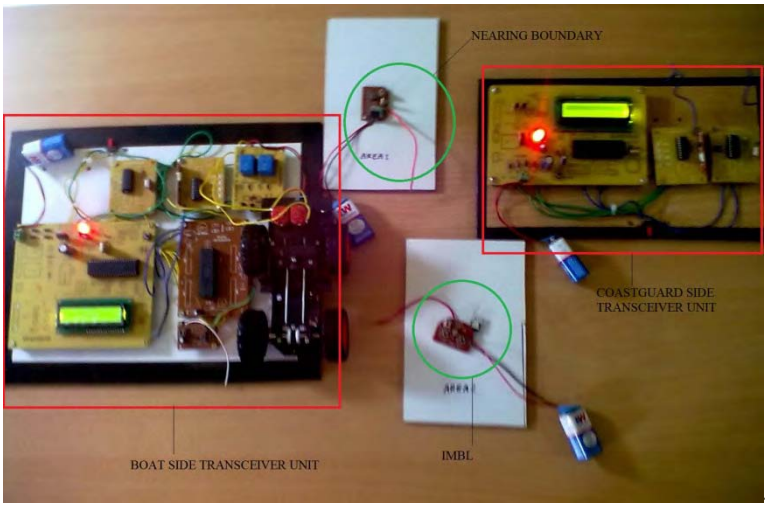

Fig 3. Hardware Setup

V.SETUP DISCUSSION AND SIMULATION RESULT

MAX232 dual-driver/receiver IC converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels to operate GPS module. PIC16F877 installed in the boat side compares the value as per above stated algorithm and activates buzzer which indicates Alarm. For RF module integration Data pin(2 pin) is connected with the 26 pin in PIC .On crossing the border , location is transmitted and viewed by LCD by coast guard . For this 16 x 2 LCD is used port 0 of controller is connected with LCD control pins with 0x80,0xC0 commands 1^{st} and 2^{nd} line display is set and with 0x01 command Display can be cleared. To hand steering stepper motor is interfaced with L39D IC in hardware and for simulation direct connection can be made. The DC motors connected in 15 and 16 pin resembles the turbine rotation of the vessel.

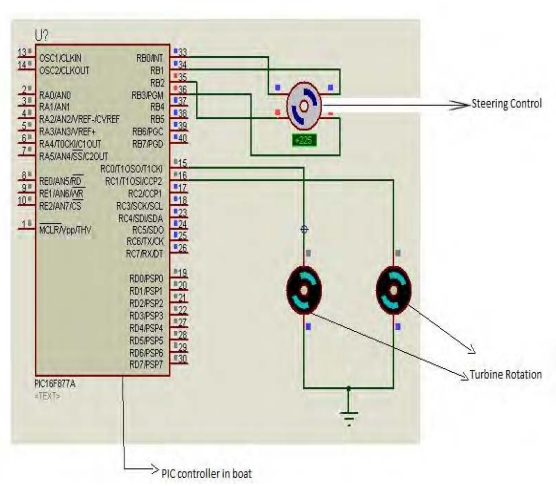

Fig 4: Simulation for Steering Control

VI. CONCLUSION AND FUTURE EXTENSION

Continuous monitoring on thousands of fishing vessels by coast guard ships through RADAR has practical difficulties. Thus with this discussed method effective surveillance is made which can monitor as well as to control the motivity of vessels. The fishermans can be penalized for seizing resources through trespassing. The idea can be extended to auto movement of fishing vessel as per the location (in term of latitude and longitude) fixed wirelessly by the coast guard ships, also effective auto-diving techniques can be brought out. Works can be made on establishing secure communication between fishing vessel and coast guard. On accounting all these issues may save many lives and resources.

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