Inter-IIT

TechMeet

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Safety System for Fishing Vessels

The Team

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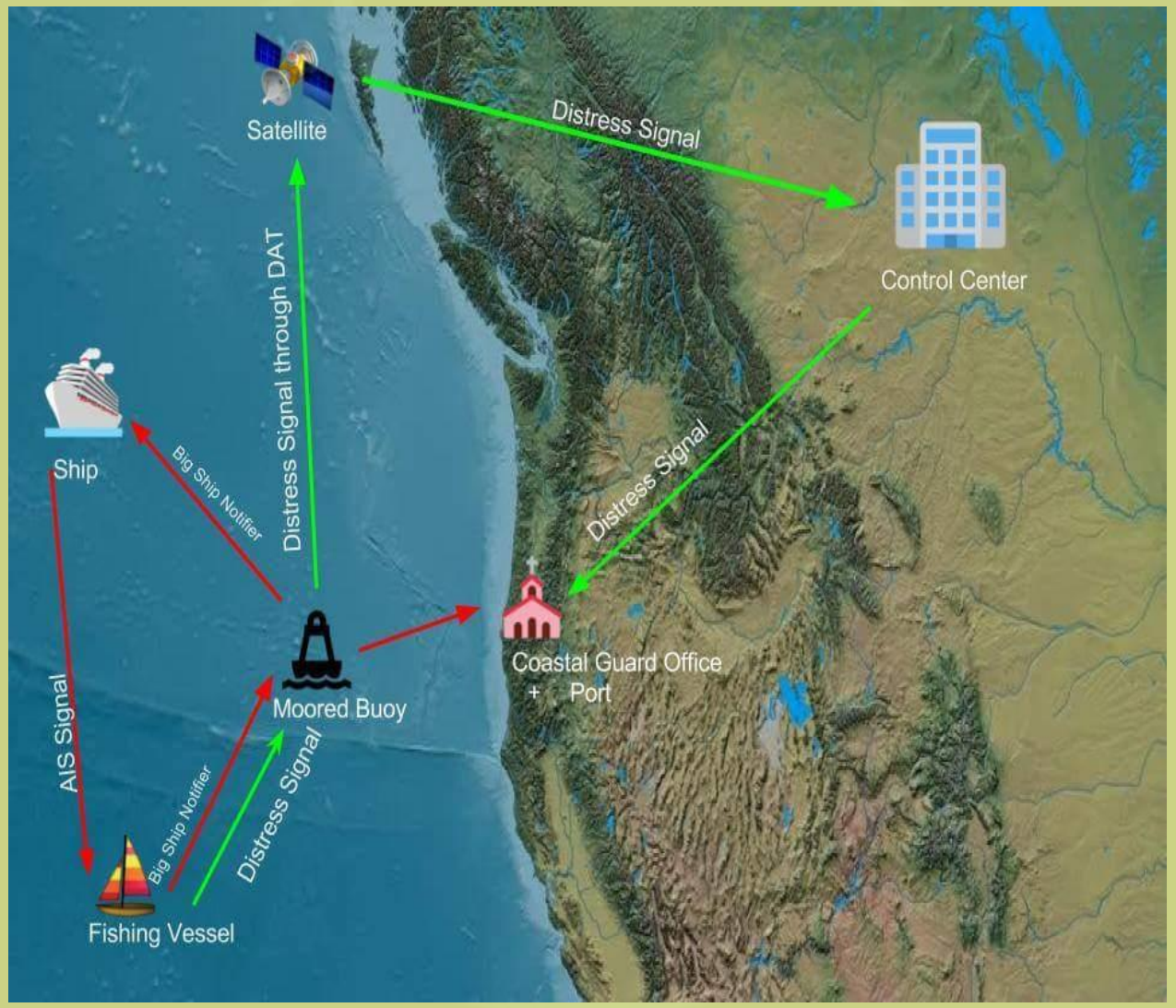
Project Objective

Currently, small marine vessels lack any safety mechanisms for anti-collision with other vessels. This often leads to collision of small vessels with huge ships especially during night time when the visibility is close to zero, which is caused due to many weather conditions like heavy rainfall or atmospheric fog. Very often, fishing vessels tend to turn off their power to conserve fuel when not needed rendering the conventional safety measures useless.

This calls for cheap, power-efficient and independent anti-collision system which can be easily installed on these fishing vessels. The currently available systems have a subsidized price around ₹35000.

Design


Satellite
Distress Signal
Control Center
Distress Signal through DAT
Ship
Big Ship Notifier
Distress Signal
Coastal Guard Office
+ Port
Moored Buoy
AIS Signal
Big Ship Notifier
Distress Signal
Fishing Vessel

Design – Notification of small vessel

- The basic principle of working is the fact that AIS signals attenuate with the inverse square of distance. Thus using the power the alert system can be easily controlled with a certain threshold.
- The relative direction of the large ship with respect to the fishing vessel is achieved by using a unidirectional antenna which is rotated *by 10° every 5 seconds.* As the antenna is unidirectional, the direction of closest approach can be predicted up to a precision of 45°. Thus, even in situations of poor visibility, the fisherman can plan a route for safe navigation.

The notification system is triggered when a certain power threshold is crossed. The notification system shall consist of two components.

- A loud alarm for the benefit of the occupants of the fishing vessel.
- A marine navigational signal light is lit up when the system is triggered. These type of lights are used on buoys to aid navigation and are effective to draw attention towards the fishing vessels.

Design – Notification of big ship

- When a small vessel gets a positive response from its system, it implies that some big ship is nearby and now it activates its low range transmitter to transmit a raw signal with very less modulation. This signal is intercepted by the big ship and hence it is warned that a small vessel is in the vicinity.

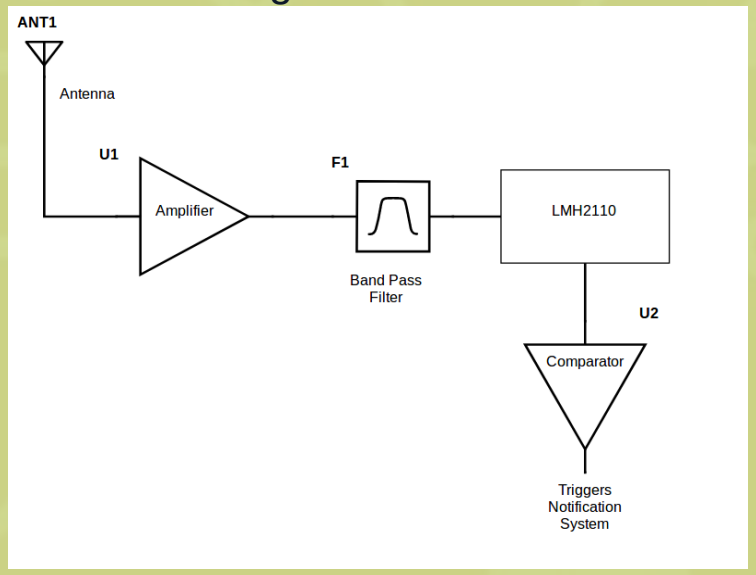
- In areas where there's a well established grid of buoys, this signal will reach the nearest buoy. Now, every single buoy will have its own transmitter and receiver. The role of buoys in warning big ships is to process the signal transmitted by a small ship in case big ship is nearby and to transmit a better modulated long range signal. The big ships will receive this warning signal from the buoy and will interpret that there are some small ships nearby and need to be careful. Hence using a network of buoys the efficiency can be improved upon.

Technical Details

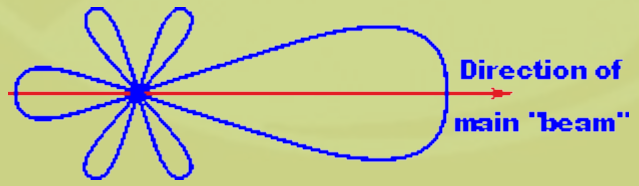
Just like any electromagnetic wave, the power of the AIS signal decays quadratic ally with distance (confirmed in many research papers like this).

$$Pr = k \cdot Pt \cdot (\lambda/4\pi d)^2$$

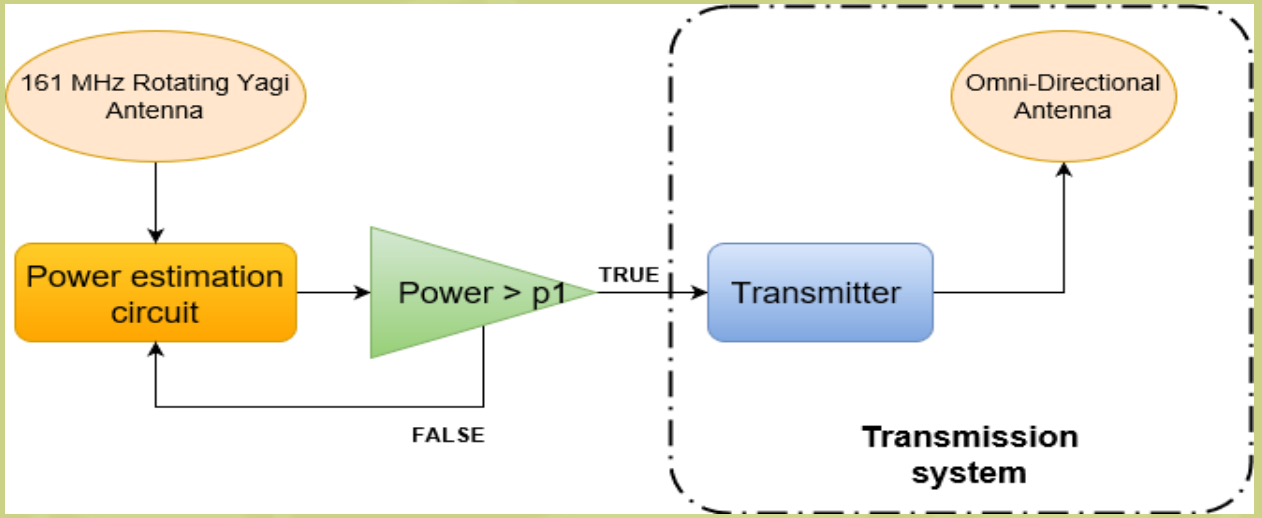
The block diagram of the circuit is given below:



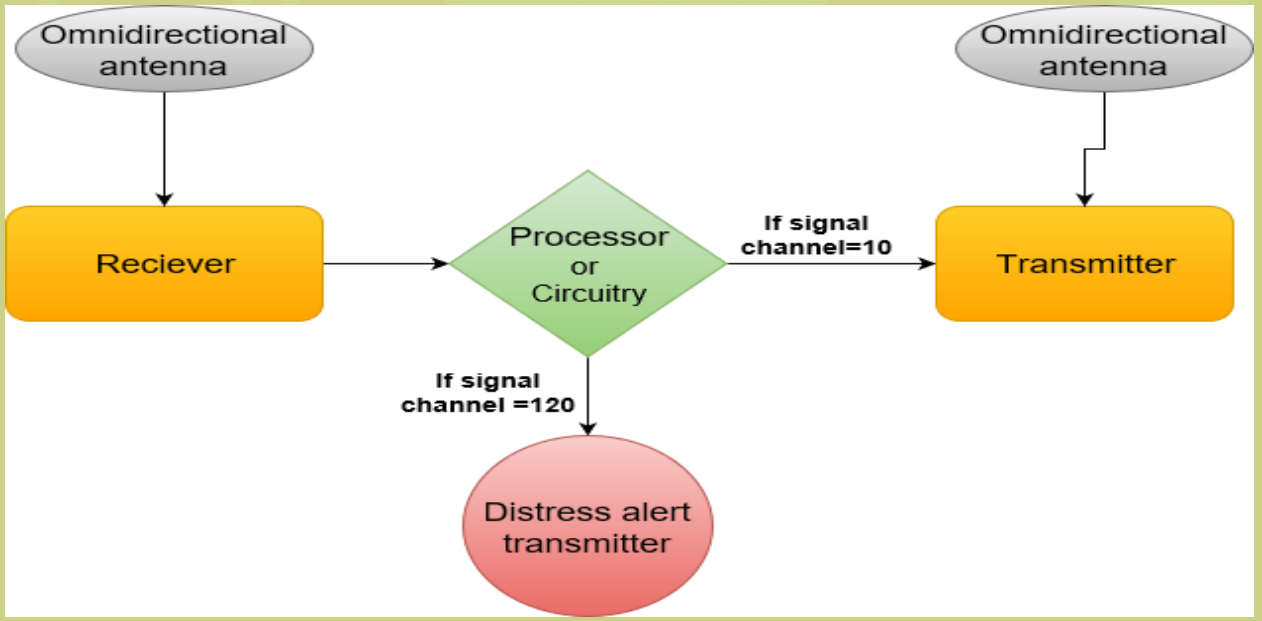
The antenna exhibits a directional pattern consisting of a main forward lobe and a number of spurious side lobes. The forward lobe indicates the direction from which it will receive the maximum power of the signal.



Technical Details



Circuitry included in the device on the small boat

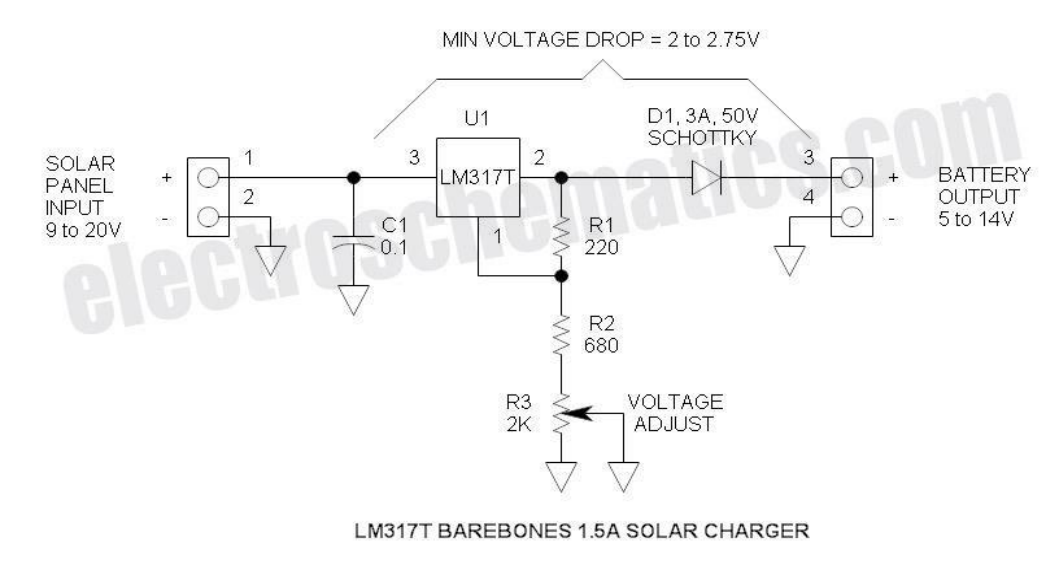


System proposed on buoys

Powering the entire system

Solar battery charger specifications

- Solar panel rating: 10W (6V)
- Output voltage range: 5 to 14V (adjustable) (may be reduced further by shorting R2)
- Typical dropout voltage: 2 to 2.75V (depending upon load current)
- Maximum current: 1.5A (internally limits at about 2.2A)
- Voltage regulation: ±100mV (due to regulation of series rectifier)
- Battery discharge: 0mA (this control will not discharge the battery when the sun doesn't shine)



Solar battery charger schematic

Budget and resource consumption analysis

Small boat device

The total cost of the device to be installed on the small vessel is **₹ 4780** only.

Big ship

As we only need a transceiver and a antenna the cost of that to be installed on the big ship is a meagre **₹ 300**.

System on Buoy

With just two transceivers and a processor (Mega – Arduino), the cost of the device proposed on a buoy is **₹ 1250** only.

Additional Objectives

Alerting the Coast Guard

- The system is implemented using a transmitter on the boat and installing Distress Alert Transmitters (DAT) on the buoys in the sea/ocean.
- In case of an emergency, the user can press a switch which will prompt the transmitter placed on the small boat to send a signal. The transceiver placed on the buoys shall act as a switch for the DAT which will then send a signal to the coast guard.

Weather Alert

- In 2017, cyclones caused a total damage of approximately $8.88 billion (2017 USD) with 761 fatalities. Within 36 hours of the centre passage, the pressure begins to fall. According to Indian Meteorological Department a Deep Depression (next only to cyclone strength) occurs if the sea level pressure lies between 999-990 hPa.
- Our system works upon the differences of pressure every hour.
    - If the pressure difference is less than 0.12 hPa then it glows level 1 indicator.
    - If the change is between 0.12hPa and 0.24 hPa it shows level 2 indicator,
    - If the change is more than 0.24 hPa, level 3 signal is triggered indicating approaching Severe Cyclone Storm.

Additional Objectives

National Boundary Alert

To alert the fishing vessel when it crosses the territorial boundary, we once again use our grid of buoys in the sea. The transmitters on the buoys will always send a signal carrying no information. If the fishing vessel is in the proximity of the port, it shall keep on receiving the signal. The received signal does not need to be demodulated, it just needs to be received. If the receiver fails to gather the signal, it implies that the fishing vessel has travelled too far away from the port and hence trigger an alert.

Market analysis(how this can replace existing alternatives)

- The current safety mechanism for fishing vessels costs around ₹ 35000 whereas our system costs only about ₹5000. When implemented on a mass scale, the saving is humongous.
- The device we are proposing to install on the small ship is quite compact and hence can be installed on any kind of vessel.
- Since our device does not use any heavy processor or a lot of sensors, its maintenance cost is very less which is quite beneficial in the market.
- Powering the system is done using a solar panel which is really cost effective and lasts for a long time without creating problems. Also, it's a renewable source of energy and eco-friendly.
- In India, there are about 2,00,000 traditional craft, 55,000 beach landing craft with outboard motors and 51,000 mechanised fishing vessels. The cost of a DAT system is ₹ 9999. Now, installing a DAT on every boat costs a lot of money which is why the current system is not feasible to implement everywhere. However, by installing DAT on only the nearby buoys which are way less in number compared to the number of boats we can cut down on the total cost of the system by a huge margin. Also, maintenance of a few DATs on buoys in much more easier than the maintenance on every vessel.