Emergency Indication and Warning System for fishermen

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Abstract— **This paper is done in the intention of saving and protecting our fishermen from natural disasters and boundary crossing. The device will consist of a tracker and a travel logger that will help locate the position of the fishermen by the coast guard. It will give a warning when the fishermen cross the boundary to themselves and to the coast guard. It will also consist of a sensor that will detect storm, and warn the fishermen and the coast guard in case of danger such as heavy storm, etc. In case of such danger or of any kind, the coast guard, nearby police station and hospital will be intimated automatically. The fisherman can also manually intimate the coast guard, nearby police station and hospital. If in case of tsunami alerts, the coast guard or the nearby police station can intimate the fishermen. This device also enables the alerts to reach the fishermen. Also the device will be made using a material such that it will float on water and will not be affected due to contact with water. The device will be run by solar cells and in the absence of sunlight, will be supplied by a 5V rechargeable battery.**

Keywords— **Lightning sensor, GPS tracker, GSM, energy efficient system, floatation device.**

I. Introduction

Commercial fishing is an industry where fishers and fishing vessel operators catch and trap various types of marine life for human consumption, animal feed, bait, and other uses. The vessels used by fishermen vary from small family owned boats that may consist of a crew of two or three fishermen to large vessels with large crews that are capable of bringing in thousands of pounds of fish and employ over 100 persons. Commercial fishing is the most dangerous profession in the India. On average, there are 118.4 deaths for every 100,000 workers each year. The main fatal events for fishing are: drowning, storm, boundary crossing, tsunami and also personal injuries. Considering the high risk involved in fishing, proper usage of safety equipment is needed to keep fishermen safe. Given the high risk of fishing, safety is an ongoing concern. Since the number of days a fishing boat has is limited, it becomes a challenge for fishermen to stay safe and still make a profit. If fishermen go out to sea only to find a dangerous storm, they might choose to fish through it because otherwise it would mean the loss of a day of fishing which would hurt their profits significantly. Fishermen on smaller vessels that return everyday to dock and don't spend as much time at sea each trip were less likely to ignore and belittle the dangers of fishing. These fishermen who work with smaller vessels have more control over when they fish and what conditions they go out to fish in, but they stay closer to shore than some of the larger fishing vessels.

This project is mainly done in the intention to protect and save these small scale fishermen. This refers to fishermen and other related fishing activities in order to help show the scope of this problem.

II. The system

A. Architecture

The system consists of a lightning sensor that is interfaced to the GSM unit via a microcontroller. The communication between the system and the coast guard is through a GSM unit. A GPS tracker is connected to determine the position of the fishermen. There is an emergency button that sends signal to the others via GSM unit along with the data from GPS tracker. Two separate alarms are used to indicate warnings of storm and tsunami. There is another alarm kept to warn them using the GPS when they are about to cross the boundary.LED displays indicate the status for easy communication.
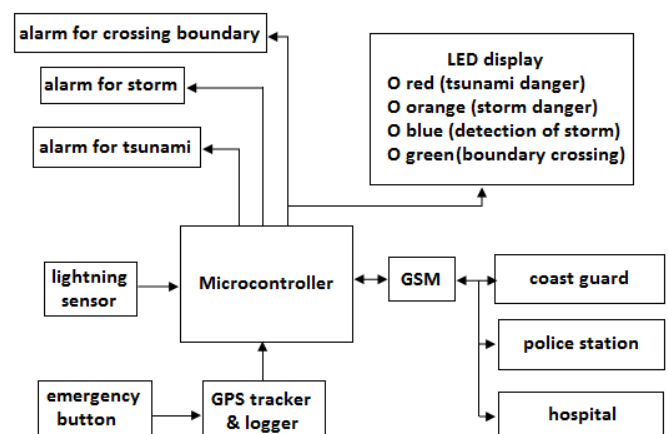
B. *The lightning sensor*

The AS3935 lightning sensor is a programmable fully integrated Lightning Sensor IC that detects the presence and approach of potentially hazardous lightning activity in the vicinity and provides estimation on the distance to the head of the storm. The embedded lightning algorithm checks the incoming signal pattern to reject the potential man-made disturbers.

The AS3935 can also provide information on the noise level and inform the external unit (microcontroller) in case of high noise conditions, with the noise floor generator and noise floor evaluation blocks. The AS3935 can be programmed via a 4-wire standard SPI or an I²C. Two clocks are internally generated by two different RC-Oscillators: TRCO and SRCO. The AS3935 can be either supplied by an internal voltage regulator or directly by VDD.

AS3935 is ideal for Weather Stations, Clocks, Sports Equipment, Portables, Pool Safety, Uninterruptible Power Supply (UPS), Global Positioning System (GPS), Cellular phones, Watches, and Golf equipments.

Key Features

- Franklin Lightning sensor provides early warning of lightning storm activity within a radius of 40km
- Distance estimation to the head of the storm down.
- Detects both cloud-to-ground and intra-cloud (cloud-to-cloud) flashes
- Embedded man-made disturber rejection algorithm
- Antenna Tuning to compensate variations of the external components
- Supply voltage range 2.4V to 5.5V
- Temperature range: -40° to 85°

B.1 *Pin description*
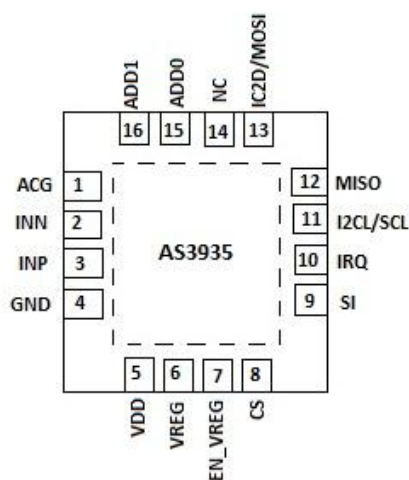
The choice of interface type (SPI vs. I²C) is accomplished using pin 9, SI (Select Interface). When the SI is connected to GND, the SPI is selected. When the SI is connected to VDD, the I²C is selected. Pins ADD0 and ADD1 are used to select among 4 different I²C address. The internal voltage regulator can be enabled by connecting EN_VREG to VDD. If the internal regulator is not used, a capacitor is not needed and VREG must be connected to VDD. In this case, the AS3935 can be directly supplied by VREG and VDD (EN_VREG to GND).

AS3935 needs the following external components:

- Power supply capacitor – CBAT – 1µF
- Load capacitor on the ACG and VREG pins; the latter is needed only in case the voltage regulator is enabled
- One, RLC resonators for the antenna
- One resistor on the I2CL pin to VDD, if I²C is active (R2 > 10kΩ)

B.1.1. *Lightning Algorithm*
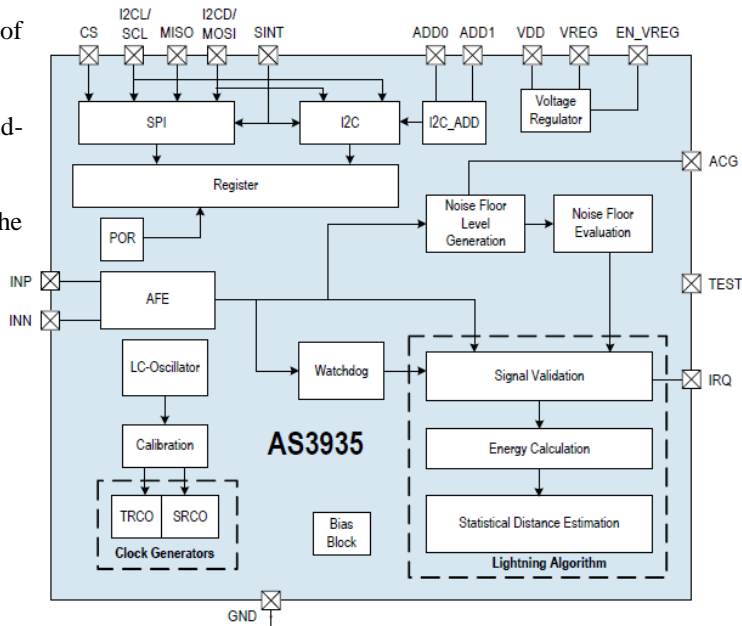
The external antenna is directly connected to the Analog Front-end (AFE), which amplifies and demodulates the received signal. The watchdog continuously monitors the output of the AFE and alerts the integrated lightning algorithm block in the event of an incoming signal. The lightning algorithm consists of hardwired logic.

The Lightning algorithm is broken up into three sub blocks:

1. **Signal validation:** Verification that the incoming signal can be classified as lightning.

2. **Energy calculation:** Calculation of the energy of the single event.

3. **Statistical distance estimation:** According to the number of stored events (lightning), a distance estimate is calculated.

Signal Validation

The watchdog enables the lightning algorithm block in the event any activities are detected at the antenna. As this happens the output signal of the AFE is evaluated by the Signal Validation block, which checks the pattern of the received signal. The signal validation checks the shape of the received signal.

Energy Calculation

If the received signal is classified as lightning, the energy is calculated. The result of the energy calculation is then stored in the registers. This value is just a pure number and has no physical meaning.

Statistical Distance Estimation

The AS3935 generates an assessment of the estimated distance to the head of an approaching storm. This assessment is done based on statistical calculation. The energy of the single event (lightning) provided by the Energy Calculation block is stored in an internal memory, together with timing information, in the AS3935. The events stored in the memory are then correlated with a look-up table by the statistical distance estimation block, which provides a final estimation of the distance to the head of the storm.

REG	Distance [km]
111111	Out of range
101000	40
100101	37
100010	34
011111	31
011011	27
011000	24
010100	20
010001	17
001110	14
001100	12
001010	10
001000	8
000110	6
000101	5
000001	Storm is Overhead

B.1.1.1. Operating Modes

Power-down Mode

In Power-down Mode, the entire AS3935 is switched off to reduce the current consumption to minimum.

Listening Mode

In listening mode the AFE, the watchdog, the noise floor level generation, the bias block, the TRCO, and the voltage regulator (in case it is enabled) are running. In this mode the system can push down the power consumption to a minimum (typ 60μA). In case the maximum voltage supply does not exceed 3.6V, it is possible to switch off the voltage regulator to save power.

Signal Verification

The AS3935 enters in this mode every time the watchdog detects dynamic activity picked up by the antenna (the incoming signal crosses a certain threshold). The IC will leave this mode either if the incoming signal is classified as disturber or if the analysis of the single event (lightning) is finished. If the received signal is classified as a disturber, then the AS3935 will automatically go back to listening mode without any needed action from outside and an interrupt will be generated (with option bit this interrupt can be masked). If the received pattern matches all requirements, the energy calculation is performed and the AS3935 provides distance estimation.

B.1.1.1.1. Noise Floor Evaluation

The output signal of the AFE is also used to generate the noise floor level. The noise floor is continuously compared to a reference voltage (noise threshold). Whenever the noise floor level crosses the noise threshold, the AS3935 issues an interrupt (INT_NH) to inform the external unit (e.g. MCU) that the AS3935 cannot operate properly due to the high input noise received by the antenna (e.g. blocker). It is possible to set the threshold for the noise floor limit with the bits as defined in the table below. INT_NH is displayed as long as the input noise level (blocker) is higher than the noise floor threshold. By default the setting **REG0x01 [6:4]** =010 is used.

I/P noise level (outdoor)	I/P noise level (indoor)	REG0x01 [6]	REG0x01 [5]	REG0x01 [4]
390	28	0	0	0
630	45	0	0	1
860	62	0	1	0
1100	78	0	1	1
1140	95	1	0	0
1570	112	1	0	1
1800	130	1	1	0
2000	146	1	1	1

C. Implementation of the system

The device which consists the lightning sensor AS3935 senses the storm that is within a radius of 40km, the output of which is fed to the microcontroller. The warning signal along with the information from the GPS tracker is sent to the coast guard, nearby hospital and police station via a GSM unit. The warning is also indicated to the fishermen by activating an alarm and also giving a light display through LED lights. The LED displays are programmed to make the blue light glow

when the storm is detected within the 40km range. The orange light glows when the storm approaches very close.

The tsunami warning that usually does not reach the fishermen can also be given to the fishermen using this device. When there is a tsunami alert, the coast guard or the police can send a warning signal to the fishermen through the GSM unit. The indication is given to the fishermen through another alarm. The LED is also programmed to show red light when there is a tsunami alert. The position of the fishermen from the GPS tracker is also sent to the coast guard and others during this process.

The device also warns the fishermen using the GPS tracker when they near the boundary. The green LED glows when they are a kilometre near the boundary using GPS logger. The alarm warns when they almost reach the boundary.

The emergency button is given in order to help the fishermen during personal injuries and other problems. When the emergency button is pressed, a signal is sent to the coast guard and the others, again along with the position of the fishermen from the GPS tracker.

This device will also be designed and made using a floatation material, a material that will float on water and that will not drown under water. It will be designed in a way that it is water-proof and float-free. The device will be supplied by power from solar cells and during the absence of sunlight, will be supplied by a 5V rechargeable battery.

III. Existing systems and disadvantages

A. Emergency Position-Indicating Radio Beacons (EPIRBs)

EPIRBs are electronic devices mounted on vessels in order to aid the Coast Guard in locating vessels in distress. Having a properly installed and registered EPIRB helps the Coast Guard perform a more efficient Search and Rescue. But many fishermen are unwilling to purchase EPIRBs for their vessels. Restrictions on where and when fishing is allowed have reduced profit margins and forced fishermen to cut expenses wherever possible. Due to the cost of purchasing EPIRBs, ($500 to $700 for Category I EPIRBs and $400 for Category II EPIRBs), some fishermen feel that the benefit of using EPIRBs is not worth the expense

Unfortunately, there is much false activation of EPIRBs. The main issue faced is that due to improper use and training, false alarms may occur. There are many factors that can trigger an EPIRB false alarm, several of which are related to incorrect installation. One potential reason for this is a lack of proper education, on how to install, test and maintain an EPIRB. The second problem is that of the EPIRBs in use on fishing vessels, 18% are not registered with the National Oceanic and Atmospheric Administration (NOAA).Another issue is physical problems with EPIRBs. These problems can lead to false activations that the crew is unaware of.

B. Further advantages

The existing systems are used only for large vessels. Hence the small scale fishermen can benefit from this project. The independent fishermen may possess additional motivation to be cautious since they will bear the cost of any loss. Also this device uses very less signal power whereas the existing systems use as much as 5watts.

The device gives a warning before disasters happen and works automatically, i.e., the signals transmission and reception takes place automatically unlike earlier systems. There is also no need to wait for a response from the fishermen or the coast guard like earlier system. There is automatic two-way communication.

The EPIRBs require training for operating the beacon whereas this device does not require any training. It is mostly automatic. This is very much advantageous in Indian fishermen as most of them are illiterates. Separate alarms for tsunami and storm, and also LED light displays make it easy for such fishermen.

The fishermen have suffered a lot because of the boundary issues. This device helps them in preventing themselves from crossing thus preventing national conflicts.

The device is float-free, i.e., it does not drown under water. The device is also corrosion resistant and water resistant. It uses solar cells for supply and in the absence of sunlight, it uses a rechargeable battery. This gives a long battery stand for the device. Safety to these fishermen is not just having expensive equipment, they take a cautious approach to fishing and they believe it keeps them safe.

IV. Conclusions

No matter how many safety regulations are introduced or mandated by the Coast Guard and training made available to commercial fisherman it is inevitable that vessels at sea will get in trouble. Fast and efficient search and rescue of the fishermen is essential. The developed device achieves this capability. This device is especially very advantageous for Indian fishermen due to its compatibility and affordability.

Acknowledgment

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