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Shipborne Monitoring System Using Lora Technology

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Abstract: This Paper proposes a global localization system based on Lora technology where the position data is parsed and displayed for the end-user's consumption. This work provides an alternative ship-tracking system to the existing Automatic Identification System (AIS), A reader installed on the boat measures the received signal strength indication (RSSI). This paper focuses on implementing border identification system for all boats. However, the existing system is not powerful enough to prevent the crime against fishermen as it gives only the information about the border identification but not about the exact distance that the boat has travelled from the border. It provides lesser possibility to know about their location in case of any danger. The proposed system's transmitter section includes Seismic sensor and Ultrasonic sensor in order to pick up Tsunami seismic signals and Coral reefs respectively, Arduino microcontroller Lora module, APR voice playback circuit, Relays and DC motor and the receiver section includes Master Lora module which is connected to PC as monitoring database in the controlroom of the port.

Keywords - Ultrasonic sensor, LoRa, Vibration sensor, UART.

.I. INTRODUCTION

The main Objective of our project is the boat localization based on the LORA technology This project focuses on the boat localization that is finding the location of the boat irrespective of the climatic conditions and border identification that is guiding the boat about the border and making the boat not to cross the border by turning off the engine .The proposed system comprise of Arduino UNO, Lora modules, DC motor and the monitoring will be done by the PC in the control room.

This system gives three kind of alerts to the fisherman in the boat .The first alert will be given in the form of message The second alert is ,if the distance between the fisherman and the border does not decrease despite of the alert message then the APR voice board will alert the person that there is a border at a certain distance ahead .The third alert will be in the form of action that is the boat engine will be turned off so that he cannot cross the border, In case of disaster we can also communicate from the base station to every boat using this LORA module, we can also alert the base station from boat if the seismic sensors in the boat reached its threshold, we are using a ultrasonic sensor to detect coral reefs which helps to prevent the fishermen's net get damaged.

II. TECHNICAL DESCRIPTION

A. Ultrasonic sensor

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distance to particulate in the air or water. An ultrasonic transducer is a device that converts energy into ultrasound, or sound waves above the normal range of human hearing. While technically a dog whistle is an ultrasonic transducer that converts mechanical energy in the form of air pressure into ultrasonic sound waves, the term is more apt to be used to refer to piezoelectric transducers that convert electrical energy into sound.

B. Vibration sensor

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. Piezoelectric sensors have proven to be versatile tools for the measurement of

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various processes. They are used for quality assurance, process control and for research and development in many different industries. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones.

Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000°C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezoceramic materials.

Principle	Strain sensitive	Threshold	Span to threshold ratio
Piezoelectric	5.0	0.00001	100,000,000
Piezoresistive	0.0001	0.0001	2,500,000
Inductive	0.001	0.0005	2,000,000
Capacitive	0.005	0.0001	750,000

C. UART

A Universal Asynchronous Receiver Transmitter is a type of "asynchronous receiver transmitter", a piece of computer hardware that translates data between parallel and serial forms. A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. The UART takes bytes of data and transmits the individual bits in a sequential fashion. The UART takes bytes of data and transmits the individual bits in a sequential fashion. A UART is used to convert the transmitted information between
its sequential and parallel form at each end of the link. Each UART contains a shift register which is the fundamental method of conversion between serial and parallel forms.

D. LoRa

LoRa Module LoRa is a less power wide area network (LPWAN) protocol invented by semtech. It is based on spread spectrum intonation techniques derived from chirp spread spectrum (CSS) technology. LoRa module works on technology named LoRaWAN which is the communication protocol and system architecture for the network, while the LoRa physical layer enables the long-range communication link. LoRaWAN is also responsible for managing the communication frequencies, data rate, and power supply for all devices.

Devices in the network are non-synchronous and transmit when they have data available to send. information sent by an end-node device is received by multiple gateways, which forward the data packets to a centralized network server. The network server remove impurities and duplicate packets, performs security checks, and controls the network. Data is the forwarded to application servers.The technology shows highly reliability for the moderate load; however, it has some performance issues related to sending acknowledgements. LoRa Gateway The LoRa sensors sends data to the LoRa gateways. The LoRa gateways connect to the internet via the standard IP protocol and send the data received from the LoRa embedded sensors to the Internet i.e., a network, server or cloud. The Gateways devices are always connected to a power reference. LoRaWAN supports communication in both directions. A single LoRaWAN Gateway can assists 1,000s of devices or nodes, multiple Gateways provide flexibility to smart solutions.

III.PROPOSED SYSTEM

The proposed methodology uses LORA technology and it is used to measure the exact distance between the boat and the border. It uses the same technology to send the message to the fishermen that there is a border ahead. Next it uses APR voice alert to send a voice note to the fishermen.

If the boat continues to go ahead in spite of the alerts given then this system will help to turn off the engine by converting the electrical energy to the mechanical energy to save the fisherman from crossing the border. The key components used

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in this system are Arduino Uno, LORA modules, APR voice Board, Vibration sensor (seismic), ultrasonic sensor, Relays and DC motors .

IV METHODOLOGY

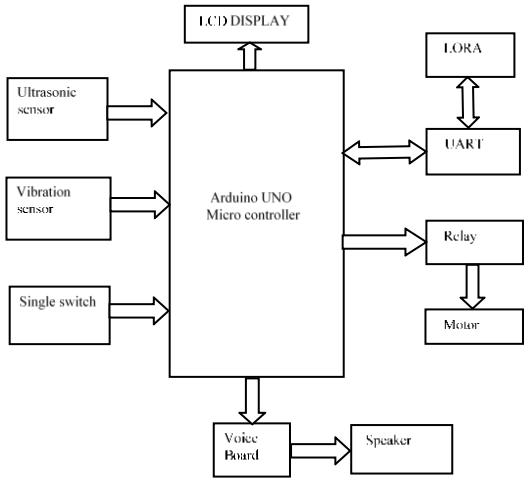

Figure 1. Block Diagram of transmitter section

Figure 2. Block Diagram of receiver section

V. FUNCTIONAL DESCRIPTION

The sensing element is a precise piezoceramic ring-shear system. It measures vibration acceleration. The acceleration signal is amplified followed by an integrator for vibration velocity.

The signal is high pass filtered at 1.5 Hz (KSI 80VB) or 10 Hz (KSI 82VB) and low pass filtered at 1000 Hz with 2 pole filters. The frequency band of model KSI 82VB from 10 to 1000 Hz is usually sufficient for vibrations caused by unbalance. It is also recommended in standard ISO 10816-1. In some applications with slow running machinery it may be necessary to measure from 1.5 to 1000 Hz with model KSI 82VB. A true RMS rectifier and a 4-20 mA current loop converter make the signal ready for long distance transmission. With the KSI 80VB / KSI 82VB no separate power supply is required. The sensor is loop powered.

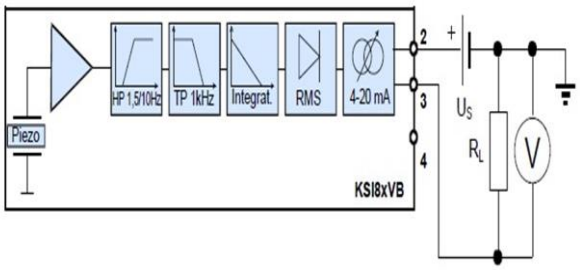

Fig.3 Function of piezoceramic ring-shear system

APR 9600

The APR9600 block diagram is included in order to give understanding of the APR9600 internal architecture. At the left hand side of the diagram are the analog inputs. A differential Microphone amplifier, including integrated AGC, is included in-chip for applications requiring its use.

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The amplified microphone signal is fed into the device by connecting the Ana_Out pin to the Ana_In pin through an external DC blocking capacitor. Recording can be fed directly into the Ana_In pin through a DC blocking capaciton. However, the connection between Ana_In and Ana_Out is still required for playback. The next block encountered by the input signal is the internal anti-aliasing filter. The filter automatically adjusts its response according to the sampling frequency selected so Shannon's Sampling Theorem is satisfied. After anti-aliasing filtering is accomplished the signal is ready to be clocked into the memory array. This storage is accomplished through a combination of the Sample and Hold circuit and the Analog Write/Read circuit. These circuits are clocked by either the Internal Oscillator or an external clock source. When playback is desired the previously stored recording is retrieved from memory, low pass filtered, and amplified as shown on the right hand side of the diagram. The signal can be heard by connecting a speaker to the SP+ and SP─ pins.

Chip-wide management is accomplished through the device control block shown in the upper right hand corner. Message management is controlled through the message control block represented in the lower center of the block diagram.

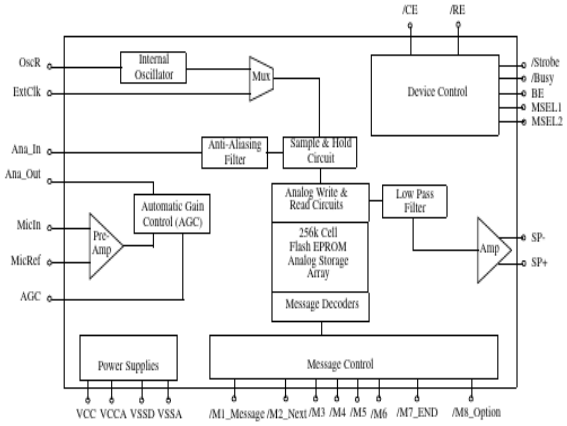

Figure 4.Block diagram of APR 9600

Message Management General Description:

Playback and record operations are managed by on chip circuitry. There are several available messaging modes depending upon desired operation. These message modes determine message management style, message length, and external parts count. Therefore, the designer must select the appropriate operating mode before beginning the design.

Operating modes do not affect voice quality, for information on factors affecting quality refer to the Sampling Rate & Voice Quality section.

Modes cannot be mixed. Switching of modes after the device has recorded an initial message is not recommended. If modes are switched after an initial recording has been made some unpredictable message fragments from the previous mode may remain present, and be audible on playback, in the new mode.

These fragments will disappear after a record operation in the newly selected mode.

Table 1 defines the decoding necessary to choose the desired mode. An important feature of the APR9600 message management capabilities is the ability to audibly prompt the user to changes in the device's status through the use of "beeps" superimposed on the device's output. This feature is enabled by asserting a logic high level on the BE pin.

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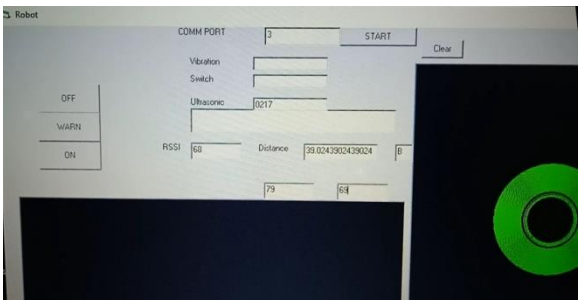
Table 1

Mode	MSEL1	MSEL2	/M8_Option
Random Access 2 fixed duration messages	0	1	Pull this pin to VCC through 100K resistor
Random Access 4 fixed duration messages	1	0	Pull this pin to VCC through 100K resistor
Random Access 8 fixed duration messages	1	1	Becomes the /M8 message trigger input pin
Tape mode, Normal operation	0	0	0
Tape mode, Auto rewind operation	0	0	1

Features of APR s9600:

1. Non-volatile Flash memory technology.
2. User-Selectable messaging options.
3. User-friendly, easy-to-use operation.

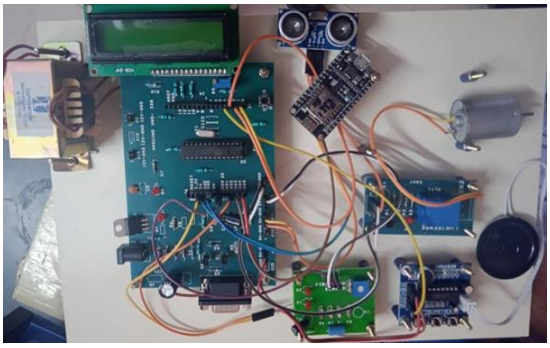
VI RESULTS AND DISCUSSIONS



Thus an efficient internal ship communication is carried out using LoRa technology. All the parameters within the ship are monitored and transmitted using LoRa module without any delay. All these data are received in control room of the port. It gives an exact distance that the boat has travelled from the border and it provides greater possibility to know about their location incase of any danger. Added advantage of LoRa technology is that they can be used even underwater where no other means of communication would be possible and reliable.

VII CONCLUSION

The RSSI level affected by the human body, when the human stands at the different distance within All and nearby the wireless links, is studied. The effect of human movement with different movement patterns on the RSSI level is also investigated. The experimental results using a 2.4 GHz, IEEE 802.15.4 wireless network demonstrate the characteristic of the average RSSI level for the case the human standing at each distance. Also, real-time RSSI signals affected by human movement for different movement patterns are shown. In the future work, an RSSI-based human detection and tracking system with more transmitter and receiver nodes will be developed. Also, human detection and tracking algorithms will be designed based on findings investigated in this work.



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