Reliable Surveillance System for Intruder Detection using Wireless Sensor Network

Radhika G
Asst. Professor, Dept. Of ECE
MVJ College Of Engineering
Bangalore-560067,Karnataka,India

Remya Ramesan
Asst. Professor, Dept. Of ECE
MVJ College Of Engineering
Bangalore-560067,Karnataka,India

Pavana H
Asst. Professor, Dept. Of ECE
MVJ College Of Engineering
Bangalore-560067,Karnataka,India

***Abstract* - Surveillance is a most serious problem for border control, protection of power stations and other security of commercial facilities [1]. The protection against intruders, unlicensed marine ships, such as picaroon, smugglers or, unauthorized fishermen is difficult. In this paper, we present a reliable solution for ship intrusion detection. Equipped with ultra sonic sensors and 3 axis accelerometer deploy an experimental Wireless Sensor Network (WSN) on the sea's surface to detect ships. Ultra sonic sensor will be used to detect the objects if it comes across and 3-axis accelerometer will detect the intruder ship whenever it's axial position changes. The detected analog signal from 3-axis accelerometer and digital signal from ultrasonic sensor will be given to the microcontroller .From the microcontroller the digital signal will be formed as a packet consisting of date, time and node id and will be sent to the server node using Zigbee. The server will receive this signal using Zigbee in the receiving side and it will be displayed as alert message using LabVIEW software in the surveillance system.**

Keywords - Intruder detection, wireless sensor networks, surveillance system, LabVIEW

I. INTRODUCTION

Intrusion detection on the sea is a very crucial surveillance problem today, particularly for security of power stations, and protection of oil platforms. The detection using satellite images will be easily affected by bad weather and by using radar fails to detect small boats [1]. Another disadvantage is that they offer high cost.

The invasion detection on sea surface using wireless sensor network is recently developed. Due to the advancements in the wireless communication, information technologies and electronics field, Wireless sensor network are the recent trends [2].

Low-cost, low-powered, sensors development are receiving more attention today. Recent developments use acoustic sensors, thermal sensors [2]. Sensor network is designed to detect the intruders, then collect the data, process the data and transmitting information to surveillance system. These sensors are working well on the land surface and fail to detect on the sea surface. Since, while deploying such sensors on sea they are not stationary, will be moving randomly [1].

Wireless sensor network has been used in high-end applications and detection of nuclear-threats system, ships detections and biomedical applications [2].

In this paper, we propose a new approach: detecting ships by taking the characteristics of waves generated by ships with WSNs [1]. Experimental WSN to detect ships by using ultrasonic sensors along with three-axis accelerometer sensor have been deployed on sea surface on buoys. The use of ultrasonic sensor will detect the intruder whenever they pass across and three axis accelerometer will detect the intruder whenever it's axial position changes.

The ultrasonic transmitter in the aerodrome will transmit the signals in all the four direction, these signals will reflect back to the receiver when any object or person comes on transmitting line. At any time if there is any object or person entering in to the area, we are indicating by passing this information to the control room with Zigbee transmitter.

By using the combination of both the sensors, our project is very efficient and more effective. Whenever both the sensors detect then, that will be intimated as a high priority alert to the surveillance system and if single sensor is detected, that will be intimated as medium priority, and then we have to give attention to nearby nodes. If we use three axis accelerometer alone, we may miss to detect boats if they frequently stops and move. This combination of sensors increases the effectiveness and reduces the risk of missed alert and false alarms.

II. SURVEILLANCE SYSTEM DESIGN

The hardware platform used for our project consists of two node types.

One is sensor node which is to be set up on the sea surface and other one is server node which is connected to the PC at the surveillance system security manager's room. Once the detection found, it will be displayed as alert using LabVIEW software.

A. Sensor node Components

In this setup we are going to use 2 types of sensors. One is 3 axis accelerometer sensor, which is to be set up on the sea

surface another is ultrasonic sensor which is above the sea surface.

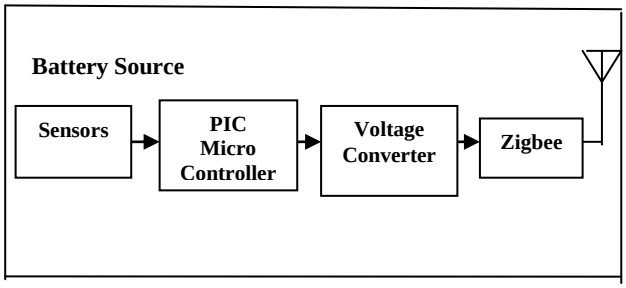


Fig: 1 Block diagram of Sensor node Component

1.Sensors:

- **Three-Axis Accelerometer:**

In our project the 3 axis accelerometer will sense the intruder's ship whenever it's axial position changes. It measures the analog voltage according to the angle of tilt and it will be send to the PIC micro controller as voltage and it will be converted as angle and intimated to receiver side using Zigbee device which is at the sensor node side.

- **Ultra Sonic Sensor:**

Ultrasonic sensor detects the intruder's ship whenever it passes across. We placed 4 ultrasonic sensors at the top to detect intruder in all direction. These detected signals will be sent to PIC Micro controller and which is intimated to surveillance system server node using Zigbee at the sensor node side.

2. Voltage Regulators

In our project we are using 2 voltage converter one to down convert the voltage according to PIC Microcontroller, and other converter to convert voltage level according to Zigbee.

3. PIC Microcontroller

The PIC microcontroller processes data and controls functions of all components in the sensor node. We can also use microprocessors, digital signal processors, Field programmable gate array or Application specific ICs [2]. The advantages of microcontroller like low power utilization and flexibility in connect to other devices makes microcontroller for choosing as the best choice among the others [2]. As microprocessors need more power we are not selecting it on the other hand as we want wireless communication meek and simple we have not chosen Digital signal processors as our choice [2].

4. Zigbee at Transmitter side

Zigbee is a wireless mesh network standard which is low in cost and occupies less power consumption. Since Zigbee is of low in cost it is commonly deployed in wireless monitoring Applications. Its low power consumption characteristics allow longer battery life. Generally Zigbee vendors provide Zigbee with 60KB and 265KB flash memory. Wireless mesh network provides higher reliability and wide range.

Zigbee Operates in ISM radio Band. Zigbee protocols are proposed for embedded applications requiring low data rates and low power consumption. Typical application areas of Zigbee include embedded sensing and industrial control.

B. Server node Components

The Server node components include, Zigbee, Personal computer with Graphical User Interface and RS232 cable for PC to Zigbee interface. In our project we are using LabVIEW software to show the alert in the surveillance system.

The Zigbee at the receiving side continuously receives data from sensor node and stored in the database. Whenever it crosses the maximum limitations it will be will be displayed as message with priorities includes Medium and High, Which will be stored in database for future reference

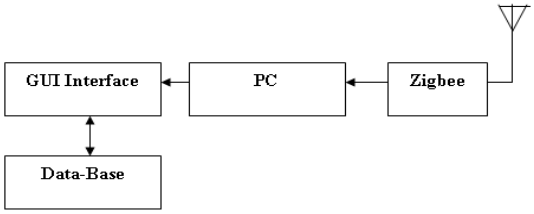


Fig: 2 Block diagram of Sensor node Component

1. Zigbee at receiver side

In the server node the Zigbee is used to receive the data from the sensor node. The data message from the transmitter side will be of the form of packets consisting of date, time and node ID and stored in the database for future reference.

2. LabVIEW

It is a visual programming language from National Instruments. This programming language in LabVIEW is also referred to as G. This is a dataflow programming language. The structure of a graphical block diagram determines the execution. The programmer connects different function-nodes by drawing wires.

The variables are propagated through this wires and any node can execute once all its input become available. The built in scheduler will automatically exploit the multiprocessing and multithreading hardware, it will multiplex the multiple OS threads.

- GUI Interface (LabVIEW)

We are using LabVIEW as GUI interface to display the alert message. The alert message is of different priorities. When signals from both the sensors are positive, we are displaying it as high priority and if the detection is from a single sensor, it will be of medium priority and the nearby clustering nodes have to be monitored for final decision.

III.METHODOLOGIES USED

We are using two different sensors in order to make the detection decision more effective. One is ultrasonic sensor and other is 3 axis accelerometer sensor. The 3 axis

accelerometer is deployed on the sea surface using buoys and the ultrasonic sensor is placed two feet above the sea surface.

The three axis accelerometer will detect the intruder whenever it's axial position changes where as the ultrasonic sensor will detect the intruder whenever they pass across. The detected signal will be processed by microcontroller and sent to the surveillance system server using Zigbee at the sensor node.

At the receiving end, server node side the Zigbee is used to receive the alert message and sent to the Personal computer using RS232 cable and displayed as alert message using LabVIEW.

A.Detection Types

- Node level
- Group level

Node Level Detection:

In the node level detection, the aim of the single node is to detect ship waves generated by a close by passing ship [1]. Once the node detects the intruder ship, it will be intimated to a local head node for further classification. As because the ship waves are train of waves, it last for only few seconds, so we have set the threshold accordingly [1]. The local head node will sent it back to the surveillance system room using PIC and Zigbee. At the node level the detection will be of two forms, one from 3 axis accelerometer and other from Ultrasonic sensor. Sometimes node level detection fails to detect the intruder due to the surroundings and weather condition. To make the detection more reliable we are also provide Cluster level detection.

Group level Detection

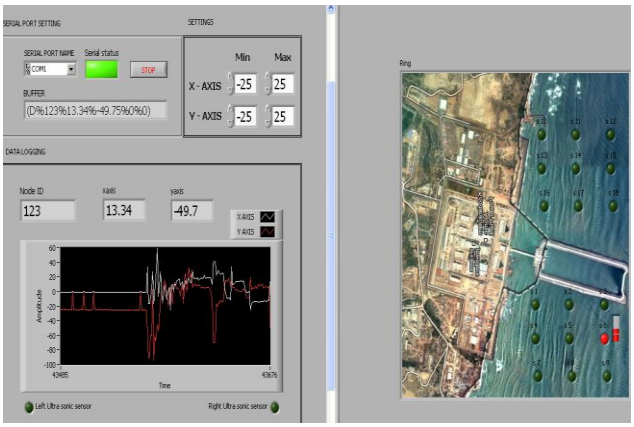
In order to provide better and reliable detection and also to reduce the false alarm rate as much as possible we are providing another solution called cluster level detection. In Group level detection, groups are formed according to the geographical area [1].

In the Group level detection, Detection from all nodes is sent to local header node for final confirmation [1].

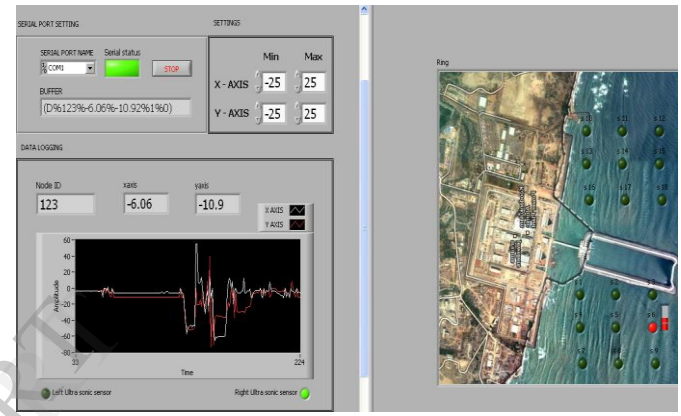
Even though we are using 2 sensors to make the detection more powerful, we are providing group level detection to make the detection still more reliable and efficient.

IV.RESULTS

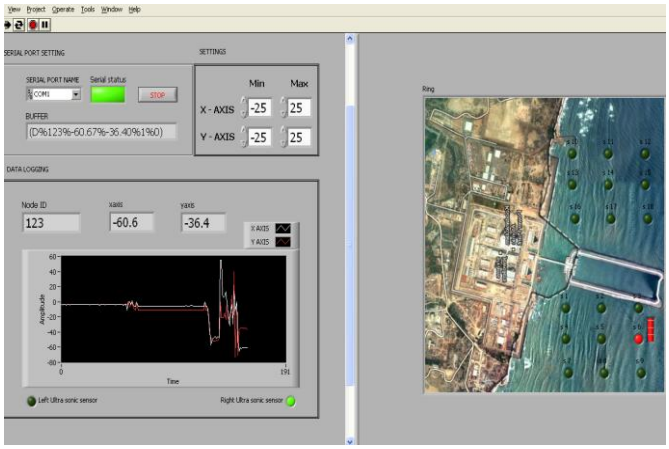
i) LabVIEW snap shot for the detection of intruder when using 3-axis accelerometer alone.



ii) LabVIEW snap shot for the detection of intruder when using ultrasonic alone.



iii) LabVIEW snap shot for the detection of intruder when the detection is from both 3 axis accelerometer and ultrasonic sensor.



In the First case the priority will be minimum as the detection is only due to 3 axis accelerometer and for the second case the priority is high, since the detection from both the sensors.

The graph shows the improved detection rate by using the combination of 2 sensors instead of using any one.

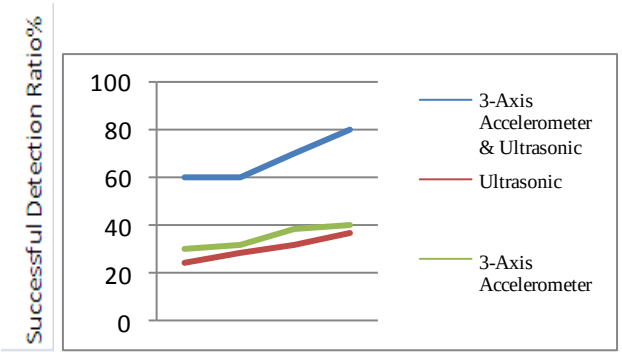


FIGURE 4.1: COMPARISON GRAPH

V.CONCLUSION AND FUTURE WORK

In this Paper we introduce a creative method to detect the intruder in the sea surface using wireless sensor networks. We are used the combination of two wireless sensor namely three axis accelerometer sensor and ultrasonic sensor. By using the combination of two sensors, the detection will be more reliable and also we reduced the false alarm rate as well as detection failure rate. We are also giving priority to alerts to make the detection more significant. From the results we concluded that the surveillance detection system using the ultrasonic and three axis accelerometer can be useful for more reliable detection on the sea surface.

Power management is another important thing in this project; we are going to try using solar panels to get power instead of using batteries. This we left for our future work

6. REFERENCES

[1]. Hanjiang Luo, Kaishun Wu, Zhongwen Guo,Lin Gu , and Lionel M. Ni,"Ship Detection with Wireless Sensor Networks" IEEE Transactions On Parallel And Distributed Systems,Vol.23, No 7, July 2012

[2]. Yussoff, Y.; Abidin, H.Z.; Rahman, R.A.;Yahaya, F.H., "Development of a PIC-based wireless sensor node utilizing X-Bee technology" The 2nd IEEE International Conference on Information Management And Engineering (ICIME), 2010

[3]. Absar-ul-Hasan, Ghalib A. Shah & Ather Ali," Intrusion Detection System using Wireless Sensor Networks 2010" on EJSE International Special Issue.

[4]. T. He, S. Krishnamurthy, J. A. Stankovic,T. F. Abdelzaher,L. Luo, R. Stoleru, T. Yan, L. Gu, J. Hui, and B. Krogh. "An energy-efficient surveillance system using wireless sensor networks". In Proc. of Intl. Conf. on Mobile Systems, Applications, and Services (MobiSys), June 2004

[5]. Y.M.Yussoff, R.A.Rahman, N.H.Abidin, F.H.Yahaya, "Performance Analysis of Wireless Sensor Network", Conference on Signal Processing and Applications (CSPA 2009).

[6]. M. Augusto, M. Vieira, C.N. Coelho.Jr., D.C. da Silva Jr., J. M. daMata, 'Survey on Wireless Sensor Network Devices',W.S. Lan FAkyildiz, yogesh Sankarasubramaniam, Erdal Cayirci,"A Survey on Sensor Network,"IEEE Communication Magazine,pp. 102,

[7]. L. Gu et al., "Lightweight Detection and Classification for Wireless Sensor Networks in Realistic Environments," Proc.Third Int'l Conf. Embedded Networked Sensor Systems (SenSys '05),pp. 205-217, 2005

[8]. A. Arora et al., "A Line in the Sand: A Wireless Sensor Network for Target Detection, Classification, and Tracking," Computer Networks, vol. 46, no. 5, pp. 605- 634, 2004.

[9]. S. Kumar, T. Lai, and A. Arora, "Barrier Coverage with Wireless Sensors," Proc. MobiCom, pp. 284-298, 2005.

[10] M. Duarte and Y. Hen Hu, "Vehicle Classification in Distributed Sensor Networks," J. Parallel and Distributed Computing, vol. 64, no. 7, pp. 826-838,2004.