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Marine Monitoring & Early Warning Detection using Wireless Sensor Networks: Challenges

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Abstract: *Marine monitoring using wireless sensor networks (WSN) is a challenging area of research due to the instability of the oceanic environment. The early warning system for ocean monitoring and defending is an instant need of the hour constraint for avoiding huge losses in marine world. It can be possible using the information gathering technologies, such as ultrasonic, radar, machine vision, infrared, laser, and other integrated technologies, such as wireless sensor networks, underwater marine detectors and computer information processing. It sound like science fiction, but the fact in today's technology is to know about the complexity in ocean monitoring, managing and protecting the marine safety. This paper mainly focuses on the applications of WSNs and early detection measures of marine Traffic Control Technology using WSNs involved to protect oceanic marine world.*

Keywords: Wireless Sensor Networks, Marine monitoring, applications of WSN, Sensor Nodes

INTRODUCTION

The only way to save the Oceanic environment is to open up the new ways in which we learn and understand the complexity of marine life, and we can monitor waters and coasts. The key aspect for turning on the vision of saving the marine life put into reality is the availability of an effective and cooperative underwater sensing, reasoning, and communication platform. This makes possible for sensing and actuating devices to exchange data and signals, network (connect) together, collaboratively and locally asses their observation environment and act upon.

The Early detection of oceanographic threats and traffic control has been recognized as one of the first priorities and effective ways in saving marine environment. However, the detection is based on some of the traditional morphological methods that represent enormous technical challenges in the marine realm. The design, implementation and deployment of a WSN for oceanographic applications that poses new challenges different to the ones that arise on land, as the impact of the marine environment on the sensor network limits and affects their development. This paper highlights the main components necessary to form an ideal marine based WSN system, and some projects involved in implementing control and security in Marine WSNs.

Objectives of the study

1. A study on the applications of WSNs a
2. To study on early detection measures of marine Traffic Control Technology using WSNs.

Research Methodology

The study is based on secondary sources.

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Applications of WSNs:

Let us see few of the real-time applications [4] where WSNs plays a vital role in identifying and detecting the problems in early stages and can take immediate & effective measures to resolve the problem. The following are the different categories of applications based on WSNs,

➢ **Home automation & Consumer Electronics** - Developing commercial application of sensor network is no so hard to imagine. The Home appliance like

- Smoke detectors,
- Refrigerator door detectors,
- alarms, watches, electric kettles,
- sensor doors, sensor lights, etc.

➢ **Industrial Control & Monitoring** - An interesting application to civil engineering is the idea of Smart Buildings: wireless sensor and actuator networks integrated within buildings which allows the distributed monitoring and control, improving living conditions and reducing the energy consumption.

➢ **Security & Military Surveillance** - Military applications are many.

- DARPA's[4] is a self-healing minefield, where it organizes by itself in a sensor network and its peer-to-peer communication between anti-tank mines is used to respond to attacks and redistribute the mines in order to heal breaches, complicating the progress of enemy troops.
- Another application called "Urban Warfare" has distributed sensing lends itself to assemble nodes that could be deployed in a urban landscape to detect chemical attacks, or track enemy movements.

➢ **Environmental Sensing** - Two different real-time examples will help us in knowing the importance of sensors in Environmental and habitat study.

- Intel's Wireless Vineyard [4], this application helps to collect and interpret data, but also to use such data to make decisions aimed at detecting the presence of parasites and enabling the use of the appropriate kind of insecticide.
- Habitat monitoring on Great Duck Island - This project is successfully running using WSNs to watch the habitat of ducks in the process of
  - nesting burrows over the 24-72 hour cycle
  - members of a breeding pair alternately
  - incubation and feeding at sea …
  - Changes in burrow and surface environmental parameters during the 7-month breeding season …

➢ **Health care** - Medical research and healthcare can greatly benefit from sensor networks:

- Sensors used in Vital sign monitoring and accident recognition
- wearable sensor nodes that can store patient data such as identification, history, and treatments.
- a sensor that helps in taking care of the elderly people, especially if they are affected by cognitive decline
- a bunch of network sensors and actuators could monitor them and even assist them in their daily routine by reminding them of their meals and medications.
- Sensors are effectively used to capture vital signs from patients in real-time and relay the data to handheld computers.

Sensor Node Components

The sensor node components of a WSN enables wireless connectivity within the network, while connecting an application platform at one end of the network with one or more sensor nodes or actuator devices in any part of the network. The specific use of components such as gateways and nodes is to create a transparent data path between application platform and the physical world. Wireless sensor networks are used to exchange information between an application platform and different sensor nodes. This exchange takes place in a wirelessly.

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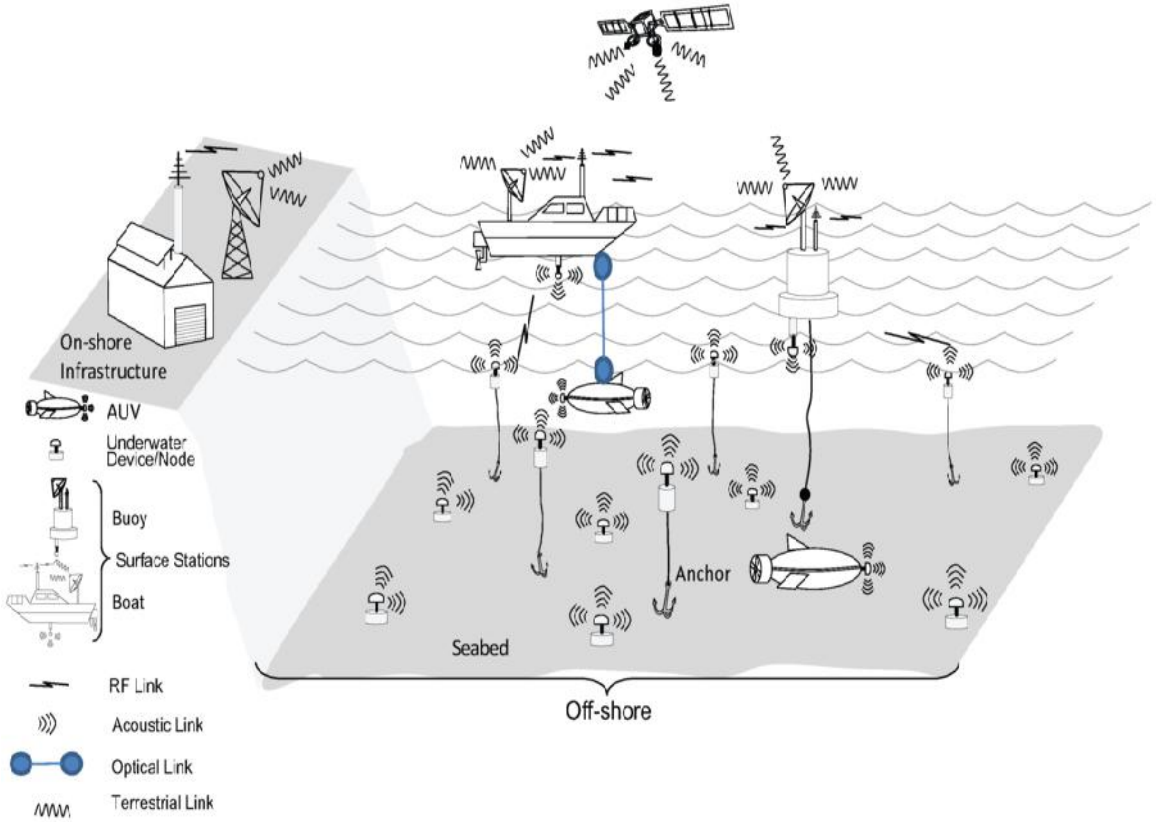

Figure 2.1 Shows the scenario of the elements commonly used in the design and implementation of a sensor nodes. It includes a flotation device such as a buoy to keep part of the node out of the water. This out-of-the-water part always includes an antenna for RF transmission, optionally a harvesting system to supplement the power source. And in some cases there is need to essentially monitor meteorological data with one or more external sensors to control wind speed, air temperature, atmospheric humidity, etc. The AUV (Autonomous Underwater Vehicle) is submerged into the water and is a part of the node is composed of one or more sensors, which may be placed at different depths. An Off-shore Infrastructure set up is made ready to control the acoustic and radar signals for detection the sensors signals in a marine traffic environment. There is an optical link provided to the AUV and to boat to receive the propagated signals from the architecture of sensor nodes. An additional support of terrestrial link is given by wireless Sensor network in connection with Satillete signaling and sensor base station signaling to receive the acknowledge of signals and connectivity to each other in this architecture.

Operating systems in Sensor Nodes

The Operating systems that supports Sensors are TinyOS[2] and Contiki[1]. TinyOS [3] is an open source, flexible, component based, and application-specific operating system designed for sensor networks. TinyOS can support concurrent programs with very low memory requirements. Contitki is a lightweight open source OS written in C for WSN sensor nodes. Contiki is a highly portable OS and it is build around an event-driven kernel. Contiki provides preemptive multitasking that can be used at the individual process level. A typical Contiki configuration consumes 2 kilobytes of RAM and 40 kilobytes of ROM. These two are the most widespread operating systems. Other operating systems developed for WSNs include MANTIS, SOS, SensorOS and MagnetOS.

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Main Tasks of Sensor Nodes:

There are different models for monitoring applications, where the data flows primarily from the sensor node to the gateway, and for control applications, where the data also flows very frequently from the gateway to sensor nodes. The following figure shows the main tasks of sensor nodes which includes

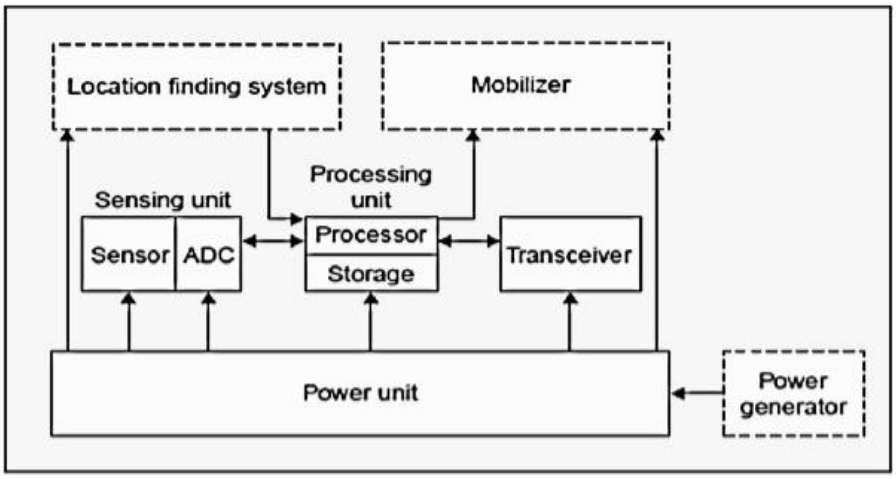
Processing Unit - has a Processor with Storage unit connected to Power Unit works exclusively to process and stores the data and the signals received from the Transceiver and carries forwards to Mobilizer and Sensing Unit for further action.

Sensing Unit - has a Sensor and ADC (Analog-to-Digital Converter) connected to a main Power Unit for power generation. This unit mainly senses the acoustic and radar signals from the water and helps to find the location of AUV.

Transceiver - is connected to a main Power Unit which gives the signals to the processing unit

Power Generator - hold the whole control on the sensor node system and gives the power supply internally connected to each component of the system.

Mobilizer - is a unit which acts a mediator between the signal receiver and the signal generator for finding the location of a any marine vehicle in the ocean.



Early Detection of marine Traffic Control:

Due to the characteristics of the water environment, there are certain considerations which must be taken into account before the establishment of marine based wireless sensor networks. The following are some of the most important factors to consider the need of early detection of marine traffic:

- The aggressive nature of marine environment is one of the factors in which it requires greater levels of device protection.
- Allowing movement of nodes must be made for the cause of tides, waves, vessels, etc.
- It is generally necessary to cover large distances, while communications signals are attenuated due to the fact that the sea is an environment in constant motion since the energy consumption is high.
- The price of marine based WSN instrumentation is significantly higher than in the land-sited WSN.

In spite of all these negative aspects, various studies of monitoring of marine ecosystems using WSNs can be found in reviews and literatures. The solutions have in common is that they are largely designed and implemented ad-hoc (buoys, electronics and software), and oceanographic sensors and other related components.

The Communication of information performed in under water environments is via a hybrid network, which combines a multi-hop underwater acoustic communications with cabled communications (whenever

require and available). An option to improve link reliability or bridge otherwise, the Collaborative beam forming will also be considered in disconnected network portions. The resulting underwater monitoring platform is then interconnected with centers where the information is stored and processed.

To enhance the utmost early detection in marine realm the following factors can influence. These include the deployment of wireless nodes (WNs), energy consumption, network connectivity and security.

Conditions/ Situations	Environmental Set up/ Conditions	Suggested measures to be taken into consideration
High Waves & tides,	Connect the signal through off-shore base station by the help of optical and terrestrial waves to detect where the AUV is.	Monitor the System Based on ZigBee Wireless Sensor Network
High Wind & Strom	Connect the signal through off-shore base station by the help of optical and terrestrial waves to detect where the AUV is.	Monitoring System Based on ZigBee Wireless Sensor Network
Signal off due to damage of AUV	Connect the signal through Satellite station by the help of optical and terrestrial waves detect where the AUV is.	Smart Environmental Measurement & Analysis Technology (SEMAT): Wireless Sensor Network in Marine Environment
Network Damage made by marine Animals	Connect the signal through Satellite station by the help of optical and terrestrial waves detect where the AUV is.	Development of Data Video Base Station in Water Environment using Wireless Sensor Networks
Not Receiving any signals from the control station	Physical surveillance is required to know the last seen signal propagation	Development of Data Video Base Station in Water Environment using Wireless Sensor Networks

Submarine Surveillance through WSNs:

A Project named CLAM assigned to University of Twente, Norway, The Netherlands University of Rome, Italy University of Padova and Italy CINI, Italy in the year 2010 for the purpose of submarine surveillance has successfully reached the point of effective monitoring and control using Wireless Sensor Networks.

The ultimate goal of the CLAM [3] project is to provide to the technical problems of meeting requirements of various underwater applications. [3] It has got a constructive solution to develop a collaborative embedded monitoring and control platform for submarine surveillance by combining cutting edge acoustic vector sensor technology and 1D, 2D, and 3D sensor arrays, underwater wireless sensor networks protocol design, advanced techniques for acoustic communication, new solutions for collaborative situation-aware reasoning and distributed data and signal processing and control for horizontal and vertical linear sensor arrays. In this scenario Autonomous Underwater Vehicles (AUVs) can travel through such systems, the data is continuously processed and disseminated in real time, thereby providing a live view of what's happening.

Measures to protect Oceanographic Marine World:

The deep-seated parameters relating to WSNs, combined with the technologies such as Beidou navigation and positioning, images and meteorological sensor information, geographic information, remote sensing information, forms a marine resource digital information management system that provides a full range of electronic monitoring and protection for the oceans.

What policy planners can save our Ocean [6]

- The best plans for developing coastal management plans and marine spatial planning, including marine protected areas.
- Increase efforts to develop more sustainable fisheries and aquaculture

- Marine World Heritage site managers can be strengthen the network so that they can serve as drivers for ocean conservation to protect our Crown Jewels.
- Protection measures to be taken to increase coverage for the most iconic ocean places for under the World Heritage Convention.
- Adopt or develop few models for the legal protection of natural and cultural heritage located in regions beyond national jurisdiction. This can be done, through a cooperation model as proposed by the UNESCO Convention on the Protection of the Underwater Cultural Heritage.[6]

The task of an engineer, based on information collecting technology and wireless sensor networks and the wireless sensor network is a self-organizing network composed of a large number of sensor nodes, which sets such three technologies as the sensors, micro-electromechanical systems and network in one. With the continuous development of micro-electromechanical system MEMS, wireless communication technology and electronic technology, the practical field of wireless sensor networks is becoming wider and wider.

Conclusion:

Imagine a world where we just spread a number of sensor nodes in the water, some on the sea floor, others floating at different depths, and these devices were able to communicate with each other, in parallel they organize themselves into a network, exchange data among themselves, identify the regions and resources that are experiencing some phenomenon of particular concern to the user, and eventually deliver this information to one or more collection points where it can be easily and economically accessed or transmitted.

The WSN's aim is to sense, collect and process the information of the objects in the network coverage and send it to the data processing center to provide the basis for ocean monitoring and managing and protecting the marine safety. In turn autonomous underwater vehicles (AUVs) can travel through such systems and by transmitting messages with various sensors, downloads the data and bring it back ashore for the scientists to examine. Here the data is continuously processed and disseminated in real time, thereby providing a live view of what's happening in the marine worlds to access the threats before a huge loss. Today's technology is in fact very close to making all these possible by opening up new ways in which we learn and understand the complexity of submarine life, and we can monitor waters and coasts.

References:

1. Dunkels, A.; Gronvall, B.; Voigt, T. Contiki a Lightweight and Flexible Operating System for Tiny Networked Sensors. In Proceedings of the 9th Annual IEEE International Conference on Local Computer Networks, Washington, DC, USA, October 2004; pp. 455-462.
2. Levis, P.; Madden, S.; Polastre, J.; Szewczyk, R.; Whitehouse, K.; Woo, A.; Gay, D.; Hill, J.; Welsh, M.; Brewer, E.; Culler, D. Tinyos: An Operating System for Sensor Networks; Available online: http://dx.doi.org/10.1007/3-540-27139-2_7 (accessed on 17 April 2011).
3. CLAM CoLlAborative eMbedded networks for submarine surveillance: Project Coordinator Name: prof.dr. P.J.M. Havinga Institution: University of Twente Email: p.j.m.havinga@utwente.nl
4. Wireless Sensor Networks for Oceanographic Monitoring: A Systematic Review Cristina Albaladejo, Pedro Sánchez *, Andrés Iborra, Fulgencio Soto, Juan A. López and Roque Torres
5. Wireless Sensor Networks: Applications and Challenges of Ubiquitous Sensing Abstract © DIGITAL VISION Feature Daniele Puccinelli and Martin Haenggi
6. Healthy Ocean, Healthy People, Know your Ocean – UNESCO Study