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− A Short Note

UNDERWATER WIRELESS SENSOR NETWORKS

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ABSTRACT

Underwater communication is necessary for scientific applications like monitoring climate change, algae bloom, seismic activities, industrial applications like oil exploration and military applications. The deployment of underwater sensor nodes is being carried out after the successful implementation of terrestrial sensor networks. With the disadvantages faced by traditional communication methods when deployed underwater, the underwater sensor networks are fast gaining acceptance. The problems faced by underwater nodes are different from those faced by terrestrial nodes. In this paper we provide a study of the developments in underwater wireless sensor networks. The use of Underwater Wireless Sensor Networks (UWSN) with Autonomous Underwater Vehicles (AUN) has helped in monitoring the ocean beds, oil exploration, military observations etc.

Key words: Underwater communication, UWSN, UAN.

INTRODUCTION

With more than 70% of our planet covered by water underwater studies are required for the next generation of science and business[1]. It is however difficult to collect underwater data. The successful deployment of wireless sensor networks on the ground lead to their underwater deployment. Communication between sensors and base station or between the nodes is different from the terrestrial scenario. Communication using electromagnetic waves is not feasible because of high attenuation and absorption effect of water. Optical communication is affected by scattering. Acoustic communication is the most feasible mode of communication[2]. Acoustic modems have severe range limitations and channel variations[3]. A solution is to use mobile autonomous underwater vehicle (AUV) equipped with an acoustic modem to gather data from the sensors[4].

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Deployment of networks

The deployment of underwater sensor networks can be done in two types of architectures. In the two dimensional architecture[5] the nodes communicate with the sink through a multihop path. The sinks have a horizontal transceiver for communicating with the nodes and a vertical transceiver for communicating with the surface station. In the three dimensional architecture the nodes are floating at different depths[5]. The underwater communication faces the challenges of propagation delay, absorption, noise interference, multipath interferences etc. The range is also limited. We have to deploy underwater vehicles to collect the data from the nodes. Autonomous underwater vehicles (AUV) are deployed to gather data through acoustic modems.

Issues and challenges

The deployment of senor nodes underwater has its own issues and challenges. The nodes can get damaged or lost. Hence redundancy has to be factored in. The nodes are also supposed to be underwater for longer duration and energy consumption should be limited. Techniques like sleep mode have to be considered. The modulation techniques to be used should take into consideration the bandwidth, speed and bit error rates applicable. Frequency Shift Keying has good bandwidth efficiency and can resist channel variations. The disadvantage or drawback is the low data rate due to guard bands and guard time intervals. Frequency hopped FSK has been proposed to remove the guard intervals. Modulation techniques including CDMA and MIMO have been considered lately. Localisation problems also have to be considered. The drift of sensors and AUVs due to ocean currents is also a factor.

Data collection

The AUV with its acoustic modem is used to collect the data from the sensors. The AUV moves around the water bed and data has to be collected. The path of AUV should be planned so as to minimize the time and fuel spent. Hollinger et al.[5] have considered this problem by extending approximation algorithms for variants of the travelling salesman problem. Carrick Detweiler et al.[6] have proposed gradient based decentralized controller that dynamically adjusts the depth of a network of underwater sensors to optimize sensing for computing maximally detailed volumetric models

Applications

The applications of underwater wireless sensor networks range from scientific to military applications. Climate changes can be monitored by observing the algae growth using underwater networks. The seismic activities taking place underwater can be monitored for early warning systems. With tsunamis occurring frequently these networks are very much essential. Oil exploration costs form a big part of the oil extracting expenses. Deploying these networks reduce the exploration costs. Monitoring of underwater equipments can be done using these networks. Monitoring the international maritime borders for intrusion is an effective application. Monitoring the movement of fishes and guiding the fishermen is also a potential application of underwater wireless sensor networks.

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