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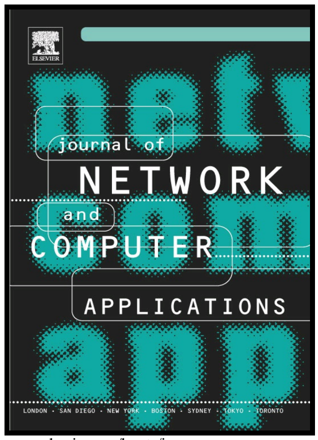

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Chien-Fu Cheng, Lung-Hao Li

PII: S1084-8045(16)30239-9
DOI: http://dx.doi.org/10.1016/j.jnca.2016.10.010
Reference: YJNCA1737

To appear in: *Journal of Network and Computer Applications*

Received date: 13 April 2016
Revised date: 26 September 2016
Accepted date: 18 October 2016

Cite this article as: Chien-Fu Cheng and Lung-Hao Li, Data Gathering Probler with the Data Importance Consideration in Underwater Wireless Senso Networks, *Journal of Network and Computer Applications* http://dx.doi.org/10.1016/j.jnca.2016.10.010

Data Gathering Problem with the Data Importance Consideration in Underwater Wireless Sensor Networks

Chien-Fu Cheng[1,2,*] and Lung-Hao Li[1]

[1] Department of Computer Science and Information Engineering,
[2] Graduate Institute of Networking and Multimedia,
Tamkang University
No.151, Yingzhuan Rd., Tamsui Dist., New Taipei City 25137, Taiwan
Email: *cfcheng@mail.tku.edu.tw* (*Corresponding Author)

Abstract

In Underwater Wireless Sensor Networks (UWSNs), if sensors rely on multi-hop transmission to send sensing data to the sink above the water, sensors that are closer to the water's surface will deplete energy sooner because they share a larger load of the packet relaying work. This problem becomes worse if the water being monitored is very deep. This imbalance in energy consumption can be effectively mitigated by using an Autonomous Underwater Vehicle (AUV) to collect data. However, if the data to collect are important, the delay time required by this data gathering method may be too long. In this study, we integrate the two data gathering mechanisms mentioned above, namely utilization of AUVs and multi-hop transmission, to reduce the problem of unbalanced energy consumption and long delay time. Moreover, we also investigate how to determine the importance level of data and set delay time requirements without domain knowledge. Our purpose is to deliver data of higher importance to the sink within the delay time requirement. Our experimental results confirm that the proposed method can effectively mitigate the imbalance in energy consumption, reduce the delay time required for delivering important data, and also prolong the network lifetime.

Keyword: *underwater wireless sensor networks, data gathering, importance level of data, delay time requirement*

1. Introduction

Underwater Wireless Sensor Networks (UWSNs) have received attention from many researchers in recent years. This is due to the fact that UWSNs allow us to acquire various kinds of information about an ocean or a lake for various applications (Domingo, 2012; Mitra et al., 2015; Vasilescu et al., 2005). For example, by monitoring the movement of seawater (i.e. ocean currents monitoring), we can forecast climate changes or detect earthquakes (Mohapatra et al., 2013); by monitoring the concentration of a specific pollutant in the ocean (i.e. pollution monitoring), we can maintain the health of the ocean environment (Jadaliha and Choi, 2013; Li et al., 2015; Yang et al., 2002); by monitoring military waters (i.e. strategic application), we can prevent invasion of enemy battleships, submarines or torpedoes (Headrick and Freitag, 2009).

However, UWSNs are very different from terrestrial Wireless Sensor Networks (WSNs) in nature. For instance, terrestrial wireless communications exchange messages via radio waves at a transfer rate is about 3×10^8 *m*/*s* (Radio Broadcasting, 2016). In underwater, radio waves do not work for wireless communications, because seawater is a natural filter that will reduce the traveling distance of radio waves to only about 1