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A Multi-Layer Cluster Based Less Energy Consumption Routing Algorithm for Underwater Sensor Networks

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ABSTRACT: Underwater Wireless Sensor Networks (UWSNs) have drawn tremendous attentions from all fields because of their wide application. Underwater wireless sensor networks are similar to terrestrial Wireless Sensor Networks (WSNs), however, due to different working environment and communication medium, UWSNs have many unique characteristics such as high bit error rate, long end-to-end delay and low bandwidth. These characteristics of UWSNs lead to many problems such as retransmission, high energy consumption and low reliability. To solve these problems, many routing protocols for UWSNs are proposed. In this paper, a localization-free routing protocol, named energy efficient routing protocol based on layers and clusters (MLCEE) is proposed. Protocol consists of three phases: layer and unequal cluster formation, transmission routing, maintenance and update of clusters. In the first phase, the monitoring area under the water is divided into layers; the nodes in the same layer are clustered. For balancing energy of the whole network and avoiding the "hotspot" problem, a novel unequal clustering method based on layers for UWSNs is proposed, in which a new calculation method of unequal cluster size is presented. Meanwhile, a new cluster head selection mechanism based on energy balance and degree is given. In the transmission phase, MLCEE protocol proposes a novel next forwarder selection method based on the forwarding ratio and the residual energy. In the third phase, Intra and inter cluster updating method is presented. The simulation results show that the MLCEE can effectively balance the energy consumption, prolong the network lifetime, and increase the amount of data transmission compared with DBR and MLCEE protocols.

KEYWORDS: Multi-hop routing, Cluster Head (CH), Underwater Sensor Network (UWSN), Depth Based Routing (DBR), Energy efficient

I. INTRODUCTION

The basic architecture of UWSNs is, in which sensor nodes are randomly deployed and static sink is placed on the surface of the monitoring area. The sensor nodes send their sensed data to static sink either by means of multi-hop communication or through direct communication. In multi-hop communication, sensor nodes forward the sensed data to their one-hop neighbors until the data reached the sink (surface). Due to noise and link impairments, there is an excessive chance of data corruption during multi-hop communication. Moreover, a hot-spot problem occurs in multi-hop communication because sensor nodes near sink deplete their energy very quickly and these nodes die earlier, therefore the area of interest remains unobserved. To cope with the hot-spot problem, mobile sinks are used in many routing protocols for data collection from sensor nodes in their vicinity. Furthermore, in existing protocols sensor nodes near sink are often nominated for data sending, such unstable load of transmission on these nodes cause initial death of sensor nodes and produce energy holes in the network. As a result of these energy holes, some areas in the network remain un-sensed. Whereas in direct communication, nodes at distant positions in the network also send their sensed data directly to surface sink which causes quick consumption of energy of those nodes. The nodes at a distant position die earlier and cause coverage whole problem.

The mobile sinks are better to collect information from sensor nodes at minimum distance in order to avoid coverage whole problem. In this article, we present an MLCEE routing protocol for UWSNs. This protocol aims at mitigating the issues of hotspot, high error rate and high consumption of energy In this scheme, the entire network region is divided into different layers from surface to bottom and in every layer, nodes are clustered. According to Ekman from the surface, the stream of water is very high and sensor nodes will change its position quickly. Therefore, taking energy balance into consideration in first layer due to the high stream of water, clustering will not be formed and the nodes in the first layer will directly transfer data to the sink node. So other than the first layer, clusters will be formed at each layer for the purpose to balance the energy consumption. In this scheme, we present different algorithms such as an algorithm for assigning Hopid and clustering. Data aggregation performed by CHs and transfers the aggregated data to sink node by utilizing hop by hop route from one CH to another.

II. RELATED WORK

In previous UWSN [1] Design of efficient routing protocols for underwater sensor networks is challenging because of the distinctive characteristics of the water medium. Currently, many routing protocols are available for terrestrial wireless sensor networks. However, specific properties of underwater medium such as limited bandwidth, high propagation delay, high bit error rates, and 3D deployment make the existing routing protocols inappropriate for underwater sensor networks. In this paper, we provide a guideline on use of existing underwater routing protocols, identify their shortcomings, and give an insight on what is needed to design an efficient and reliable underwater routing protocol.[2] Terrestrial wireless sensor networks (TWSNs) are subject to extensive research and development. Numerous applications take advantage of low-cost, small-sized, easily configurable and scalable TWSN nodes to monitor, detect, and track various environmental phenomena and events. The recent advancement in electronics and sensor miniaturization and low power technologies enabled TWSNs to extend their reach to underwater applications. Underwater wireless sensor networks (UWSNs) can be used in many new applications. Yet, UWSNs development is dependent on a number of technological challenges that need to be overcome. In this paper, we present an overview of UWSNs, their applications, and their challenges. We also present a survey of various UWSN architectures currently used in deployed UWSN systems.

III. PROPOSED WORK

In an environment like underwater, the acoustic signal is embraced as correspondence medium for communication, that prompts more consumption of energy. The sensor nodes energy is constrained and difficult to be provided. Consequently, in a routing protocol, energy balance and energy efficiency are essential design goals. It has been demonstrate that protocols based on clusters are viable with respect to sparing energy. UWSNs consumed much energy on transmitting of data as compared to receiving of data. In this way, decreasing the number of transmissions is valuable in diminishing the consumption of energy. Fusion and aggregation of data by CHs can viably diminish the quantity of transmission. Since communication at long distance prompts more consumption of energy, to spare the energy in our scheme multi-hop routing is implemented by means of CHs. CH directed data towards sink by means of another CHs. Consequently, in this scheme we intents to plan a routing technique based on clusters which is more appropriate for UWSNs. In UWSNs, the ratio of delivery is low and bit error is high because of the harsh condition. Therefore, links with high quality can reduce energy consumption and enhance the ratio of delivery. Accordingly, the imperative issue is the determination of routing routes which have links with high quality. Amid the choice of next sender, residual energy and link quality are considered in MLCEE schema

IV. ALGORITHM DESCRIPTION

Each node will be assigned their Hop id by means of Inquiry Message (IM) from the sink node. Towards nodes, an inquiry Message (IM) broadcasted from the sink node. Every node will get a Hop id from the inquiry Message which is received, so as to allocate Hop id to every node in the entire network.

Every node will rebroadcast the IM by an increment of one in the field of Hop id and add layer number which is computed by every node. This procedure will carry on until every node got Hop id and determined the layer number to which it belongs. The first portion is the type of inquiry message which means that whether the inquiry message is received from sink or another sensor node. The second portion is the Sink id portion which is unique For the purpose of recognizing the destination, the sensor node utilized the Sink id the last portion is layer count; at first, the layer count portion is zero but after receiving the sensor nodes add its layer number in this portion.

V. SIMULATION RESULTS

The simulation studies involve the deterministic nodes under the Uwsn as shown in Fig.1. The proposed energy efficient algorithm is implemented and the calculating the energy for every node is shown in Fig.2. Then the cluster has been formed in this Fig.3. and the cluster head selection is take place if any node in the cluster have the energy high when compared to other node that nodes is selected has the cluster head this head have all the information regarding address of the node in the cluster. This cluster head will act as a bridge between the one cluster to another cluster by transmitting the data file between the other cluster. This is shown in the fig.4.

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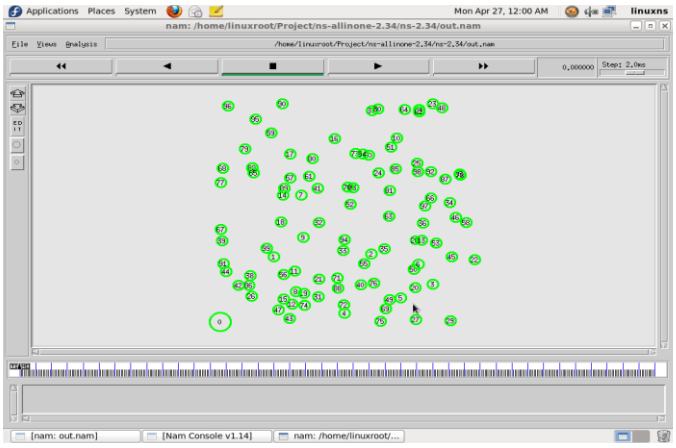

Fig.1. Nodes under the UWSN

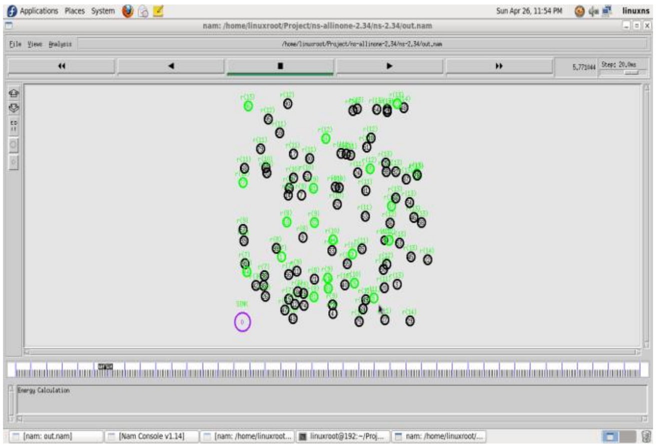

Fig. 2. Energy Calculation for Every Node

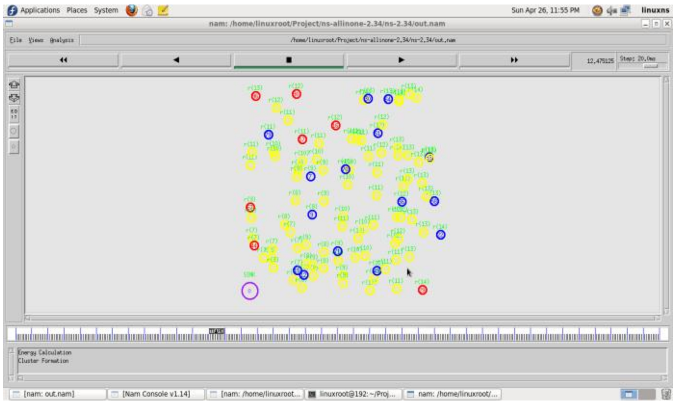

Fig. 3. Cluster Formation

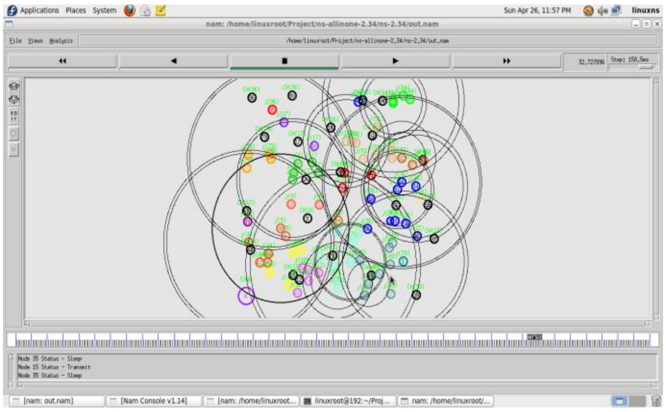

Fig 4. Transmit the data between the nodes

VI. CONCLUSION

It is very difficult to substitute the batteries of submerged sensor nodes; hence, in UWSNs energy efficiency is the main research issue. To tackle this, in this article, we proposed a Multi-Layer Cluster based Energy Efficient routing protocol. This scheme intends to resolve the issues of high error rate, high consumption of energy, and end-to-end delay. There are different stages in MLCEE, first stage is the division of the whole network in layers, the second stage is cluster formation where sensor nodes are clustered at a same layer and the third phase is the forwarding of data towards sink. Further, to mitigate the issue of hotspot, the dynamic approach of clustering is suggested and also for the selection of CH, the probabilistic approach is introduced in which every node calculates its Bayesian Probability. In the phase of data forwarding, MLCEE exploits residual energy and Hopid as routing matrices. Simulation results demonstrate the adequacy of MLCEE which achieves superior results than DBR and EEDBR routing techniques in view of network lifetime, energy consumption and end to- end delay. In future work, we are looking forward to using AUV for data collection which can help further to reduce the end-to-end delay.

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