Location Based Cluster Head Selection Technique for Under Water Wireless Sensor Network

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Abstract

A Wireless Sensor Network (WSN) is composed of sensor nodes spread over the field to sense the data. The sensed data must be gathered & transmitted to Base Station (BS) for end user queries. Many algorithms have been proposed for reducing the power consumption in under water wireless sensor network but did not define how to select the best sensor node which acts as a Cluster Head. In this paper, a location based Cluster Head selection algorithm is proposed to select the best Cluster Head in under water wireless sensor network without affecting the network life time and energy consumption. In layer based (Cluster based) WSN each Cluster Head is responsible to send the aggregate data to the base station. The proposed algorithm achieves a good performance in terms of network lifetime by rotating the responsibility of the Cluster Head among all the nodes in under water wireless sensor network. The proposed technique also helps to increase the network lifetime in under water environment where battery replacement of individual sensor node is not possible after their deployment

1. Introduction

Wireless Sensor Network [1] [2] [3] (WSN) consists of autonomous sensors to monitor physical or ecological conditions, such as temperature, sound, pressure, etc. and to cooperatively bypass their data through the network to a main location. The development of wireless sensor networks was motivated by military applications such as battlefield supervision; today such networks are used in many manufacturing and consumer applications, such as process monitoring and control, health monitoring [4] etc. Every sensor node has a power source typically in the form of a battery. The base stations may have one or more components of the WSN with infinite computational, energy and communication resources [5]. They act as a gateway between sensor nodes and the end user as they typically forward data from the WSN on to a server. In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller and an energy source, usually a battery. These inexpensive and power-efficient sensor nodes works together to form a network for monitoring the target region.

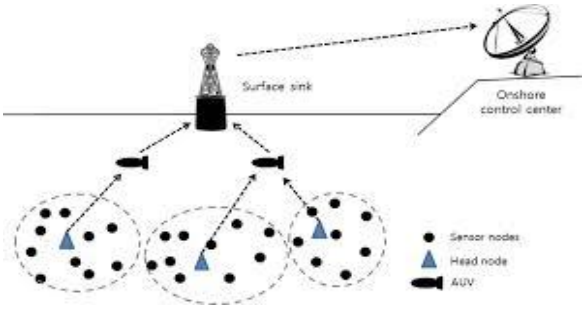

Fig: 1. Under Water WSN Architecture

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Clustering algorithms are used in wireless sensor networks to reduce energy consumption. Operation of clustering algorithm is executed in rounds and each round is composed of two phases: setup phase and steady phase. Nodes are organized in independent sets or clusters. At least one cluster head is selected for each cluster. The sensed data is not directly sent to the base station but via respective cluster heads. Cluster head collects data of sensor nodes that belongs to that cluster. Clustering algorithms apply data aggregation techniques [6, 7] which reduce the collected data at cluster head in the form of significant information. Cluster heads then send the aggregated data to base station.

2. Literature Review

LEACH (Low Energy Adaptive Cluster Hierarchy) [8] is fully distributed algorithm. In set-up phase cluster heads selection, cluster formation and TDMA scheduling are performed. In steady phase, nodes send data to cluster head and cluster head aggregate the data. Aggregated data is send to base station. After a fix round time, re- clustering is performed. Role of cluster head is rotated to all the sensor nodes to make the network load balance. LEACH scheme does not guarantee about equal number of cluster heads in each round.

Jong-Shin Chen, Zeng-Wei Hong, Neng-Chung Wang, San-Heui Jhuang [9] has proposed an algorithm to select a cluster head. This study classifies the lifetime into different types and gives the corresponding CH selection method to achieve the life-time extension objective. This study presented efficient request-oriented coordinator methods for hierarchical sensor networks. The methods considered the type of a request to give the suitable coordinator selection. For a request that needs almost all of nodes are alive, the *E* selection method is a good choice. For a request that needs few of nodes are alive, the *nE* selection method is a good choice. The coordination selection is based on a node just know its energy information.

EECHSSDA [10] overcomes the problem of LEACH-C. Cluster Head Selection is same as that of LEACH-C. With decrease in energy level at CH, it selects Associate CH (ACH). If CHs energy is going to drain, ACH acts as a CH. For ACH selection, the node which has higher energy level after the energy of CH is less than average energy acts as an ACH. Due to this (ACH), no need to select the CH periodically. Hence it reduces load overhead, energy consumption and no need to select CH periodically. EECHSSDA ensures to obtain optimal cluster head, energy efficiency, but not addresses any schedulability bounds of network; hence it does not focus on predictability.

Vipin Pal, Girdhari Singh, Rajender Prasad Yadav [11] has proposed a simple and efficient cluster head selection scheme is pro-posed, named Smart Cluster Head Selection (SCHS). It can be implemented with any distributed clustering approach. In SCHS, the area is divided into two parts: border area and inner area. Only inner area nodes are eligible for cluster head role. SCHS reduces the intra-cluster communication distance hence improves the energy efficiency of cluster.

Bhawnesh Kumar, Vinit Kumar Sharma [12] has proposed a distance based Cluster head selection algorithm is proposed for improving the sensor network life time. This protocol achieves a good performance in terms of lifetime by balancing the energy load among all the nodes. This clustering technique helps to prolong the life of wireless sensor network, especially in hostile environment where battery replacement of individual sensor nodes is not possible after their deployment in the given target area. Therefore, the proposed technique to distribute the role of the cluster head (CH) among the wireless sensor nodes in the same cluster is vital to increase the lifetime of the network. This algorithm uses a distance based method for providing the cluster head selection. In this paper, a new technique is proposed to select cluster head among some of the wireless sensor nodes based on net distance with base station. The proposed technique aims to increase the lifetime of the whole network, and to increase the number of nodes, which will remain alive for the maximum period of time.

3. Proposed Model

a) Deployment of Sensor node and Selection of Cluster Head

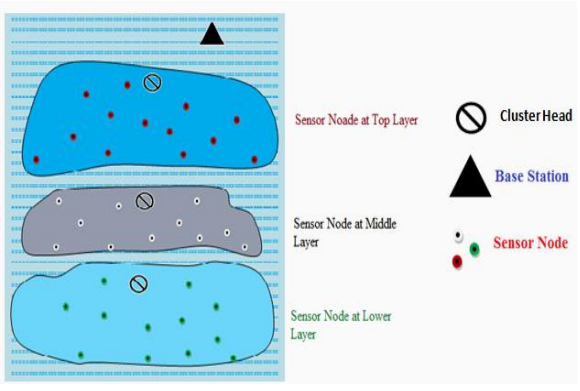

Fig: 2. Sensors Node Deployment

b) Data Transmission within Layer

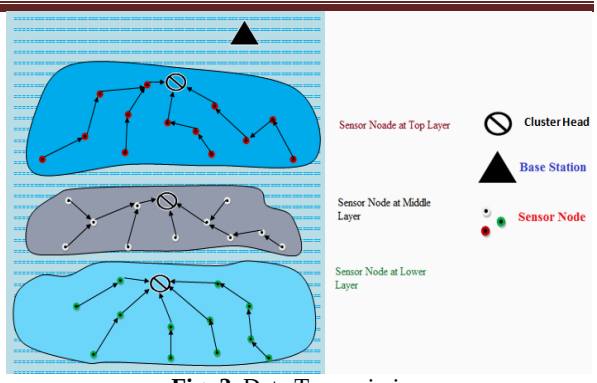

Fig: 3. Data Transmission

c) Data Transmission from one layer to another

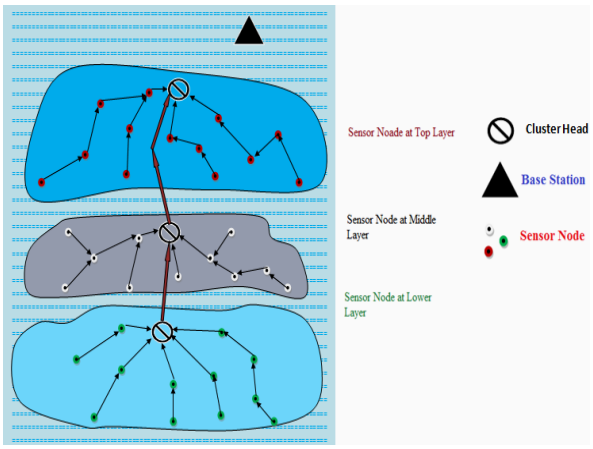

Fig: 4. Layer to Layer Transmissions

d) Data Transmission from Cluster Head to Base Station

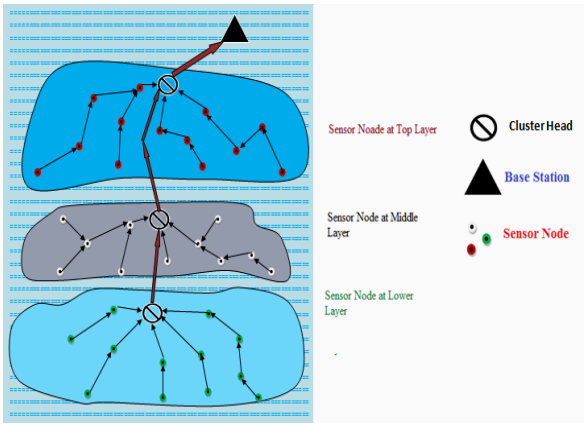

Fig: 5. Data Transmission to Base station

4. Proposed Algorithm

a) First each sensor node broadcasts their coordinate, energy status, transmission range and node_id to all other nodes into the sensor network. All sensors node calculate their coordinates with the help of GPS device which sensor node have.

b) With the help of transmission range and coordinates each node finds its neighbors and calculates the distance of each node from itself.

$Dis_{(x, y)} =<= Transmission\ range$	Equation 4.1

Where x and y are the coordinates of the node.

c) Now each node calculates the distance of all its neighbors.

$Dis_{(Total)} = Dis_{(x1, y1)} + Dis_{(x2, y2)} + Dis_{(x3, y3)} + \text{----------} + Dis_{(xn, yn)}$ equation 4.2	Equation4.2

d) The node having minimum value of **Dis** $_{(Total)}$ will be selected as Cluster Head and this node will transmit the aggregated data to the base station.

e) The neighbors of the selected Cluster Head cannot participate in the next selection process of the Cluster Head.

f) Now the Cluster Head forms a layer with its neighbors and data will transfer from layer to layer in the upward direction.

g) If the location of any node is changed then it broadcasts a message named Location_update to all other node. This message contains the node_id, residual energy, transmission range and their location.

h) Each node maintains a table which consist the node_id, coordinates, residual energy and transmission range.

i) Repeat the step from (b to e).

j) Now the node which having the maximum value will transmit the data to its neighbors and received node will aggregate the data and transmit the data to its neighbors.

k) This process will continue until the data dose note reach to its Cluster Head of their respective layer.

l) If the distance between two nodes is greater as compared to the distance between node and Cluster Head then node can directly send their data to the Cluster Head.

m) If two nodes having equal distance then Cluster Head follow the concept of TDMA technique then Cluster Head will provide a time interval to both the nodes in which they can send the data to the Cluster Head.

n) Now the Cluster Head of one layer will transmit the aggregated data to the Cluster Head of the upper layer and finally data will reach to the base station.

o) If the residual energy of the Cluster Head is greater than the threshold then the same Cluster Head will act as a Cluster Head for the next cycle.

p) If the residual energy of the Cluster Head is less than the threshold then the new threshold value will be define by the base station and all above steps will be followed.

5. Result and Conclusion

This paper presents a location based Cluster Head selection algorithm to select the best Cluster Head in under water wireless sensor network. This algorithm is using the concept of finding the minimum distance between neighboring nodes. The node having the minimum distance will be selected as the cluster head and it will be act as cluster head until all its residual energy is greater than threshold energy. This algorithm is also using layering mechanism to increase the network life time and decrease energy consumption. In layer based (Cluster based) WSN each Cluster Head is responsible to send the aggregate data to the base station. The proposed algorithm achieves a good performance in terms of network lifetime by rotating the responsibility of the Cluster Head among all the nodes in under water wireless sensor network. This algorithm uses the idea of distance measurement and the TDMA to show the better cluster head selection. The proposed technique helps to increase the network lifetime in under water environment where battery replacement of individual sensor node is not possible after their deployment by selecting the appropriate cluster head selection.

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