Selective Data Transmission In SNR Based Clustered-Underwater Wireless Sensor Network (CUWSN)

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***Abstract*—In Clustered-Underwater Wireless sensor networks (CUWSNs), battery operated sensing devices are grouped and connected with each other through wireless interfaces. Energy and processing efficiency are the two important parameters in these systems.CUWSNs with reduced number of transmissions utilize less energy and prolong the lifetime of the network. In this paper, a new protocol is proposed which is named as selective data transmission in SNR based cluster(SCSD). In this protocol, clusters are formed and the cluster heads (CH) are chosen depending on the SNR values. The number of transmissions of the cluster head and the sensor nodes are reduced by selectively transmitting the data. It also avoids congestion problem This scheme has been implemented using NS3 and it is observed that residual energy of the sensor node is improved by 2 percent.**

I. Introduction

An Underwater Wireless Sensor Network (UWSN) is a network of sensing nodes, called the sensors [2-3]. These sensors are capable of monitoring surrounding environment. The sensor nodes are connected with wireless interfaces to communicate with each other. In a Clustered UWSN (CUWSN), the network lifetime is affected by the imbalanced energy consumption among the nodes [7]. A leader sensor node is selected. It is regarded as the cluster-head (CH). The CH collects the data from the non-CHs (NCHs) in its cluster. It is responsible for sending the collected data to the base station (BS). To achieve data security, the non cluster heads encrypt the sensed data. Efficient data transmission is one of the most important issues for CUWSNs. Since, Data are transmitted continuously, the residual energy of the sensor nodes is reduced. Thus, energy consumption becomes a critical issue as CUWSN is battery operated and deployed in hostile environments. By selectively transmitting data, the number of transmissions in sensor nodes is controlled. Thereby, the energy consumption is also controlled.

In this paper, we have proposed selective data transmission protocol in SNR based clustering [1] for UWSN (SCSD).The proposed protocol is concerned about reducing the number of transmissions. Thereby, the amount of energy utilization decreases and lifetime of the network increases.The main advantage of this protocol is, keeping track of all session information and analyzing the session establishment is not required. It optimizes data processing.

II. Related Work

The LEACH (Low-Energy Adaptive Clustering Hierarchy) protocol [4] exhibited by Heinzelman et al., is generally a known and viable one to lessen and parity the total energy utilization for CUWSNs. To reduce the amount of energy utilization of the CHs, arbitrarily CHs are selected among all the sensor nodes in various rounds. Network life time is improved in LEACH (Low-Energy Adaptive Clustering Hierarchy) . EADEEG [6] is a novel distributed clustering algorithm. It elects cluster heads based on the ratio between the average residual energy of neighbor nodes and the residual energy of the node itself, which can achieve a good cluster heads distribution and prolong the network lifetime. According to the concept of epidemic routing protocol[9] proposed by Amitvahdat And David Beclet , the paths are established to all the nodes in the network and the messages are blindly stored and forwarded to all neighboring nodes and generates flood messages.

Arati Manjeshwar and Dharma P. Agrawal proposed a hybrid routing protocol(APTEEN) [11], suitable for retrieval of comprehensive information. In such network,the sensor nodes are reactive to time-critical situations. At periodic intervals, theyproduce an overall picture of the network. The users are enable to request past,present and future data from the network. However, the limited storage capability ofthe sensor nodes is a critical issue here.

In summary, the existing protocols require more amount of buffer to store the data.However, the sensor nodes are equipped with a small memory chip.Thus, storing of all the sensed data is a critical issue. To overcome such shortcoming, we propose a selective forwarding clustered model.

III. SYSTEM MODEL

The proposed model is a two-step process. Such as:
i) Design of clustered model
ii) Data and Energy model.

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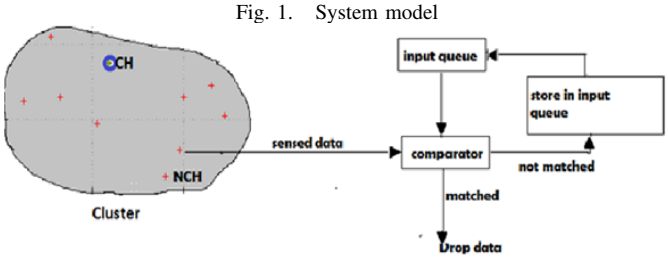
The first step describes the designed methodology of a cluster and the second step shows, how energy is consumed during different operation. The working principle of the proposed model is as shown in fig1.

Fig. 1. System model



A. Clustered Model

It is a model that describes how the sensor nodes are partitioned into cluster [2]. SNR [1] value of each sensor nodes are computed. The clusters are formed depending upon these SNR values. As a node is deployed in a UWSN , its SNR value with respect to the Base tation (BS) is computed. The cluster heads are selected depending on the SNR of the sensor nodes. The nodes with higher SNR value and energy are selected as the CH. Only one CH is selected in each cluster. All other nodes coming within the communication range [8] of the CH are included in that group and build a cluster. These nodes are called as the Non Cluster Head (NCH) or the followers. NCHs sense data from the environment and send ir to the corresponding CH.

B. Data and Energy Model

We can categorize the data transmission [5] into two types. Those are

i) Direct data transmission,

ii) Selective data transmission.

In a sensor network, each time a data is transmitted directly, the residual energy of sender node is decreased by a certain amount (Transmission Energy)Etx. Whereas, when we selectively transmit the data, the sensor nodes require processing the data. Thus, the residual energy is decreased by the sum of transmission energy and the processing energy(Eproc). This can be represented as :

$$resenergy = resenergysum(Etx, Eproc) \quad \ldots (1)$$

Similarly, we can also compute theresidual energy of the CH. However, the amount of residual energy is reduced bythe same amount, whether the data is transmitted directly or selectively. The residualenergy computed in a CH is $resenergy = resenergy - Ercch \quad \ldots (2)$, where Ercch is the receiving energy consumption per reception.For each operation, transmitting, receiving, and processing energy is consumed. The CH receive data from all other sensor nodes with in that cluster. Thus, if the node is a CH then the number of sending operation is less than the receiving operation. More energy is consumed in receiving. The energy consumption for CH and NCH is different [12].

IV. Proposed Algorithm

In this proposed algorithm, all the sensor nodes are initialized with initial energy, frequency, depth, and transmission power. After the random deployment of the sensor nodes, clusters are formed by partitioning the nodes in to group [1]. Cluster Heads(CH) are selected, depending on the SNR value of the sensor node [10]. The sensor nodes in the network sense data. Before storing it into the input queue of the node, the sensed data is compared with the rear element of the queue. Initially, the input queue is empty, so the first sensed data is assumed to be 0. If the sensed data matched with the rear data element of the queue, it is dropped and no need to store it in the buffer. However, for a dissimilar data, that will be stored in the input queue of the sensor. This process continues until the queue is full. The sensor node encrypts the data using hill cipher [13]. Block of sensed data stored in the queue are encrypted at a time. Single encrypted data is sent to the CH. The CH receives the encrypted data, decrypt it, find the average data value and sends it to the Base Station (BS).

Algorithm 1 Algorithm:

Build Cluster Depending upon the SNR values of the sensor nodes
SensedData $\leftarrow$ *0*
rear $\leftarrow$ *1*
while $rear! = Qmax$ **do**
  sensor nodes sense data
  if $SensedData! = Q[rear]$ **then**
    Q[rear] $\leftarrow$ *SensedData*
  elseDrop SensedData
Perform Data Encryption
Send Data to CH

V. Simulation Result

Based on NS3 simulation model, the proposed protocol SCSD is evaluated. In a rectangular flat region of 100 X 100, the sensor nodes are deployed to form a CUWSN. The simulation parameters used for evaluation are listed in table 2.

In Figure 2, it is observed that even if the number of nodes increases in direct data transmission, the number of transmission is not affected. Whereas, In selective case no transmission is done for same data. In selective data transmission, number of transmission is reduced. Therefore, less amount of energy is utilised as compared to direct data transmission protocol. It is shown in figure 3. Figure 4 describes that for varying number of nodes, the amount of energy utilized depends on the sensed data. For similar data, no transmission is initiated. Thereby, less amount of energy is utilized.

VI. Conclusion

In this paper, we reviewed the issues related to data transmission and data security in CUWSN. A protocol named, Selective Data Transmission In SNR based clustered (SCSD) is proposed. Using this protocol, only selected data are transmitted from the sensor nodes. If the sensed data is same

TABLE I
ENERGY CONSUMPTION

Data Transmission	Chs	NCH
Direct	resenergy = resenergy Ercch	resenergy = resenergy Etx
Selective	resenergy= resenergy Ercch	resenergy=resenergy- sum(Etx, Eproc)

TABLE II
SIMULATION PARAMETER

Area of sensing field	100 X 100
Initial energy	2.4j
Frequency	2.4ghz
Packet size	2Kb
Number of Clusters	4
Sensing range	10m
Communication range	20m
Transmission power	2w
Average capacitance switch/cycle	22pF
Electronic energy dissipation	50nj/bit
Amplifier energy dissipation	100pj/bit/m2
Leakage current	1.196mA
Number of clock cycle	0.97*106
Processor constant	21.26
Thermal voltage	0.2v
Initial battery power	3.3volt

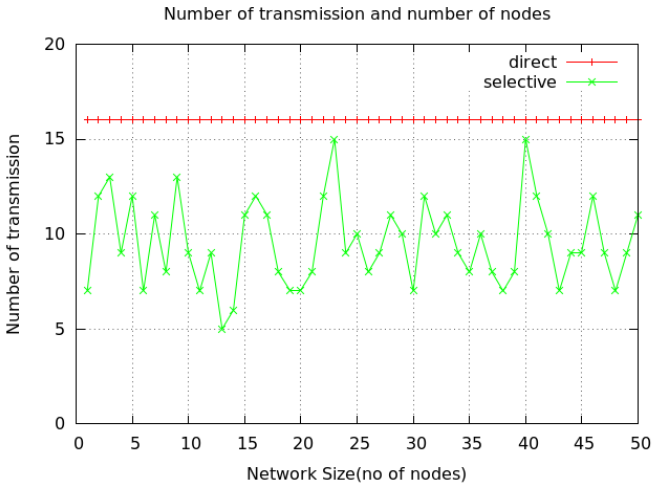


Fig. 2. Comparison of Number of transmission versus number of nodes

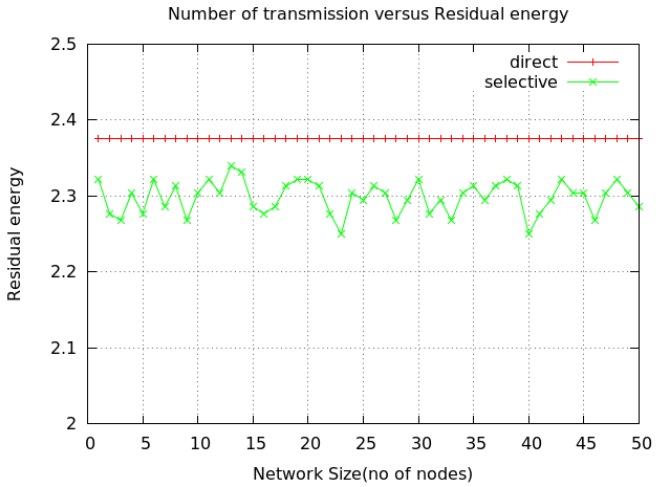


Fig. 3. comparison of Residual energy versus number of nodes

as the previous one then the sensed data is dropped. The number of Data transmission is reduced. Thus, the amount of energy consumption is also reduced. For data security, HILL cipher[13] is used as the data encryption mechanism. It is a block cipher and it makes the intruder difficult to guess the key matrix. In residual energy 2 percent improvement has been achieved. In future, the research may be extended to multilevel clustering.

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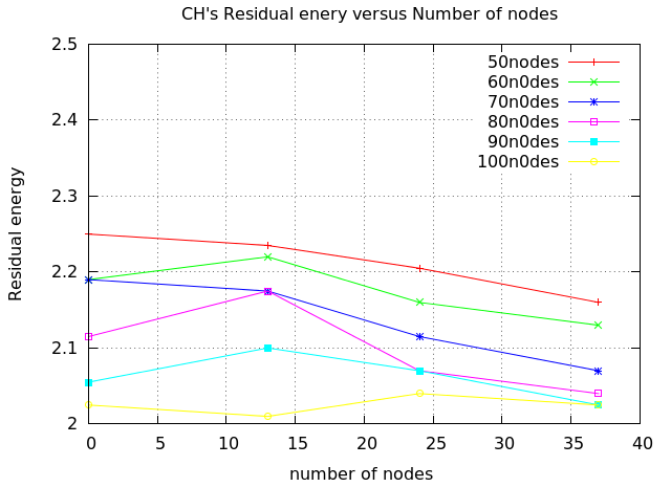

Fig. 4. Comparison CHs residual energy versus Number of nodes

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