

Manage of energy consumption of wireless sensor networks by controlling the radius of measurement

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Abstract

Wireless sensor networks to monitor parameters such as temperature, pressure, etc., from a number of nodes, are used. But these networks have limitations in energy that The main focus of this paper are management of energy consumption by controlling radius of measurement nodes. The approach of this paper, management of energy consumption by adjusting both the radius (sensory and receive / send) is. The results of the simulation show that the proposed method has acceptable performance compared to the SOM-based method in terms of the remaining energy of the nodes and coverage and the number of dead nodes.

Keywords: Wireless sensor networks, self-organizing networks, radius of measurement, management of energy consumption

Introduction:

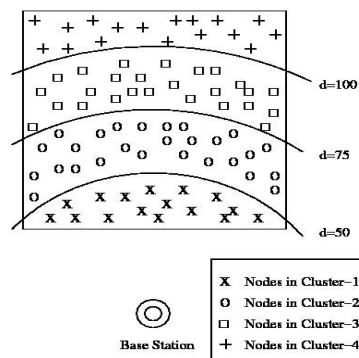
Wireless sensor networks have many challenges, most notably the management of energy consumption, Because despite difficult conditions and inaccessible to them, recharge them is impossible. Therefore, as far as energy should be saving. One way to conserve energy is controlling radius of measurement, Because There is a direct relationship between radius of measurement and energy consumption. Whatever radius of measurement is small, energy consumption is reduced and vice versa.

In this paper, the radius of sensory nodes are regulated by the SOM neural network. These networks are part of the neural network that have the ability to classify data. So that each node has its own unique place in the data center and any data shared between them. So of the redundancy and data replication can be avoided. Even these networks have the ability to determine head of clusters, But in this paper only the property of the network routing and data mining can be used to control the radius of sensory and other methods have been proposed to determine head of cluster.

The remainder of this paper, the proposed method and its phases are described. Then, on the part of the findings, the simulation and evaluation plan will be discussed and the results will be presented at the conclusion.

Method:

Wireless sensor networks cluster by HCCR algorithm. This algorithm is a self-organizing. So that, initially, the data of all nodes in the network are available in the sink. Then broadcast a message to all nodes with the transfer of well defined (eg the transmission range of 24 meters) is sent. Nodes to be hearing the message, send a message with the content of the energy situation and connections with their neighbors to sink. After transmission rate increases (for example, the transmission range of 40 meters) and the process continues until all nodes were placed within clusters. Figure 1 shows how the clustering (B. B. Misrafeb & B. K. Nayak , 2012).



Shape: (1) start-up phase clusters

When the difference between distance of nodes and their energy, in clusters is large, and or head of the cluster can not send a message to the sink, then clustering is repeated.

By entering data in each cluster, using network SOM, nodes that have data, are determined. and other groups will go into silent mode. The data collected will be sent to the heads of the fittest cluster that were used in determining the appropriate cluster of the approach shortest distance and most energy between nodes, and in the end, the data pre-coded and sent to the sink.

Routing by network SOM

These networks are self-organizing and because the property unsupervised learning with sensor networks are a good match.

By entering data on each cluster, weight vector is given to each node. Then, the shortest distance between the input vector and weight vector is calculated for each node and that node is selected as a winner node. According to the nature of these networks, in addition to winning node, the radius determined by its neighbors to update according to equation (1) and under the Kohonen law.

(1)

$$W_i(k) = w_i(k-1) + \alpha(p(k) - w_i(k-1)) \\ = (1-\alpha)w_i(k-1) + \alpha p(k)$$

Where; α , learning rate and w , weight of nodes and p , input vector and k is the number of repetitions. According to Kohonen law, this operation is repeated, along with learning network, steady state applied at the network level and nodes that are closest to the data, to be determined and with their kindle is determined. path data transmission. Also, according to property of data mining these network, each node clustering data related to itself and there is no shared between data of nodes.

$$R^k = \bigcup_{i=1}^N c_i, \quad c_i \cap c_j = \emptyset \quad \forall j \neq i \quad (2)$$

According to equation (2) Share of cluster C_i with cluster C_j is empty then the sensory radius for the i -th node is too small as there is no shared between it with the j -th node. sensory radius of the i -th node is set to the smallest state.

Determine head of cluster

Data collected by the nodes should be transferred to the cluster head to send to the sink.

Determine head of cluster has three conditions:

1. adjacent nodes in a cluster are grouped.
2. have good energy.
3. The network should be distributed.

Having regard to the above three conditions in this article as a cluster head node is selected that has the most energy in the cluster and the shortest distance to all nodes along the route of data transfer are. in fact, the cluster head is placed in the center of other nodes that the radius of sending and receiving brings to the slightest degree then regulate the radius of sending and receiving at this phase.

Research Findings

The proposed method by (Chiranjib Patra et al, 2011) assesses that in that way only checked the routing SOM network and modify network topology and radius measurement will not be considered. therefore, due to the proximity of these two methods and observing the performance of the proposed method based on the radius measurement approach, these two methods assesse in a simulated environment $100 * 100 \text{ m}^2$ by sending a 10,000 packet data accidentally been implemented in MATLAB.

Parameters measured include:

- **The remaining energy**

Energy consumption in wireless sensor networks based on the relationship (3) is calculated.

$$E = E_{\text{cpu}} + E_{\text{send}} + E_{\text{receive}} + E_{\text{active}} + E_{\text{Stand By}} \quad (3)$$

Where,

E_{cpu} is energy consumption is processed that accordance with the relationship (4) is calculated (Xiang Min Etal, 2009).

$$E_{\text{cpu}} = 7 * 10^{-9} * k \quad (4)$$

k is submissions bit rate or length message that 2000 will be considered.

E_{send} is submissions energy consumption that according to equation (5) to calculate (Xiang Min Etal, 2009).

$$E_{\text{send}} = E_{\text{elect}} * k + E_{\text{amp}} * f_{\text{mp}} * (\text{distance})^4 * k \quad (5)$$

E_{elec} the equivalent of 50 nj / bit is and E_{amp} equivalent 5 nj / bit is. if the distance between the nodes to sink more than the distance threshold then the distance between the nodes and the sink arrives biquadratic and would be multiplied in f_{mp}

Otherwise ,

$$E_{\text{send}} = E_{\text{elect}} * k + E_{\text{amp}} * f_{\text{s}} * (\text{distance})^2 * k \quad (5)$$

the distance between the nodes and the sink arrives square and would be multiplied f_s , that f_s and f_{mp} is 10 pj/bit/m^2 and $0.0013 \text{ pj/bit/m}^4$ respectively .

E_{receive} is receive consumption energy that according to the relationship (6) is calculated.

$$E_{\text{receive}} = \text{hits} * E_{\text{elect}} * k \quad (6)$$

Where, hits is the number of collision datas whit nodes.

For the messages exchanged between the nodes and cluster heads are used the average of sending and receiving energy that in relation (7) is given (Sepideh Adabi Et Al, 2008).

$$E_{\text{active}} = (0.2 * d^2 * 10^{-4}) + 0.016 \quad (7)$$

Where, d is the radius of the sensing nodes.

If there is no data for node and also cluster does not exist, is considered as unemployed nodes that according to equation (8) is calculated (Sepideh Adabi Etal, 2008).

$$E_{\text{Stand By}} = 6 * 10^{-6} \quad (8)$$

So, each node based on its role in network will consume energy which is deducted from their remaining energy. then the average residual energy of network nodes plotted on the graph. figure 2 shows the average residual energy.

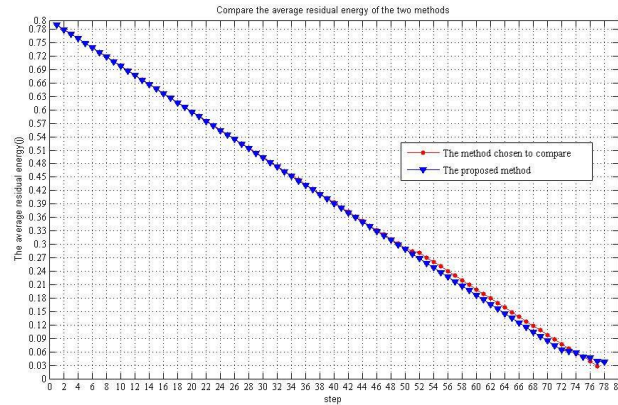


Figure 2: Average residual energy in two methods

- **network coverage**

network coverage is obtained based on the percentage of ratio of active nodes area to total area. figure 3 shows the percentage of cover two networks.

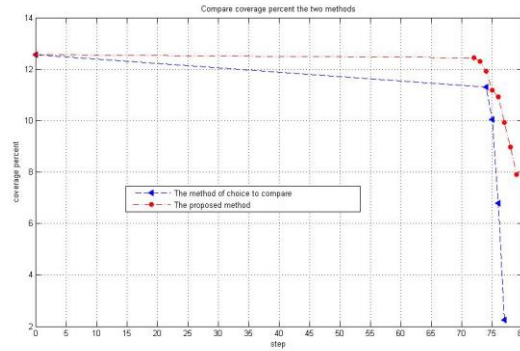


Figure 3: The percentage of network coverage in two methods

- **The number of dead nodes in the network**

At each stage, the number of nodes that the remaining energy is less than the threshold they fail and the so-called die, plotted on the graph. figure 4 shows the number of dead nodes.

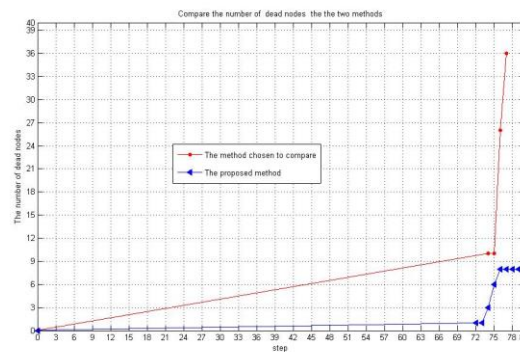


Figure 4: The number of dead nodes in two methods

Conclusion:

suggested method in the three levels of nodes and cluster heads and sink implemented. that in terms of the average percent improvement of remaining energy and the percentage of coverage and number of dead nodes respectively, 11.262 % and 26.869 % and 46.982% better than (Chiranjib Patra et al, 2011) acts. Nodes are important in this method that have data or are cluster head, otherwise, go to silent mode. but this method is heavily dependent on the density of network nodes and as soon as reduce the density decreases network performance.

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