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Total Energy Consumption Reduction in WSN Using Mobile Sink Node

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ABSTRACT
Clustering or grouping of sensor nodes is used to increase the performance of WSN as it reduces the total number of nodes taking part in data transmission. The proposed work reduces the total energy consumption of the cluster based WSN using mobile sink mechanism. Mobile sink node is made to move in a boundary of the network. Cluster heads adjust their routing path towards the moving sink node for data transmission. Experimental results are provided with different cases of input data pattern and mobility of the sink node to show efficiency of the proposed mechanism. Results show that the proposed mechanism reduces the total energy consumption of the network when compared with the static sink network. It also reduces the work load on the penultimate node of the static sink node.
Keywords- *WSN, Clustering, Mobile sink node, Cluster head, Energy consumption.*

INTRODUCTION

Efficiency is a most important issue for data transmission in Wireless Sensor Network (WSN). Efficiency is in terms of minimized energy consumption of the WSN. This efficiency can also be increased by minimizing the work load on particular sensor node and distributing among many sensor nodes. This results in total energy reduction of the network and increases the network life time.

RELATED WORK

S.Yi et al., [1] proposed PEACH protocol for reducing the energy consumption in cluster formation and to increase the total network life time. W Heinzelman et al., [2] in their LEACH protocol used cluster head rotation among all member nodes for balanced energy distribution. Huang Lu et al., [3] in their clustering protocol called SET-IBS and SET-IBOOS used additive homomorphic encryption for data aggregation to decrease the computational overhead on cluster head in collecting data from its members.

PROPOSED WORK

To give balanced energy dissipation among all sensor nodes mobile sink concept is introduced in this work and it is made to move in the network boundary to collect data from different clusters. Fig 1 gives the architecture of the mobile sink method.

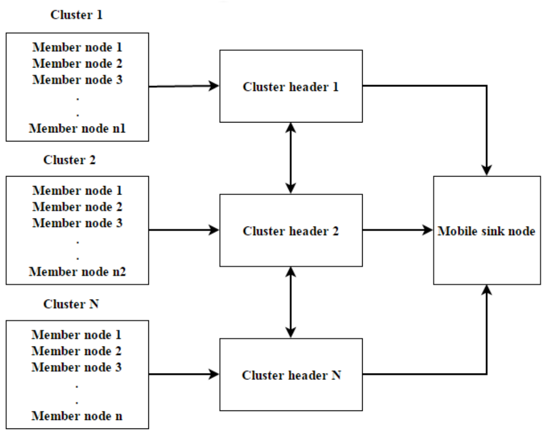

Fig.1 Architecture of mobile sink method

Route adjustment

As the sink node is mobile in nature all CH need to keep updated minimum distance to the mobile sink node. In the beginning mobile sink node shares its location details with nearest CH. CH has to adjust its routing path whenever the sink node moves from one place to another. Route adjustment is initialized by the CH which is closest to the mobile sink node and it is known as Sender Cluster Head (SCH). SCH passes the same information to the previous cluster head (PCH). All CHs has to follow some procedures for route adjustment to keep updated route to the mobile sink node. The procedures to route adjustment includes following steps.

Step 1: Once SCH finds the moving sink, it will check if its next hop in the transmission is moving sink or not. If yes it will not propagate sink update message. If not step 2 is followed.

Step 2: SCH adjust its next hop in transmission to moving sink node and shares the sink location details with PCH.

Step 3: In case if PCH is not directly reachable, SCH shares sink location trough nearest member node.

Step 4: If PCH receives sink location details directly from SCH, adjust its next hop as SCH.

Step 5: If PCH receives sink location details from any other member node, adjust its next hop as that member node towards moving sink.

Step 6: If the sink location update is same as the previous update CH drops the sink location update packet. If sink location update is new or it is different set its next hop to new SCH and update the same.

EXPERIMENTAL RESULTS

The system is experimented with different cases of input data patterns and different patterns of mobility of sink node to tabulate total energy consumption of the network and head node energy consumption. These values are tabulated for both systems with mobile sink node and for system with static sink node. System with static sink is designed using Dynamic Source Routing (DSR) protocol for finding minimum distance between sensor nodes and static sink node. Criteria used are as follows.

Criteria for sink mobility pattern

Mobility pattern 1: Sink node is made to move in anti-clock wise direction in the network boundary with a constant speed of 2000 m/s (Simulation units).

Mobility pattern 2: Sink node is made move to in clock wise direction in the network boundary with a constant speed of 2000 m/s (Simulation units).

Criteria for input data pattern

Input pattern 1: Every node is inputted with same integer data.

Input pattern 2: Every node is given random integer data (0 to 10).

Total energy consumption from all cluster heads is tabulated in Table 1 for both networks with static sink node and with mobile sink node. For network with mobile sink, mobility pattern 1 is applied. Constant integer data is given to all nodes.

Table.1 Total energy consumption with mobility pattern 1 and input pattern 1

	Network With Mobile Sink	**Network With Static Sink**
Total Energy Consumption In Joules	39.27	49.86

Energy consumption from each cluster head for mobility pattern 1 and input pattern 1 are tabulated in Table 2.

Table.2 Cluster head energy consumption with mobility pattern 1 and input pattern 1

Cluster	**Energy Consumed With Mobile Sink**	**Energy Consumed With Static Sink**
1	7.5431	2.1383
2	8.6419	2.9602
3	3.7241	2.9602
4	2.2596	2.9602
5	2.1383	4.9667
6	2.362	2.9602
7	2.960	3.7241
8	6.719	8.1963
9	2.9173	18.9905

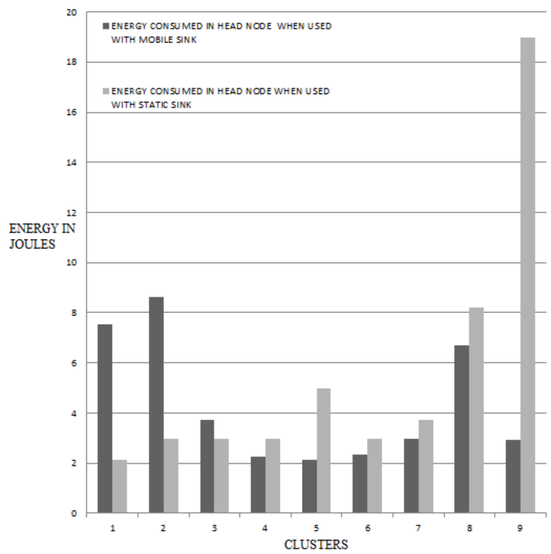

Fig.2 Cluster head energy consumption with mobility pattern 1 and input pattern 1

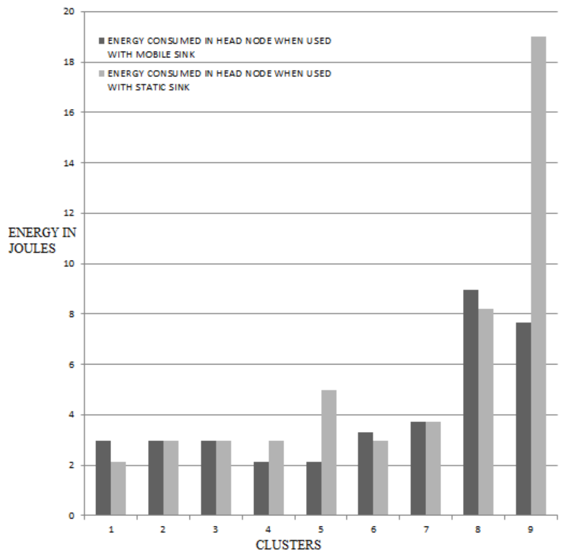

Fig.3 Cluster head energy consumption with mobility pattern 2 and input pattern 2

Total energy consumed from each cluster head for mobility pattern 1 and input data pattern 1 is shown in Fig 2.

Total energy consumption for mobility pattern 2 and input pattern 2 are tabulated in Table 3.

Table.3 Total energy consumption with mobility pattern 2 and input pattern 2

	Network With Mobile Sink	**Network With Static Sink**
Total Energy Consumption In Joules	36.81	49.87

Energy consumption from each cluster head for mobility pattern 2 and input pattern 2 are tabulated in Table 4.

Table.4 Cluster head energy consumption with mobility pattern 2 and input pattern 2

Cluster	**Energy Consumed With Mobile Sink**	**Energy Consumed With Static Sink**
1	2.9602	2.1386
2	2.9602	2.9602
3	2.9602	2.9602
4	2.1383	2.9602
5	2.1383	4.9667
6	3.3051	2.9609
7	3.7241	3.7241
8	8.9611	8.1963
9	7.665	18.9905

Total energy consumed from each cluster head for mobility pattern 2 and input data pattern 2 is shown in Fig 3.

From Fig 2 and Fig 3 it is observed that head node of cluster 9 in static sink network consumes highest amount of energy. This is because cluster 9 in static sink network is near to sink node and it will rise to hot spot issue as it has to forward data from all other cluster heads to the sink. As work load for header node of cluster 9 increases it consume more energy. This problem is solved using mobile sink node. It will not cause over load on a single node and hence reduces total energy consumption of the network.

CONCLUSION

According to experimental results (for mobility pattern 1 and input pattern 1) static sink network consume 49.86 joules of total energy or an average of 5.54 joules of energy. Whereas mobile sink network consume 39.27 joules of total energy or an average of 4.36 joules of energy. It is also observed that, penultimate node in static sink system consume highest energy (18.9 joules) when compared with highest energy (7.5 joules) consumption in mobile sink network. The experimental result (for mobility patter2 and input pattern 2) shows that static sink network consume 49.87joules of total energy or an average of 5.54 joules of energy. Whereas mobiles ink network consume 36.81joules of total energy or an average of 4.09 joules of energy

Introduction of mobile sink reduces the work load on the single node. The experimental results with different types of mobility pattern and input pattern show that it also reduces the total energy consumption in the network. Hence it increases the life time of wireless sensor network.

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