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Modified Based Random Efficient Energy Routing Algorithm(BREERA)

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ABSTRACT

Recently Wireless sensor Networks (WSNs) takes interesting researches due to there important and crucial applications. WSNs have limited energy so all researches focused in designing routing algorithms to save energy and to make each one operating for longer possible time. Based Random Efficient Energy (BREERA) is one of WSNs routing algorithms saved energy of the whole network because its sensor nodes needn't to know any information about their sensor nodes neighbors. This paper suggests two approaches to modify the performance of the routing algorithm BREERA and make a comparison between the performance of the original BREERA and the performance of the modified BREERA. The first suggested method was called weights method which improved the performance of BREERA with the average received messages, lost messages, PDF, and average total energy. Weights method used two cases of energy weights (w1= 0.1 and w1= 0.8). With the value of the energy weight equal to 0.1 obtained higher received messages average, higher PDF average, less lost messages average and less died nodes average. While with the value of the energy weight equal to 0.8, a higher total energy was obtained. The second suggested approach is to limit the number of members for each cluster head which improves the performance of BREERA in received messages, lost messages, died nodes, PDF and total energy .The simulator Net Logo version 4.1.3 was used to design the simulation program of the routing algorithm BREERA .

Key words: Wireless sensor networks, clustering, BREERA, PDF.

INTRODUCTION

Wireless Sensor Networks (WSNs) are collection of sensors which distributed independently in the environment and connected with each other wirelessly. Sensor sense the changes happened in the environment like temperatures, light, sound…etc. It measures these phenomena and then converts it into one of the data forms which can be communicated with other sensors in the network through communication devices like laptop or mobile phone according to the nature of the network goal and its application. Sensing data transmitted from each node to the neighbor node toward the sink called hop. Hops number means the number of Cluster-head between the sink and the node where the new message was generated. WSNs have limited

energy, therefore the researchers designed many routing algorithms that helps in saving energy for each node and then for the whole network. This paper takes one of the routing algorithms of WSNs which is Based Random Efficient Energy Routing Algorithm (BREERA) and modified it by suggested two methods: weights method and limit number of members for each cluster head node. One of the Major drawbacks of BREERA is losing more active nodes rapidly from the network[1].

Sensor Node

Sensor node is a device which has capable to gather sensory information and connect it .The basic components of sensor node are: controller, transceiver, external memory, power source and sensor[1].

Clustering

Clustering is to organize unordered objects in groups called clusters. Clustering make any system very easy to identify and approach. All clustering techniques have the same public concept that each cluster consist of two components: cluster head and members. The best performance for any clustering technique can be measured by computing Packet Delivery Fraction (PDF) value. The better performance for clustering will be achieved when PDF value is approaches to one[2]. PDF is the Ratio between number of Messages Received and number of messages sent towards the sink[3].

Related Works

M.Chatterjee at 2001 designed Weighted Clustering Algorithm (WCA) depending on weights for each node to select the cluster – head. He took four factors to compute the weight for each node .The four factors are the difference degree ,distance summation to all its neighbors,mobility and the accumulative time .The coefficient used in weights calculation are w1=0.7, w2= 0.2 , w3= 0.05 , w4 = 0.05. The sum of these co-efficient is equal to 1 .The weight for each node can be calculated according to certain given formula[3].

Sucec.J at 2002 designed clustering algorithm called Highest-degree Algorithm, based on the degree of the node to select the cluster-head and then forming cluster. Node degree means : the number of neighbors for The node, hence the node with maximum degree become cluster-head and other neighbor become members[4].

Toh.c.k at 2002 Designed clustering algorithm called Lowest Identifier Algorithm (LID).This algorithm selected the node with lowest ID to become a cluster head and broadcast to neighbor nodes to become its members[5].

Tzung – Pei Hong at 2010 observed the wireless sensor networks have more restrictions than traditional ad hoc networks .WSNs consume power more than MANETs.So he supposed to add another weight (fifth weight) to the old (WCA) to make it more suitable to be implemented reliably with WSNs. The resulted Weights values are, w1=0.5, w2= 0.1, w3=0.05, w4= 0.05 and w5= 0.3.Experimental results of this method (IWCA) showed that the behavior of this algorithm will be better than the old (WCA) for long system life time[6].

S.Muthuramalin proposed a Dynamic Clustering Algorithm for MANETs by Modifying Weighted Clustering Algorithm with Mobility prediction at 2010.The scenario of this algorithm was divided into two sections, the first section is to perform steps of weighted Clustering Algorithm (WCA) that mentioned previously to select cluster head and then perform the cluster, while the second section is clustering maintenance by using the Linear Auto regression concept (AR).The node Cluster Member (CM) make local effect on the topology of the cluster if it moves out of the boundary of its cluster, but if the leaving node was cluster-head (CH) , the cluster should reform according to WCA to select the cluster head[7].

Muhammad at 2011 proposed clustering called Based Random Efficient Energy Routing Algorithm (BREERA) .The scenario of (BREERA) is to make the active node as a cluster head and its broadcast for all neighbors to become members to its cluster. Each node send their messages to their cluster head and it is send their messages to the next cluster head .The cluster head will make the distant node member from it as a next cluster head. All clusters heads connected with each

Table 1: WSN environment

Parameters	Values
The simulator	Net Logo 4.3.1 version (2011)
Protocol	BREERA
Pause time type	uniform , 1s
Speed nodes type	uniform 5m/s
broadcast range	15 m
Hops number	6
Energy weights	0.1 And 0. 8

Table 2: Simulation results according to parameters in the table (1)

BREERA	Received Messages Averages	Lost Messages Averages	Died Nodes Averages	Total Energy Averages
Before modified	82.03333333	17.96666667	1.1	46977.91667
After modified by using w1=0.1 and w2=0.9	97.36666667	2.633333333	0.566666667	47673.03
After modified by using w1=0.8 and w2=0.2	96.83333333	3.166666667	0.666666667	47963.19333

Table 3: WSN environment

Parameters	Values
The simulator	NetLogo 4.3.1 version (2011)
Protocol	BREERA
Pause time type	uniform , 1s
Speed nodes type	uniform 5m/s
Broadcast range	15 m
Hops number	6
Members number for each cluster head	70 and 100

Table 4: Simulation results

BREERA	Received Messages Averages	Lost Messages Averages	Died Nodes Averages	Total Energy Averages	PDF Averages
without limit members number	82.03333333	17.966667	1.1	46977.92	0.820333
Members=70	96.3	3.7	0.9	46168.47	0.914333
Members=100	93.56666667	6.4333333	0.8	46783.65	0.879333

Fig. 1: Clustering according to BREERA

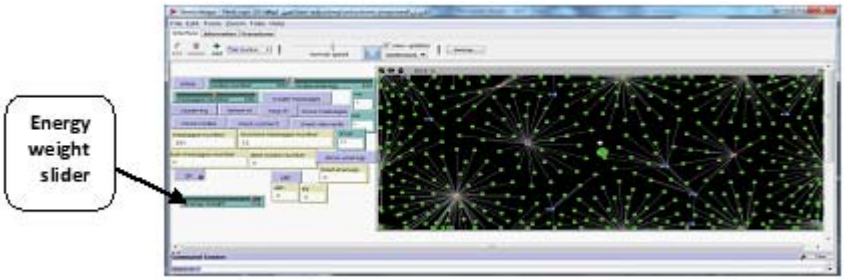

Fig. 2: Net Logo display clustering 500 sensors nodes according to the protocol BREERA with weights method

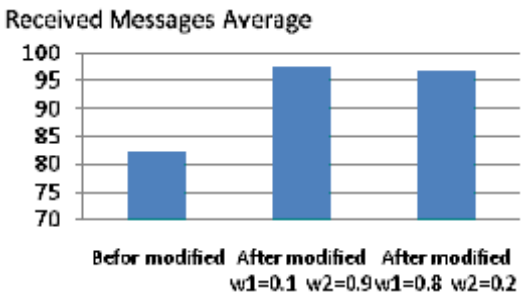

Fig. 3: Received messages average of BREERA before and after using weights

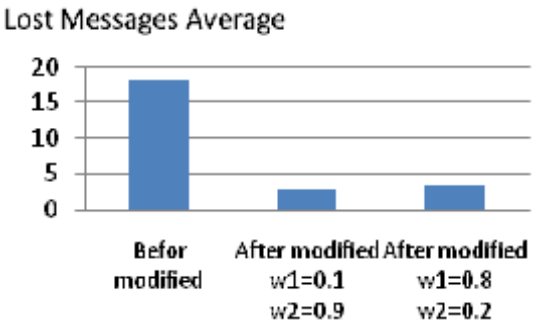

Fig. 4: Lost messages average of BREERA method before and after using weights Method

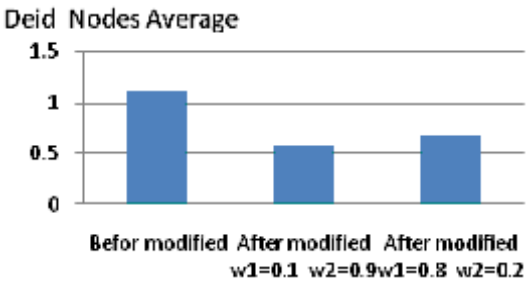

Fig. 5: Died nodes average of BREERA before and after using weights method

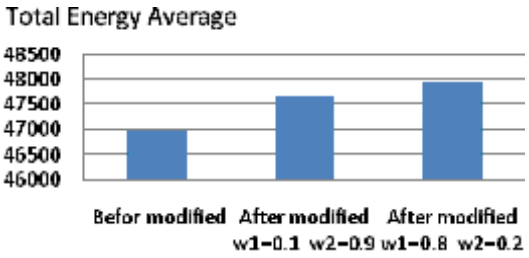

Fig. 6: Total energy of BREERA before and after using weights method

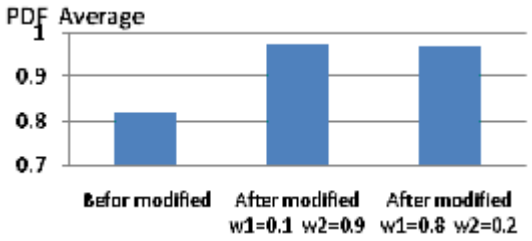

Fig. 7: PDF average of BREERA before and after using weights method

others. Each node in the network need to know who its cluster head and needn't to know any information about their neighbors like the previous algorithms that mentioned previously[1].

Proposed Works

The performance of the routing algorithm BREERA made more active nodes lost rapidly from the network. Its scenario not achieves load

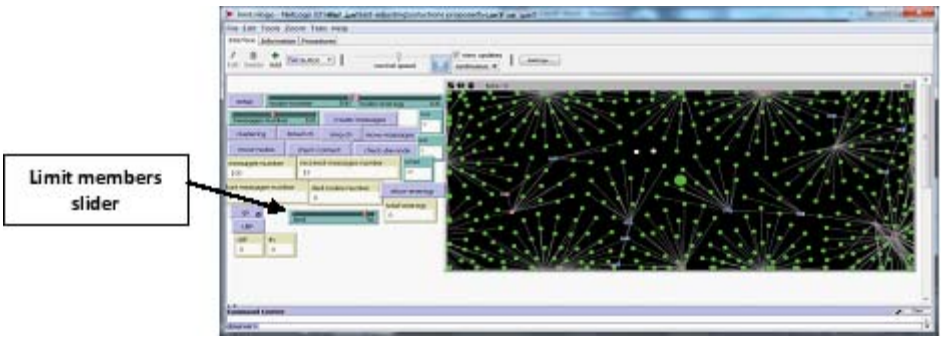

Fig. 8: Net Logo display clustering 500 sensors nodes according to the protocol BREERA with limited member's

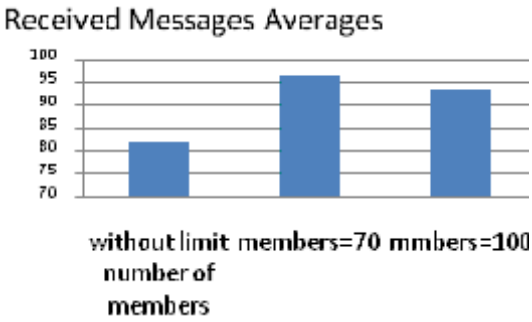

Fig. 9:Received messages average of BREERA before and after using limited members method

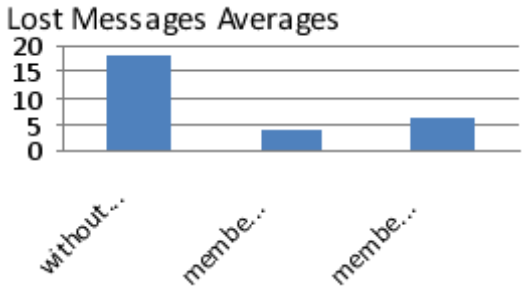

Fig. 10: Lost messages average of BREERA before and after using limited members method

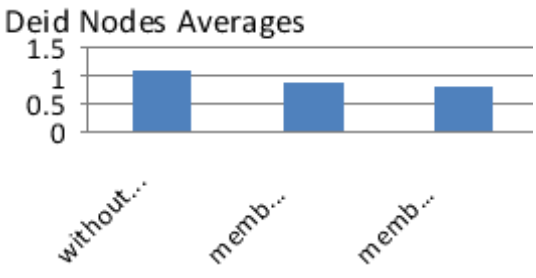

Fig. 11: Died nodes average of BREERA before and after using limited members method

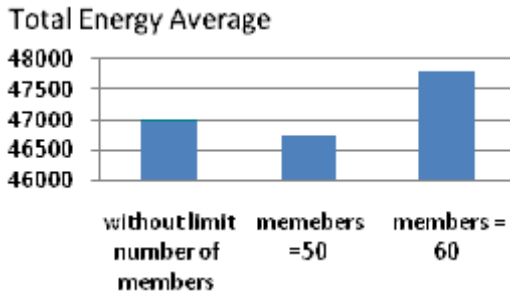

Fig. 12:Total energy average of BREERA before and after using limited members method

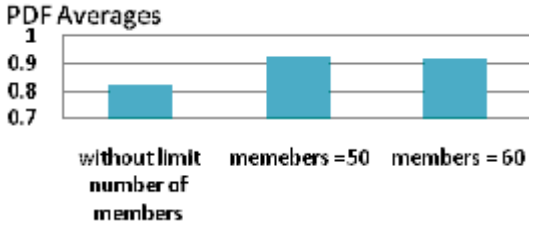

Fig. 13: PDF average of BREERA before and after using limited members method

balancing on the clusters heads nodes. Figure (1) shows a simple explanation of the clustering process of such algorithm[1].

When a node A become active it may send to all nodes existing in its broadcast range certain messages indicated in it that it became a cluster head and all of them became their members. Suppose after one second the nodes B and C will become active too then, node B connected with just four nodes as their members and node C haven't any nodes in their broadcast range so it will not connected with any node. According to such suggestions two methods were suggested to achieve balance in the load on the clusters heads nodes.

Using Weights

This method don't based on the energy as a unique criterion to select the next cluster head who send the messages toward the base station (target member node), it is based on two critical criteria (messages number in the queue of the node and the battery energy of the node). To compute the weight for the cluster head node we need to use the formulae of weighted clustering algorithm[3]. We modified these weights formulae to achieve our work by suggesting two energy weights to improve the performance of BREERA. The coefficients in weight calculations were assumed the following values; w1= 0.1, w2 = 0.9 and w1 = 0.8, w2 = 0.2. The weight for each cluster head can be computed according to the following formulae:

W_v = (Energy of the node * w1) + (number of messages in the node queue *w2)….. (1)

The cluster head with minimum weight is selected to be the forward message to it. Algorithm (1) illustrates the main steps of weights procedure as below:

Action 1
Input: hops number, the range broadcast of the node.
Output: transmit messages from the cluster head to neighbour cluster head with minimum weight.
Process:
1. Start.
2. Ask the clusters heads nodes if one of their members is a sink then
3. Ask messages if their hops number less than threshold then
4. Move to the sink node.
5. Else if
6. Ask messages die
7. Else if
8. Move to the next cluster head.
12. End.
Action 2:
Process:
1. Start.
2. Ask the next clusters heads nodes if one of their members is a sink then
3. Ask messages if their hops number less than threshold then
4. Move to the sink node.
5. Else if
6. Ask messages die
7. Else if
8. Compute weights of the neighbour's clusters heads
9. Move to the neighbour cluster head which have minimum weight.
10. End.

Algorithm (1) of weights procedure

Figure (2) shows the simulation program of BREERA with weights method by using the simulator Net Logo.

Simulation Scenario

In this paper a WSN with fixed parameters was created as shown in table (1). These parameters were applied in the simulation program for 90 times, first 30 results for the BREERA before modified, second 30 times for the BREERA after modified by using weights method when energy weight equal to 0.1 and messages number weight equal to 0.9, and third 30 times for the BREERA after modified by using weights method when energy weight equal to 0.8 and messages number weight equal to 0.2.

Table (2) produced from large table contains 90 result .Each row in the table (2) represent average of 30 rows in the resulted huge data table with one of energy weights.

The simulation results in table (2) can be graphed to explain the comparison in the performance of BREERA before and after applying the weights method as shown in figures (3) ,(4), (5), (6) and (7).

Limit Number of Members for Each Cluster Head

This way achieve balance in the load on the clusters heads nodes for the network and saved energy for whole the network and decreases the number of lost nodes. Limited number of members for each cluster head is allow for other near active node to become a cluster head for number of neighbours nodes. Algorithm (2) explains procedure steps of limited number of members for each cluster head in the network.

Action1
Input: broadcast range of the nodes, limited number of members for each cluster head.
Output: form clusters with limited number of members.
Process:
1. Start.
2. Set I ⟶ 0.
3. Ask nodes if node have messages and far from the sink and it is not member for any cluster then
4. Set its colour ⟵ red.
5. Broadcast for all neighbour nodes that not connected for any cluster to become their members
6. If the neighbour nodes not connected for any cluster and I != limited number of members then
7. Set its colour ⟵ green.
8. Set i ⟵ i + 1
9. Create link with cluster head node
10. Decrease energy of member node
11. End if
12. Decrease energy of cluster head node
13. End if

Action 2
Process:
1. Ask nodes member of clusters to make the fairest one of them from it to be the next cluster head node.
2. Set I ⟶ 0.
3. Set its colour ⟵ red.
4. Broadcast for all neighbour nodes that not connected for any cluster to become their members
5. If the neighbour node not connected for any cluster and I! = limited number of members then
6. Set its colour ⟵ green.
7. Set i ⟵ i + 1
8. Create link with cluster head node
9. Decrease energy of member node
10. End if
11. Decrease energy of cluster head node
12. End if
13. End .

Algorithm (2) limited member's procedure

Figure (8) shows the simulation program of the protocol BREERA with limited member's method by using the Net Logo simulator.

Simulation Scenario

Table (3) shows the suggested parameters for the certain WSN with fixed parameters. These parameters were applied and repeated in the simulation program for 90 times, first 30 results for the BREERA before modified , second 30 times for the BREERA after modified by using limited number of members for each cluster head method when members number equal 70 and third 30 times for the BREERA after modified it by using limited number of members when members number equal to 100.

Table (4) contains the simulation results which obtained by performed parameters resulted from the simulation program.

The simulation results in the table (4) can be graphed to explain the comparison in the BREERA performance before and after using limit number of members for each cluster head method as shown in figures (9), (10), (11), (12) and (13).

CONCLUSION

Based Random Efficient Energy Routing Algorithm was improved by using weights method. Energy Weights used in this method was chosen after applying various weights of (0, 0.1, 0.2, 0.3, …, 1) in the simulation program repeated 30 times and the average values were computed to each weight on the network (received messages , lost messages , died nodes and total energy).

The highest total energy of the network was obtained with energy weight of 0.8 and highest received messages average, less average of lost messages and less average of died nodes was obtained with energy weight of 0.1. Based Random Efficient Energy Routing Algorithm (BREERA) was improved by using limited number of members for each cluster head. Members numbers (70 and 100) which were used in this method was chosen after applying various members numbers (10, 20, 30, 40,…100) members in the simulation program for the wireless sensor network and to find with members number 100 as possible to obtain highest total energy and with members number 70 as possible obtained highest received messages average, less lost messages average and less died nodes average. In general using any number to determine the number of members gives better results than the protocol without specifying the number of members. The ideal number which gives the efficient results would vary depending on the number of nodes in the network.

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