International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol. 3, Issue. 3, May.-June. 2013 pp-1571-1576 ISSN: 2249-6645

Performance Evaluation of Breera Using Net Logo Simulator

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Abstract: Recently increased the attention of researchers wireless sensor Networks (WSNs) because of their active role in tracking and monitoring. In traditional WSNs the sensory information is collected and sent to the base station during specific periods of time, continuously and this method can be expensive because they reduce the life of the network because a lot of energy consumption and need high bandwidth. In this paper the sensory information will be collected and send to the base station only by the sensors which physical changes occur in their reigns. This paper shows the use of under development protocol named Base Energy-Efficient Routing Algorithm (BREERA), in the process of collecting sensory information and studies the most important factors that affect performance under terms (average PDF, average total energy, average throughput, average LBF and average dead nodes.

Keywords: *WSNs, LBF, throughput, BREERA, PDF.*

I. Introduction

Wireless Sensor Networks (WSNs) are a hundred or thousand sensors, distributed randomly or manually in specific area. There are many applications of WSNs such as environmental monitoring, facility monitoring, and target detection[1]. The simulation language used for the construction of the idea of protocol BREERA on WSN is the language NetLogo. NetLogo is a multi agent programming language distinguished by being easy language understanding and application, the possibility of speed control implementation, did not need high specification for computer which will be such as the simulation language NS2, supported many graphical interfaces and the programmer can design the graphical interface its won and support his application , free recourse and other feathers that can be recognized by the programmer through the use of them [2].

II. Sensor Node

Sensor node is a device that have ability to sensing physical changes within a specific environment and communicat it. The sensor node consists of five main components: controller, transceiver , external memory and power source and sensor

III. Clustering

Clustering is an organizing process of unordered objects in groups called clusters. Each cluster consist of two components: the cluster-head and members. In some applications of heterogeneous networks clustering is working to compilation of the same nodes together [4]. The Load Balancing Factor (LBF**)** is measures how well balanced in the cluster head nodes of the network [5].

IV. Throughput

Throughput defined as the total number of massages which received by the destination per time unit delivered from one sensor node[6] .

V. Related Works

M.Chatterjee at 2001 designed clustering algorithm based on the weight of the node in the cluster formation. Node with the lowest weight became the head-cluster and its neighbouring nodes members. This algorithm called Weighted clustering Algorithm(WCA). Calculating the weight of the node depends on four factors: the difference degree, distance summation to all its neighbours, 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 1 [7].

Sucec.J at 2002 designed clustering algorithm makes the node that has largest number of neighbouring nodes as a cluster-head. The number of degree of the node means the number of neighbouring nodes. This algorithm called Highest-degree Algorithm (HD) [8].

Toh.c.k at 2002 designed clustering algorithm make the node with lowest ID to become a cluster-head and neighbouring nodes become its members [9]. This algorithm called Lowest Identifier Algorithm (LID).

Tzung-Pei Hong at 2010 noted WSNs consume power more than MANETs, so he suggested to add fifth weight to the WCA to make it more suitable to implement with WSNs. This algorithm called Improved Weighted Clustering Algorithm (IWCA) [10].

Mohamed at 2011 designed clustering algorithm called based Random Energy-Efficient (BREERA). This algorithm makes the effective nodes become cluster-head and the other of its neighbouring nodes become members. Nodes that are close to the base station doesn't need to the clustering process but rather send its sensing information directly to the base station. Nodes away from the base station form clusters and send its sensing information with each other towards the base station. The cluster head node sends messages to the next cluster-head, which is farther member. The next cluster-head looking into its members if one of them is the target node , were not it send a messages to one of the cluster-heads of neighbouring clusters with maximum energy and so on forward the target nod (the base station). Each node in the network just need to know who its cluster head without knowing any information about their neighbours nodes like the previous algorithms that mentioned above previously. Hops number means the Number of Cluster-heads between the sink and the node from where new message is generated. Each massage in this routing algorithm have upper limit number of hops called threshold, if any message have number of hops larger than threshold value is died[2].Algorithm (1) illustrates steps of BREERA clustering as below.

Algorithm (1) : Clustering Procedure:

Action1

Input: Nodes number, messages number, broadcast range.

Output: Forming clusters.

Process :

1. Start.
2. Ask nodes if node has messages and far from the sink and not member for any cluster then
3. Make it as a cluster-head.
4. If the neighbouring nodes are not connected to any cluster then
5. Make them as members.
6.Decrement the energy of each member node.
7.End if .
8.Decrement the energy of the cluster-head node.
14.End if.

Action 2

Process :

1. Ask nodes member of clusters to make the farthest one of them from its cluster-head to be the next cluster-head.
2. Ask nodes in its broadcast range if they not connected with any cluster then
3. Make them as members.
4. Decrement the energy of each member node.
5. End if .
6. Decrement the energy of the cluster-head node.
7. End if.
8. End.

VI. PROPOSED WORK

The major drawbacks of the protocol BREERA is losing the more effective nodes from the network rapidly. We suggest using a counter with cluster-heads to avoid focuses on some nodes to play the role cluster-head for a long time. Using counter with the cluster-heads saving the energy for more effective nodes, make them work along time as possible and then saving the energy for all the network

a. Network Size Simulations

The suggested environment was designed in different scenarios, each scenario contains 25 nodes and increased by 25 in each step up to 500 nodes. Each scenario was runes and simulated in an operation manner (30) times in order to get near real results from simulation programs. The resulted information was listed in NetLogo table form contains about 600 rows. The table (1) indicates the built environment to be simulated under varying different parameters.

Table (1): WSN environment

Parameter	Value
The simulator	NetLogo 4.3.1 version (2011)
Nodes type	Genoese
Nodes number	Changeable (25,50,75,100,.....500)
Routing algorithm	BREERA
Pause time type	Uniform , 1s
Speed type	Uniform , 5m/s

We suggest all parameters are fixed except nodes numbers are variable. The simulation program with each scenario of specific nodes number repeated 30 times, to become the total simulation results 600 organized in a large data table in 600 rows.

Table (2) is the first part of the final results from the large data table that contains 600 rows. Each row in the table (2) illustrates the average of each 30 rows of the data table with specific nodes number of the network as follows.

Table (2): First part simulation results

Nodes Number	Average LBF	Average PDF
25	3.63650637	0.835
50	0.95031624	0.792333333
75	0.42116597	0.788333333
100	0.2661274	0.816666667
125	0.16096985	0.798333333
150	0.0969477	0.830666667
175	0.06251914	0.707
200	0.0863828	0.807
225	0.03889089	0.848
250	0.04610051	0.813333333
275	0.02866468	0.801333333
300	0.03032888	0.808666667
325	0.0324322	0.776
350	0.03319148	0.743
375	0.02613955	0.789333333
400	0.0156899	0.774666667
425	0.01839744	0.824
450	0.02013971	0.813333333
475	0.01336914	0.821
500	0.01716935	0.762333333

Table (3) is the second part of the final results from the large data table that contains 600 rows. Each row in the table (3) illustrates the average of each 30 rows of the data table with specific nodes number of the network as below.

Table (3): Second part simulation results

Nodes Number	Average Throughput	Average Dead Nodes
25	3.20491255	1.266666667
50	4.306367515	1.033333333
75	4.196641102	0.933333333
100	9.689316468	0.966666667
125	2.727711056	1.4
150	6.435626892	1.1
175	10.83104068	1.233333333
200	10.43457186	1.233333333
225	11.14498324	1.1
250	2.806787514	1.233333333
275	9.163704467	1.366666667
300	2.919376564	1.366666667
325	9.408042136	0.866666667
350	5.861975855	1.666666667
375	9.026012648	1.166666667
400	7.331723401	1.2
425	9.977181198	1.366666667
450	2.639134462	1.133333333
475	6.617376538	1.033333333
500	6.466969617	1.566666667

The results in the table (2) and table (3) are graphed in figures follow to show the relationship between the network metrics and their effects it behavior. Fig. 1 shows the relationship between the average dead nodes and a different numbers of nodes.

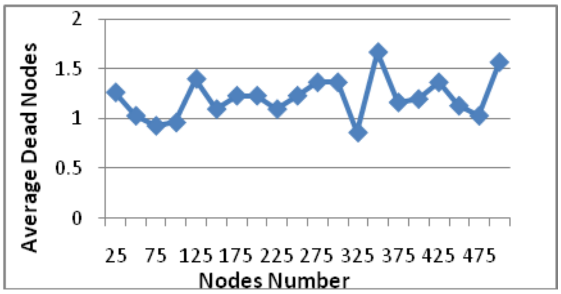

Fig. 1: Average dead nodes with a different numbers of nodes.

Fig. 2 shows the relationship between average throughput and a different numbers of nodes as follow.

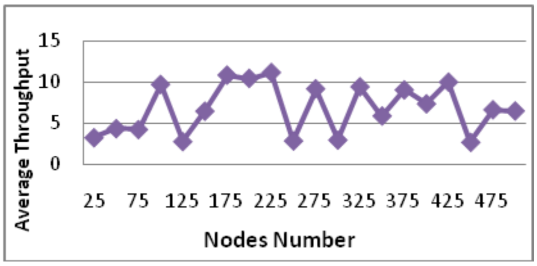

Fig. 2: Average throughput with a different numbers of nodes.

Fig. 3 shows the relationship between average LBF and a different numbers of nodes as below.

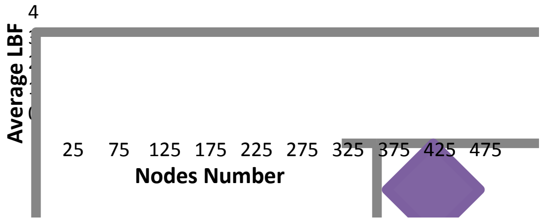

Fig. 3: Average LBF with a different numbers of nodes.

Fig. 4 shows the relationship between average PDF with a different numbers of nodes.

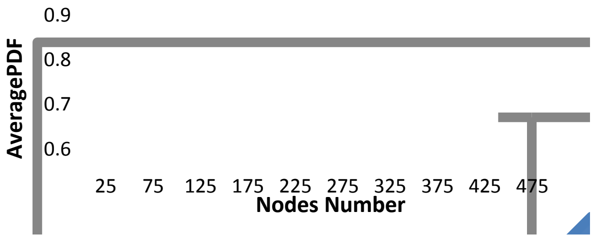

Fig. 4: Average PDF with a different numbers of nodes.

B Nodes speeds Simulations

The effectiveness of nodes speeds on the performance of BREERA was studied. We suggest apply the simulation program of WSN with three values of nodes speeds (5m/s ,10m/s and random speeds). Table (4) shows suggested WSNs environment as follow.

Table (4): WSN environment

Parameter	Value
The simulator	NetLogo 4.3.1 version (2011)
Nodes type	Genoese
Nodes number	500
Routing algorithm	BREERA
Pause time type	Uniform , 1 s
Nodes speeds type	Uniform 5m/s, 10 m/s and random speeds
Broadcast range	15 m
Hops' number	3

Parameters in the table (4) applied with the simulation program of BREERA 30 times with each nodes speed. Table (5) is the first part of the final results from the large data table that contains 90 rows. Each row in the table (2) illustrates the average of each 30 rows of the data table with specific nodes number of the network as below.

Table (5): First part simulation results

Nodes speeds	Average Dead nodes	Average Total Energy	Average PDF
5 m/s	1.0333333	48235.92667	0.5791
10 m/s	1.1	47706.38	0.906
random	0.9333333	48454.61667	0.907666667

Table (6) is the second part of the final results from the large data table that contains 90 rows. Each row in the table (6) illustrates the average of each 30 rows of the data table with specific nodes number of the network as below.

Table (6): Second part simulation results

Average LBF	Average Throughput
0.168457351	4.304558732
0.003327787	17.48638874
0.003039119	23.89773697

The results in the table (5) and in the table (6) are graphed in figures follow to show the relationship between the network metrics and their effects it behavior. Fig. 5 shows the relationship between the average dead nodes and nodes speeds .

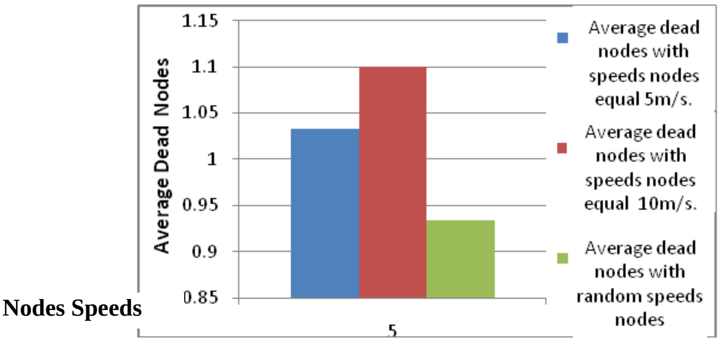

Fig. 5: Average dead nodes with a different value of nodes speeds.

Fig. 6 shows the relationship between average total energy of network and nodes speeds.

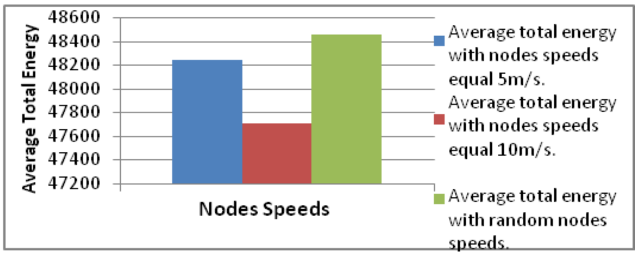

Fig. 6: Average total energy with a different value of nodes speeds.

Fig. 7 shows the relationship between average PDF and the nodes speeds.

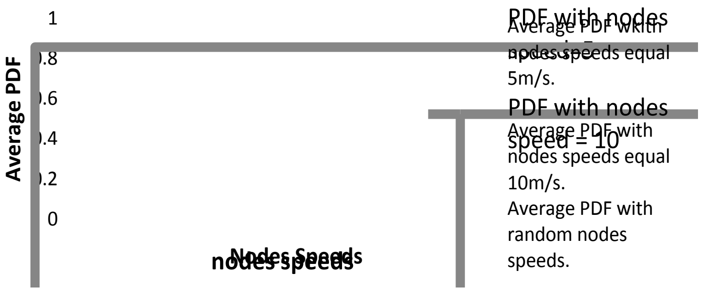

Fig. 7: Average PDF with a different value of nodes speeds.

Fig. 8 shows the relationship between average LBF and nodes speeds.

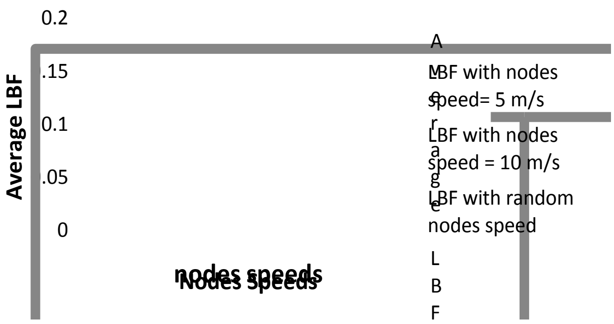

Fig. 8: Average LBF with a different value of nodes speeds.

Fig. 9 shows the relationship between average throughput nodes speeds.

Fig. 9: Average throughput with a different value of nodes speeds.

VII. Conclusion

Network size factor has an effect on the performance of the BREERA, when network size increased the performance of BREERA dropped under terms (average dead nodes, average LBF and average PDF) and rises under term average throughput. Average dead nodes increased when network size increased because the cluster-head node became responsible for the largest number of members and it will depletes their energy. Average LBF decreased when network size increased because the number of cluster-heads become very small and suitable the network size especially the number of cluster-heads according to BREERA not determined by any equation or law. Average LBF depends on the random effectiveness nodes. Average PDF decreased when the network size decreased because the hops ‘number become not suitable the size of the network. Average throughput increased when the nodes size increased because of the increased number of nodes sent the sensing data (messages) to the sink. Nodes Speeds factor has an effect on the performance of BREERA , when nodes speeds increased the performance of BREERA dropped under terms (average dead nodes , average total energy and average LBF) and rises under terms (average throughput and y a average PDF). Average dead nodes increased when nodes speeds increased because of the rapid change to form clusters. Average total energy decrease when nodes speeds increased because of the increased number of lost nodes. Average throughput increased when nodes speeds increased because of the high probability of approach the sink. Average PDF increased when nodes speeds increased because the messages will shorten long distances toward the sink with a few hops’ number and so messages may be able to access the sink before they reach the value of threshold.

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