RDWSN: To offer Reliable Algorithm for routing in wireless Sensor network

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Abstract

we would offer a reliable algorithm for routing in wireless sensor network (WSN). RDWSN algorithm by using of outstanding parameters has been evaluated compared with previous algorithms. The proposed algorithm with respect to size and distance in basic capability function has created a new target function that bears more effective than previous models. By use of RDWSN algorithm, we could improve wasted energy in WSN and also we could balance workload among CH with different paths. Parameters applied in the proposed algorithm may promote the reliability in order to make more balance. And in several simulations done by the same processor, the delay has been reduced with regard to previous algorithm in order to increase the reliability. Using a threshold detector with a combination of various parameters examined were able to help reduce delay in the area of sensor than previous algorithms and also improved power consumption and finally, The index parameters that were used in the capability function is increases sensors networks lifetime.

Keywords: *Delay, QOS , RDWSN, Reliability, routing ,Wireless Sensor Network.*

1. Introduction

Wireless sensor networks have been taken into consideration in recent years and used in different fields including medical care, industrial production, military applications and etc. Nodes are randomly distributed by uncontrollable devices in considered area and they form an adhoc network. It is natural that such a network may have hundreds or thousands of nodes. And nodes have some limitations including limited energy, low memory, limited computing power and none rechargeable batteries. Limitation of their bandwidth and short radio range. Managing a large number of nodes with these limitations can provide many challenges [2]. So, routing protocols should be in such a way that increase the lifetime of the network and improve service quality. Routing protocols are hierarchical and data collections imply to an organization based on cluster of sensors. In hierarchical structure, each cluster has a cluster head called CH [14]. And also, many of them are ordinary nodes (sn). Nodes of sensor transmit periodically their data to CH and CH transmits data to BS Station. Transmitting to BS can be done directly or through other CH. Whenever data is transmitted to the longer distance, energy consumption increases [9].
Regarding the mentioned cases, a lot of routing methods were created for WSNs which can be divided into three group's base on the most common categorization: Data–centric Algorithms, Location Base Algorithms and Hierarchical Algorithms .Data-centric protocols are query-based and depend on the naming of desired data, which
Helps in eliminating many redundant transmissions. Location-based Algorithms utilize the position information to relay the data to the desired regions rather than the whole network. Hierarchical Algorithms aim at clustering the nodes so that cluster heads can do some aggregation and reduction of data in order to save energy.
Cluster based methods benefit from a few characteristics: the first characteristic is that they divide the network into several parts and every part is directed by one cluster head. This characteristic causes the cluster based methods to be of a higher scalability level. The second characteristic is that a cluster head receives the data of its nodes and sends it BS after gathering data, which results in substantial reduction in data redundancy. We will provide a clustering algorithm, which uses a new distributed method, and a local threshold detector to perform clustering [1]. RDWSN algorithm performs routing among CH and by doing special techniques, it not only increases network life time but improves the reliability and end to end delay.

2. Related work

One of routing algorithms is Qosnet algorithm; in this algorithm for routing, a node bearing more energy is selected among other nodes.(Maxbv)and if such node dose not find among all nodes, the packet is discarded, therefore, the reliability decreases , and also end to end delay increases in order to find a node with more energy [3]. Another routing algorithm is MCMP algorithm, this algorithm has only considered to QOS and consumed energy by nodes being very important in wireless sensor networks and has not considered to the reliability and delay [4]. Another routing algorithm is DARA which uses the frequent packets for increasing the reliability, so this method causes to consume more energy in nodes for routing of frequent packets [7]. Also, algorithm MPDT has been offered to less energy consumption and life span of network that it does not consider to quality of services parameters. Many algorithms regarding the deduction of energy consumption have been offered in wireless sensor networks, such as:

SR: this protocol selects the paths based on strength and power of signals among nodes. Therefore, the paths selected are relatively stronger. This protocol can be divided into two parts. DRP is responsible for preparing and maintaining of routing table and the table related to the power of signals. SRP also studies received packets and if they have their own address, they would be transmitted to the higher layers [10,11]. Dynamic Source Routing (DSR): in this type, mobile nodes should provide temporary memories for the paths that are aware of their existence. Two main phases for this protocol has been considered: discovery of the path and updating path. [6]. Discovery of the path phase uses packet path request/reply and updating path phase uses confirmations and link mistakes. The temporarily ordered routing Algorithm (TORA)is based on distributed routing algorithm and has been designed for dynamic mobile networks. This algorithm for each pair of nodes will

determine several paths and require clock sync. Three main factors of this protocol are including: making path, updating path and destroying path. Ad hoc on demand distance vector (AODV) is based on algorithm DSDV; however, it would reduce emission because of routing at the time of necessity. Discovery of the path algorithm only starts its performance when a path does not exist between two nodes [8].

RDMAR: this type of protocol calculates the distance between two nodes through radio loops and navigation algorithms. This protocol determines the limited range of path, thus it reduces heavy traffic in network which it has less effective in improving quality of service and energy consuming [12, 13]. In Qosnet algorithm we had following equations:

$$B_{s_0 s_d}(Q) = \sum_{p \in Q} \sum_{s_i \in p} b_i(t) \quad (1)$$

$b_i(t)$ indicates Sensor battery S_i at the time of t. $B_{s_0 s_d}(Q)$ is the Battery Cost between source node S_0 and target node S_d

$$D_{s_0 s_d}(Q) = \min \{\sum d(s_i, s_{i+1})\} \quad (2)$$

$d(s_i, s_{i+1})$ indicates delay between sensor s_i and its neighbor s_{i+1} and end to end delay between S_0 and S_d is as follows:
According to Q is the collection of paths [3,4]
The reliability includes: the number of the received nodes in the target and the number of produced nodes in the source.
The reliability of end to end multi paths between S_0 and S_d in the collection of paths Q is as follows:

$$R_{s_0 s_d}(Q) = 1 - \prod_{p \in Q}(1 - r(p)) \quad (3)$$

r(p) the reliability of path is p.
D_{req} indicates end to end delay. R_{req} indicates the level of reliability Because we have (Q) $maxB_{s_0 s_d}$, must:

$$D_{s_0 s_d} \leq D_{req} \quad 4(a)$$
$$R_{s_0 s_d} \geq R_{req} \quad 4(b)$$

If we indicate the delay with L_i^d and the reliability with L_i^r in each link and h_i represents Hops and L_i^b is battery cost of each node, indicating:

$$L_i^d = \frac{D_{req} - D_i}{h_i} \quad 5(a)$$
$$L_i^r = \sqrt[h_i]{R_i} \quad 5(b)$$
$$L_i^b = \sum_{j \in f_w(s_i)} b_j(t) \quad 5(c)$$

D_i the experienced real delay in node S_i from the source node.
R_i is the requirements of the reliability given to the path via S_i.
$f_w(s_i)$ is the collection of pathfinder nodes[1].

2.1. RDWSN algorithm

In RDWSN algorithm, by using of relation which we will be explained in the following, we create a new target function and finally draw the proposed flowchart:

$$W_i = energy_i - b_i \quad (6)$$

W_i is the volume of a node.
$energy_i$ is the initial energy of a node.
b_i is the remaining energy of a node.
TD or threshold including the average of the highest energy and the lowest energy.

$$7)\ TD = \frac{maxE + minE}{2} \quad (7)$$

And finally, target function is offered by using of equations 5a, 5b, 6 as follows:

$$F = C_1 \frac{(D_{req} - D_i)}{h_i} + C_2 \sqrt[h_i]{R_i} + C_3 W_i + C_4 (dist_{ij})^L \quad (8)$$

3. proposal flowchart

Considering equation Nos. 7 and 8 , a flowchart is suggested as follows:
F_w (i) includes the collection of nodes that packet for reaching to Sink can pass from nodes; in the beginning, this collection is considered as empty set, because it has not been found a suitable node being in the ideal condition. D_{req} is the maximum delay which is tolerated to be reached packet from the source to Sink.
For this purpose, we add D_i which is equal to the delay in reaching packet from the source to node I, with d_{ij} (packet delay from node i to node), until the delay is calculated in reaching of packet from the source node to selected node i . and we consider collection of C_w(i) equal to the nodes that the delay in reaching packet to them is less than the requested amount D_{req} and residual energy of nodes must be more than threshold. if there is no node in this condition, network information would be updated; but if some nodes were accepted as candidate, we would select the most desirable node that is the nearest node to (minimum d_j) Sink with maximum reliability and minimum energy consumption and transmit the packet to such node. R_{req} is the minimum reliability to a path that packet covers the distance from the source node to Sink. The algorithm can be repeated up to Th.

To calculate the reliability, the path has used from equation $L^r_j = \sqrt[hj]{Rj}$ .And if this reliability is more than the requested reliability R_{req} , the node j considers as selected node. Also it should be noted to $\sum x_j \log(1 - R_{ij}) \leq \log(1 - L_i^r)$[4]. As it was noted, the energy of this selected node must be more than the amount of TD. This amount of threshold is calculated from equation7.

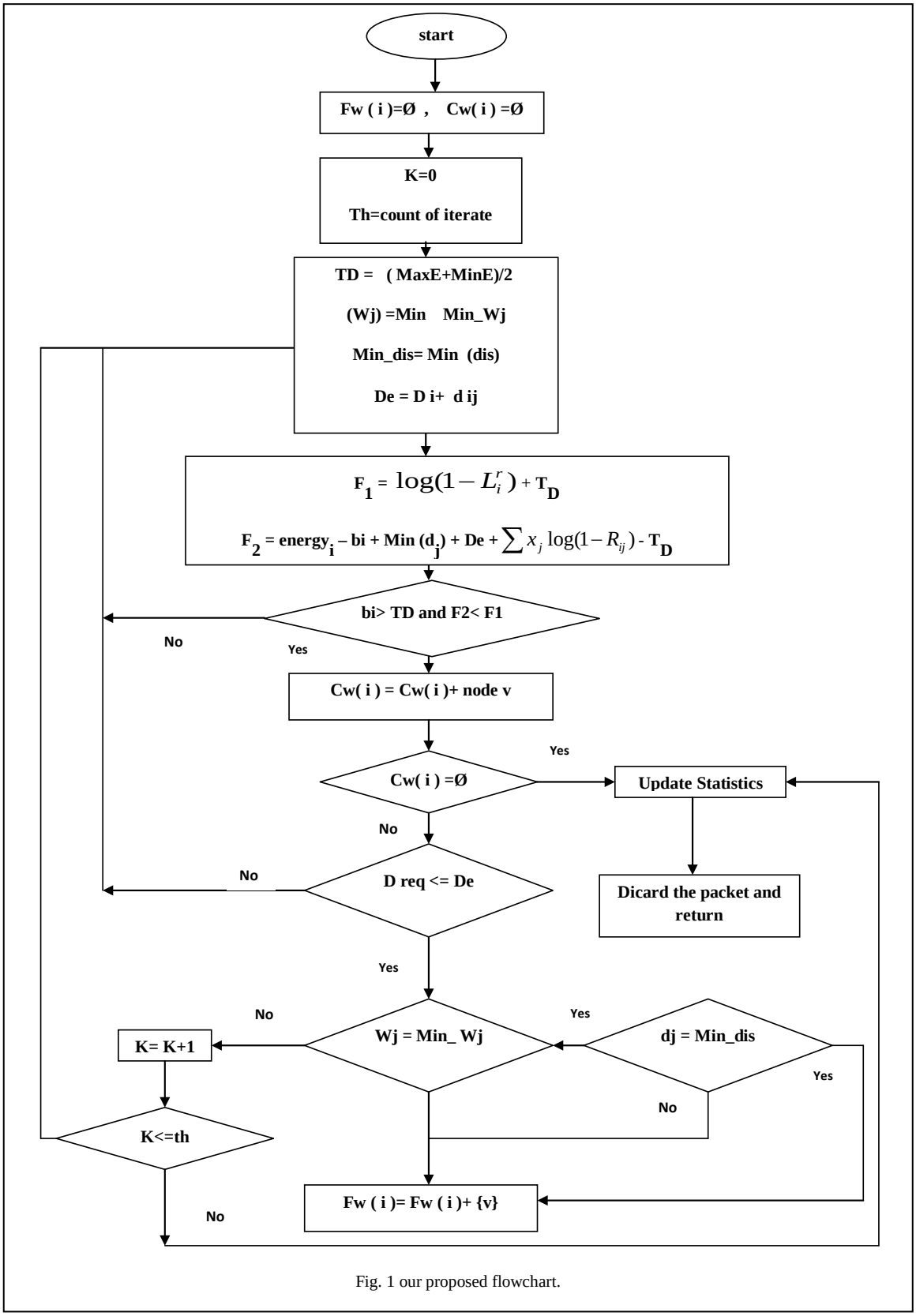

Fig. 1 our proposed flowchart.

4. Simulation

Simulation of RDWSN algorithm is performed in a restricted area of 200m *200m with about 200 nodes, We will analyze the presented algorithm in MATLAB, other simulation parameters has been displayed in table 1-1.

Table 1. Simulation of parameters

parameter	***value***
network area	200m*200m
sensors	70-200
transmission range	40m
bandwidth	250kbps
packet size	128b
simulation time	1000s
reliability	0-1
reporting rate	1 packet/s
delay	40-120

Also, to perform simulation, we need a system with hardware and software equipments that you can see this particulars in table No. 2. The nodes randomly distribute in this restricted area and Bs is installed 100 meter away from this certain area. The initial energy for all nodes has been considered 3.1 Joule. Figure 1 shows packet delivery ratio for 4 set algorithms.

Table 2.Minimum Hardware And Software Equipments

hardware or software	***Information***
Processor	Intel 1.8 GHz
Memory(RAM)	512 MB
operating system	Microsoft Windows XP
System type	32-bit Operating System

So the obtained reliability by RDWSN algorithm has improved in comparison with two algorithms MCMP and QOSNET. Of course, GODROUTING algorithm is our ideal algorithm in wireless sensor networks which has not been created up to now. Figure 2 indicates Average delivery ratio and as shown in diagram, reliability requirement has been very close RDWSN algorithm to ideal algorithm [3,4].
Figure 3 shows an average end to end delay for all algorithms in the same condition. As cleared in diagram, RDWSN algorithm after GODROUTING has the least delay among other algorithms. Figure 4 compares average delivery ration and delay requirement and in this comparison, RDWSN algorithm is better to two other algorithms.

Table 3. Simulation values

Number of nodes	***Average delivery ratio MCMP***	***Average delivery ratio QoSnet***	***Average delivery ratio RDWSN***	***Average delivery ratio GodRouting***
75	0.33	0.43	0.53	1
100	0.57	0.71	0.8	1
125	0.75	0.89	0.9	1
150	0.75	0.94	0.94	1
175	0.78	0.94	0.95	1
200	0.91	0.96	0.98	1
Reliability requirement	***Average delivery ratio MCMP***	***Average delivery ratio QoSnet***	***Average delivery ratio RDWSN***	***Average delivery ratio GodRouting***
0.7	0.9	0.97	0.98	0.99
0.75	0.9	0.97	0.98	0.99
0.8	0.9	0.97	0.98	0.99
0.85	0.91	0.97	0.99	0.99
0.9	0.93	0.99	1	1
0.95	0.95	0.99	1	1
Reliability requirement	***Average packet delay MCMP***	***Average packet delay QoSnet***	***Average packet delay RDWSN***	***Average packet delay GodRouting***
0.7	110	85	57	44
0.75	110	85	56	43
0.8	110	85	56	42
0.85	110	83	55	41
0.9	109	82	52	41
0.95	109	81	49	41
delay requirement	**Average delivery ratio MCMP**	**Average delivery ratio QoSnet**	**Average delivery ratio RDWSN**	**Average delivery ratio GodRouting**
60	0.28	0.55	0.61	1
70	0.49	0.78	0.85	1
80	0.7	0.88	0.89	1
90	0.82	0.92	0.93	1
100	0.88	0.94	0.94	1
120	0.91	0.98	0.99	1

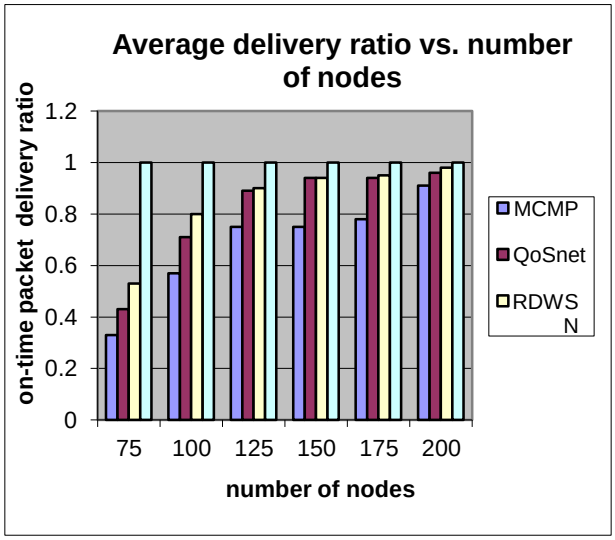

Fig. 2 Average delivery ratio VS. number of nodes.

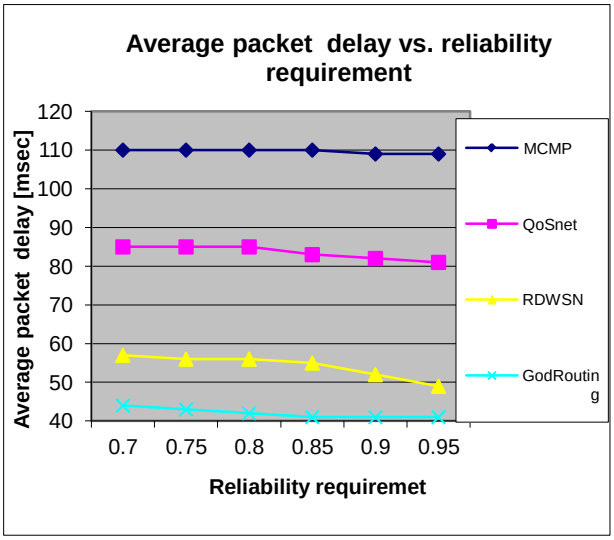

Fig. 4 Average packet delay VS. reliability requirement..

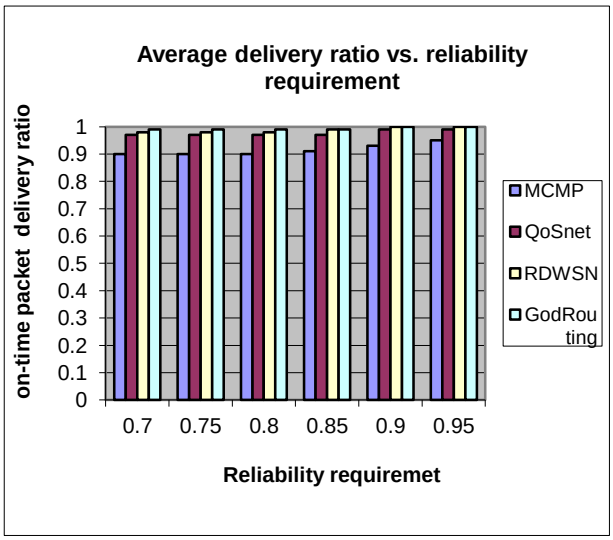

Fig 3. Average delivery ratio VS. reliability requirement.

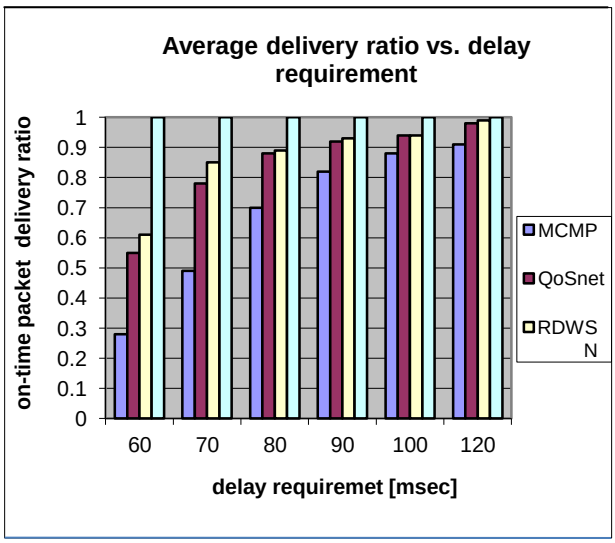

Fig 5. Average delivery ratio VS. delay requirement.

5. Conclusion

In this paper, we suggest the reliable algorithm for routing in sensor networks. RDWSN algorithm provides a reliable transmission environment with low energy consumption and less average end to end delay for transmitting packet toward BS. In this approach, TD is used for selecting next node that it is caused nodes with average energy to participate in the routing and also by weighting to nodes, we could improve the reliability and delay compared with two MSMP and QOSNET algorithms, for example, in the diagram of figure 2, as the evidence shows, by having number of different nodes, RDWSN algorithm at the best condition and special situation has increased the reliability of MCMP and QOSNET algorithms more than 0.23% and 0.10% respectively, and at the worst condition, it has been equal to QOSNET algorithm and in comparison with MCMP algorithm, it has improved at the rate of 0.07%. also considering diagram of figure 4, average delay of packets has decreased, so that with different reliabilities, average delay RDWSN at the best condition is less than MCMP and QOSNET algorithms .

We try to improve this algorithm in respect of other QOS parameters and approach to GODROUTING algorithm.

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