Modified Dynamic Power Management an Integrated Approach for Lifetime Enhancement of Wireless Sensor Network (M-DPMM)

R. Augustian Isaac
Research Scholar, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India.

Dr.M. Lakshmi
Dean- CSE, Sathyabama University, Chennai, Tamil Nadu, India.

Abstract – Routing protocol is one of the efficient methods of enhancing the lifetime of the network. Life time of the sensor node has to be increased in order to increase the battery life which does not cause frequent changing of batteries in the physical network and hence the network could be made as less maintenance network and cost effective. Multipath routing is one of the best routing path protocols for lesser energy consumption as it involves even repair of the selected path. The only challenge is this type of routing is selection of neighbour nodes. Hence proper selection of neighbours involves a modified approach where neighbour is selected based on fuzzy logic techniques rather than traditional techniques.

Index Terms – Wireless Sensor Network, energy efficient, Multipath routing, fuzzy logic techniques.

1. INTRODUCTION

Wireless networks have become most popular in the field of networking. Nowadays in recent era most popular network is resource constrained wireless sensor network. The basic resource of wireless networks such as memory, battery or energy, bandwidth etc... are very much less in sensor networks as it has to be laid in the remote location where human intrusion is not possible.

The major applications of wireless sensor networks find its way in defence, environmental monitoring, habitat monitoring etc... Nowadays it has been implemented even in patient monitoring system, vehicular networks and also in all industrial plant monitoring system. These monitoring systems could be established as event driven or continuous. Figure 1 depicts the various applications of wireless sensor networks.

Many routing protocols are implemented for wireless sensor networks. The techniques involved are cluster based routing, single path routing, multipath routing, single hop communication, shortest path routing, flooding etc... In the proposed system multipath routing has been established. A modified approach such as fuzzy logic techniques are implemented for selection of neighbours. The energy level and the distance between the source and destination node is not maintained as standard parameter. It varies dynamically during the transmission. Hence the values become unambiguous for fixing up of the threshold. Any unambiguous data could be solved easily using fuzzy logic techniques. Hence as a best approach, fuzzy techniques are implemented for neighbour selection. In this triangular membership functions are taken for all linguistic variables.

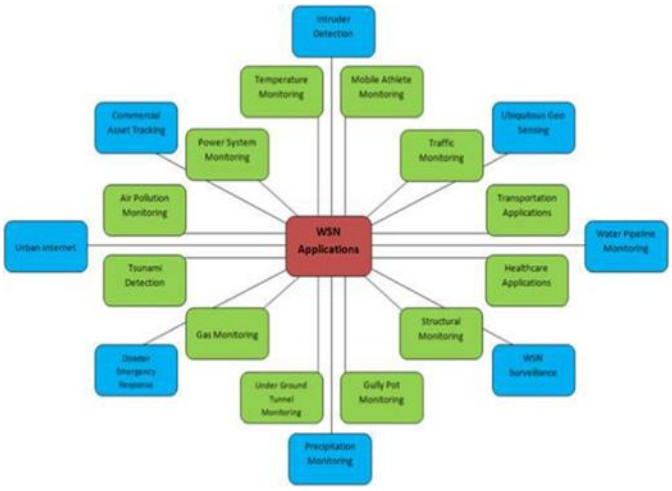

Figure 1.1 Various applications of WSN

2. IMPLEMENTATION OF M-DPMM PROTOCOL

The network is set up with the following specifications mentioned in table 1. The proposed protocol is implemented in NS-2 simulator where initial assumptions for few parameters such as number of nodes, initial energy of the node and size of the network region etc... is essential. In this assumption the initial energy of the node is assumed to be 2800 Joules to make it compatible with the energy of the battery supply in real time node. Hence to make the protocol in par with the real time measurements such an attempt is made. The transmission, receiving and idle power are given the values as per the hardware data of the nodes.

Table 1 Initial specifications of the network

SL. NO.	PARAMETERS	VALUES ASSIGNED
1.	Network Size	(0 – 200) Variable
2.	Topology	Grid topology of 1000m X 1000m size
3.	Initial energy	2800 J
4.	Packet Size	512 Bytes
5.	Queue length	50 packets
6.	Node sensing range	50 m
7.	Transmission power	97.2 mw
8.	Receiver power	97.2 mw
9.	Sensing power	0.00000175mw
10.	Idle power	0.0 mw
11.	Propagation model	Two ray ground

The proposed protocol is implemented in two phases. first phase is the dynamic power management schemes where the active nodes of the network are selected in random and also using fuzzy techniques. In the second phase the neighbour table is updated and multipath routing is setup for the network. From the set multipath the shortest path is chosen for transmission. Since the active nodes are based on residual energy of the node, the network enhances the lifetime. Table 2 depicts the algorithm of Modified Dynamic Power Management through Multipath routing M-DPMM.

TABLE 2 ALGORITHMS FOR PROPOSED PROTOCOL M-DPMM

Step 1: Fix up the initial specifications

Step 2: Acquire the residual energy of all nodes

Step 3: Based on the rule table select the active nodes in the network

Step 4: Also select the next hop node and update the neighbour table

Step 5: Select three various paths for transmission

Step 6: Choose the shortest path for final transmission

Step 7: If the path fails choose next shortest path as alternate path

Initially all nodes broadcast the information of its node ID N_ID. The received nodes acknowledge with the receiver R_ID and residual energy of the node. Based on the signal strength the distance between two nodes is estimated. On estimating the distance, the neighbour table is updated with N_ID, R_ID, residual energy and distance. The selection of next hop is done based on distance and residual energy of the node. Each node is given a radius r. If the estimated distance is lesser than r, then the possibility of the node to get selected for next hop increases. Initially on trial and error basis the threshold of the residual energy is varied and attempted for various trails. Upon multiple trails the threshold of residual energy is fixed as 24% of initial energy. It is also attempted to use fuzzy techniques for the selection of next hop. The values of the membership function are taken as given in the Table 3. and the knowledge base rules has been listed in Table 4.2. The next hop information is given as a schematic in Figure 3 The flow of the protocol is as follows and the same has been given as flow diagram in Figure 4.

TABLE 3 VALUES OF MEMBERSHIP FUNCTION

Inputs	Linguistic Variables	Type of Membership Function	Membership Function Values
Distance (meters)	Small	Triangular	(10,35)
	Medium	Triangular	(20,40)
	Large	Triangular	(35,50)
Residual Energy (joules)	Small	Triangular	(10,1800)
	Medium	Triangular	(1600,2400)
	High	Triangular	(2000,2800)

TABLE 4 RULE TABLE

Distance (meters)	Residual Energy		
	Small	Medium	Large
Small	Reject	Select	Select
Medium	Reject	Select	Select
Large	Reject	Reject	Select

3. RESULTS AND DISCUSSION

The performance of both DPMM and M – DPMM were recorded and analyzed. The life time of the network is tabulated for DPMM protocol in Table 5. and the same has been given graphical representation and compared with DPMC protocol in Figure 2.

TABLE 5 LIFE TIME OF THE PROTOCOL

ACTIVE NODES (%)	DPMC (No of rounds)	DPMM (No of rounds)
25	4720	4536
35	5400	4990
45	5646	5400
55	6900	6450
65	6940	6548
75	6962	6650

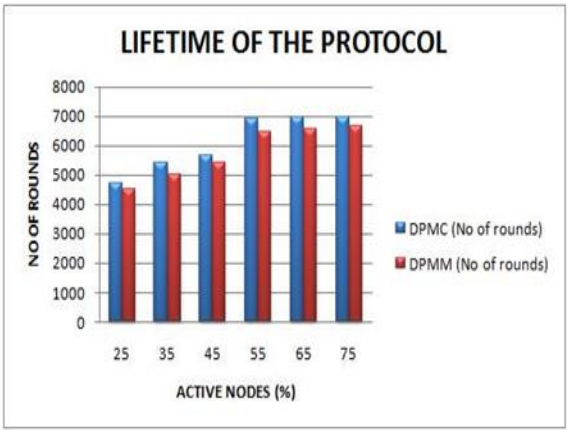

Figure 4.4 Life time of various protocols

On comparing the energy consumption fuzzy based dynamic power management gives enhanced lifetime and power consumption is very less. Dynamic power management schemes without using fuzzy techniques gives better results than any other traditional routing protocols and the average energy consumption is 315 Joules. Integration of dynamic power management and fuzzy techniques outperform better and the average energy consumption is 130 Joules and the consumption decreases by 58% thereby enhancing the lifetime of the network and the same has been tabulated in table 6.

TABLE 6 ENERGY CONSUMED BY VARIOUS PROTOCOL

No. of Nodes	LEACH (J)	EADPR (J)	GEAR	FEADPR	DPMC	DPMM	M-DPMC	M-DPMM
50	2750	2600	2432	1000	256	302	126	116
100	2764	2634	2490	1250	294	336	135	125
150	2800	2658	2493	1220	300	345	146	122
200	2826	2702	2500	1500	321	369	159	117

In the proposed fuzzy based dynamic power management multipath routing protocol M – DPMM the number of intermediate nodes involved in transmission is reduced considerably when compared to other multipath routing techniques. Using soft computing techniques the selection of nodes has been optimized thereby considerably reducing the number of intermediate nodes involved in data transmission. Given below in table 7 is the comparison of number of intermediate nodes involved in transmission. The same has been illustrated in figure 3-5.

TABLE 6 COMPARISON OF NO OF INTERMEDIATE NODES

NETWORK SIZE	MULTIPATH ROUTING	M - DPMM
25	4	2
40	7	4
50	9	6
70	13	7
85	15	8
100	19	10

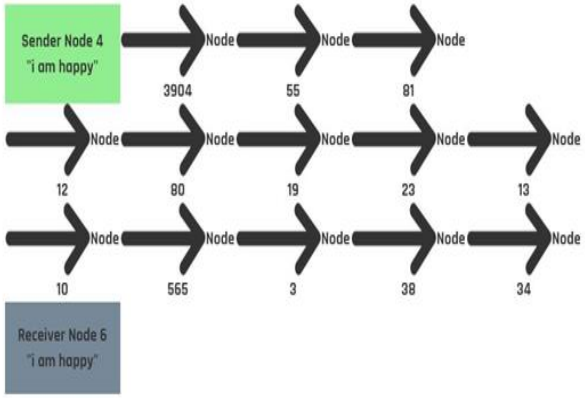

Figure 3 No of Intermediate Nodes for network size 85 (Conventional Routing)

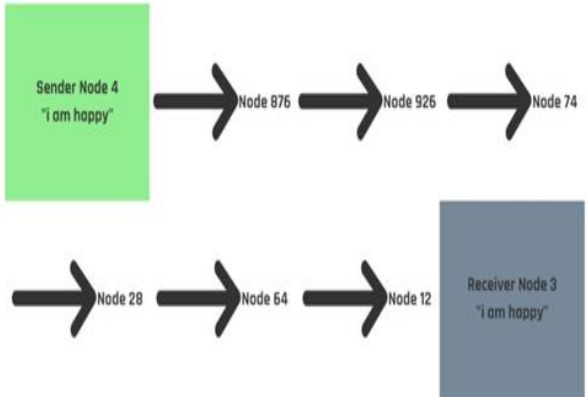

Figure 4 No of Intermediate Nodes for network size 85 (Proposed Routing)

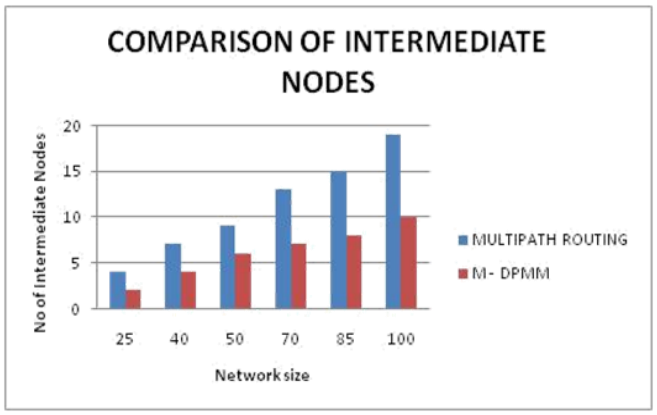

Figure 5 Comparison of No of Intermediate Nodes

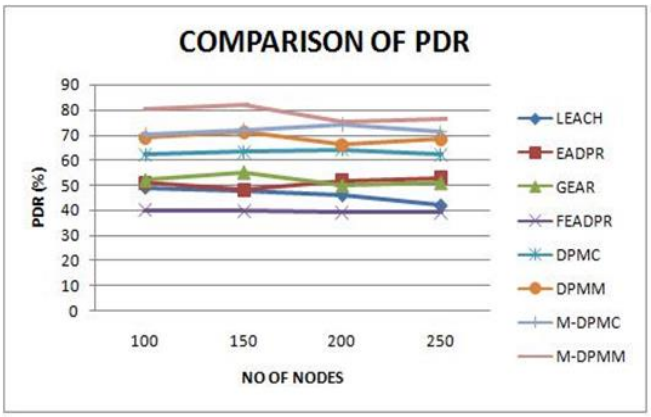

Figure 6 Comparison of PDR by various protocols

The packet delivery ratio of dynamic power management scheme protocol increases better than traditional protocol and performs in a similar fashion with respect to fuzzy based techniques and the same has been tabulated in table 7.

TABLE 7 PACKET DELIVERY RATIO OF VARIOUS PROTOCOLS

No. of Nodes	LEACH (J)	EADPR (J)	GEAR	FEADPR	DPMC	DPMM	M-DPMC	M-DPMM
100	49	51	52	40	62	69	70	80
150	48	48	55	39.5	63	71	72	82
200	46	52	50	39	64	66	74	75
250	42	53	51	39	62	68	71	76

4. CONCLUSION

After the selection of active nodes cluster based routing and multipath routing has been implemented which enhances the lifetime of the network. The number of intermediate nodes involved in transmission is considerably reduced there by managing the power consumption efficiently and lifetime of the network increases. It is analyzed that power consumption of the protocol is further reduced than any conventional routing protocols. Fuzzy based dynamic power management outperforms better. The packet delivery ratio is maintained with respect to fuzzy based routing schemes, whereas with respect to conventional routing it has been increased further. The packet delivery ratio of the proposed system is averagely maintained to 70% which is not sufficient for any efficient working of network. This may lead to loss of important data. Hence the protocol could be extended for enhancing the PDR of the network. The selection rules and values of the variables could be further optimized using any optimization algorithms which may lead to increase PDR of the network.

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