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Improved Dynamic Multilevel Priority (IDMP) packet scheduling algorithm for wireless sensor networks

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ABSTRACT

Priority packet scheduling algorithms of Wireless Sensor Networks (WSNs) are different for real-time and non real-time data packets, at sensor nodes main constraint is reducing the energy consumption and transmission delay. Existing algorithms of packet scheduling in WSNs are pre-emptive scheduling, non-pre-emptive scheduling, First Come First Served (FCFS), Earliest Deadline First (EDF), multi-level priority scheduling and Dynamic multi-level packet scheduling (DMP). These algorithms requires a high processing overhead and long transmission delay as FCFS concept is used, leads to deprivation in preemptive and non-preemptive priority scheduling. Multilevel and Dynamic multilevel priority algorithms may suffer with improper allocation of data packets in the queues. Moreover, as the scheduling of these algorithms are predetermined, they failed to adopt the changes of requirement in WSN applications. In this paper, Improved Dynamic Multilevel Priority (IDMP) packet scheduling algorithm is proposed to achieve reduction in buffering delay, process overhead and transmission delay by using different priority queues for real-time and non real-time data packets.

Key words— packet scheduling, QoS, Wireless sensor networks, FCFS, Improved Dynamic Multilevel Priority (IDMP).

I.INTRODUCTION

Wireless sensor networks are capable of collecting and forwarding the information through wireless transceivers. At the end, collected data will be delivered to sinks using multiple-hop communication method. Batteries are used at sensor nodes and it very difficult to locate and replace the batteries. Therefore, efficient utilization of energy with low power consumption and low transmission delay is in demand for WSNs [15]. However, multiple–hop communication facilitates the sensor nodes to communicate with the nearest sensor node in the place of distant sink to save energy [12]. The performance of the WSN is depends on energy conservation and lifetime of the network and the constraints of sensor nodes are energy, range, processor, memory and bandwidth. The deployed sensor nodes collects the information and transmits continuously, this defines the lifetime of node and network. Scheduling and routing algorithms are required to increase the efficiency of WSNs. Most of the WSNs are using the FCFS scheduling that processes the data in the order of their arrival time, it requires a lot of time. Real-time data must be delivered to the sink/base station at the earliest through shortest possible path. Hence, Intermediate sensor nodes require changing the order as per their importance, deadline and life time. It is also observed that the existing task scheduling algorithms of WSNs are not accepting traffic dynamics. For instance, a real-time priority scheduler in real-time applications can't be changed in WSN applications [6][9]. The schedulers mainly focus on throughput, end-to-end delay and fairness/average waiting time. This article focuses on an Improved Dynamic Multilevel Priority (IDMP) packet scheduling algorithm to increase QoS parameters such as lifetime, throughput, delay and waiting time by using preemptive task priority scheduling and circular wait condition to avoid deadlock [4].

II.RELATED WORK

Scheduling of data packets is very important as it determine the order of transmission of data packets by following different criteria's such as deadline, size and priority [16]. Higher priority is given to the real-time applications than non real-time applications. WSNs consist of different types of sensors for different data types, which include sensor sleep and wake-up scheduling [5] [14], link scheduling and dynamic traffic patterns. Packet or task scheduling algorithms are classified as per various factors such as priority, data type and queues are shown in Figure-1.

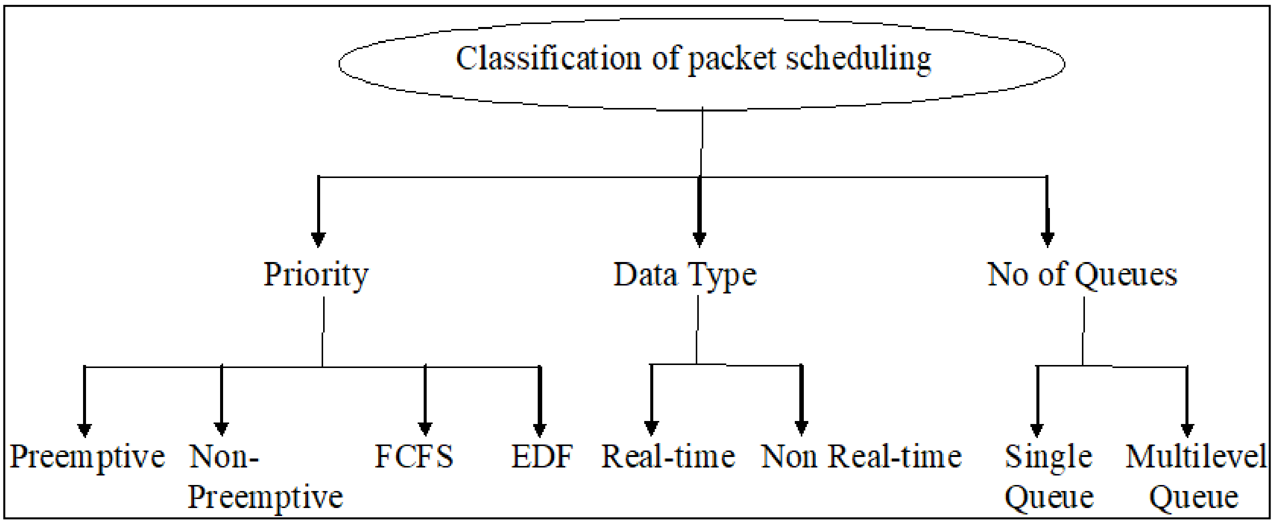

Figure-1: Classification of packet scheduling schemes as per different factors

A. PRIORITY:

1) Preemptive scheduling:

Processing of high priority packets is done first by preempting low priority packets is preemptive priority scheduling [2]. The context of low priority packets will be saved, if they are active.

2) Non-preemptive scheduling:

In Non-preemptive priority scheduling, if a task with higher priority is being executed and if subsequent task arrives, than it will wait in the ready queue until the execution of earlier task.

3) First Come First Served (FCFS) scheduling:

If the processing of data packets is done as per the arrival time then it is FCFS scheduling algorithm and it may take lot of time to deliver the data packets to the base station.

4) Earliest Deadline First (EDF) scheduling:

Each data packet has a deadline of time and it must be followed to deliver the data packet to the base station before deadline. EDF scheduling algorithm checks the deadline and earliest deadline data packet will be sent first to the base station. It improves the efficiency with respect to waiting time and transmission delay.

B. DATA TYPE:

1) Real-Time Packet Scheduling:

As per the data types, highest priority will be given to real-time data packets among all data packets, which are available in the ready queue. This offers minimum transmission delay as the data packets are set to highest priority.

2) Non Real-Time Packet Scheduling:

The priority of non-real time packets has low priority than real-time packets and hence they will be delivered to base station by either using FCFS or SJF scheduling. If real-time packet doesn't exist at the ready queue of a sensor node then these packets can be preempted by non real-time packets.

C. NUMBER OF QUEUES:

1) Single Queue scheduling:

Single ready queue is a part of each sensor node. The data packets of all type enter into the ready queue and then scheduling is done based on different criteria's such as type, priority, size, etc. Single queue scheduling has a high starvation rate.

2) Multi-level Queue scheduling:

In multi-level queue, each node has two or more queues for placing data packets into different queues as per their priorities and types.

III.PROPOSED IMPROVED DYNAMIC MULTILEVEL PRIORITY (IDMP) PACKET SCHEDULING ALGORITHM

Following steps are required to develop an Improved Dynamic Multilevel Priority (IDMP) Packet Scheduling Scheme for Wireless Sensor Network.

1) Assigning preemptive task priority based on packet life time.

2) Usage of circular wait conditions to avoid deadlock.

The above steps are additional in IDMP when compared to Dynamic Multilevel Priority and FCFS scheduling algorithms. These are required to achieve the increase in lifetime, throughput, delay and waiting time [7] [8].

1) Preemptive Task Priority Scheduling based on life time:

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If a high priority task arrives at the ready queue then it will preempt the running low priority task. Figure-2 shows the preemptive priority scheduling based on packet life time [3]. It shows that the task gets executed at any point is the task with the highest priority among all tasks in the system w.r.t. life time.

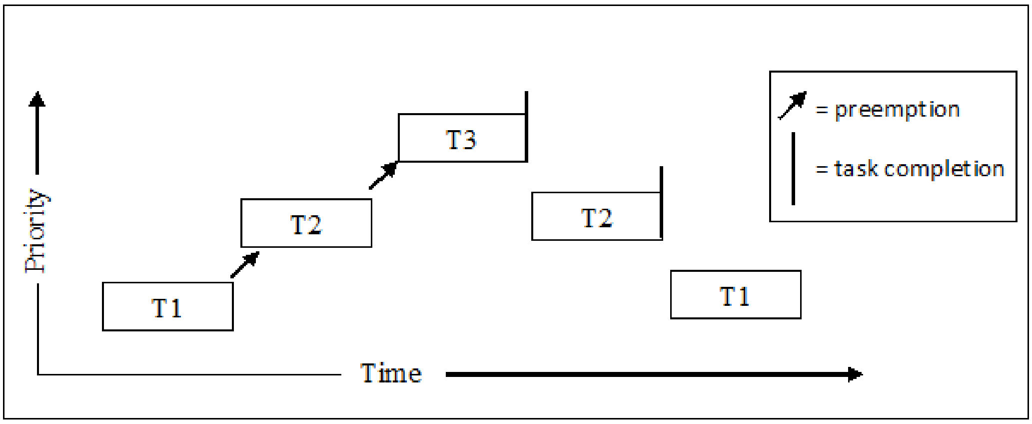

Figure-2: Preemptive Task Priority Scheduling based on life time

Real-time task scheduling support 256 priority levels, in which 0 is the maximum priority and 255 the least priority. In some of the methods, priorities are assigned in reverse order, where 255 is the maximum priority and 0 is the least priority. However, the concept is same. With a preemptive task priority scheduling, each task has a priority, and the highest priority task executed first. If a task priority is higher, then the task becomes ready to execute, the kernel saves the current task's context and switches to the higher priority task. Figure 3 shows the task-1(T1) is preempted by higher priority task-2(T2), which is then preempted by task-3(T3). When task-3(T3) completes, task-2(T2) resumes; similarly, when task-2(T2) completes, task-1(T1) resumes.

2) Circular Wait Condition to avoid Deadlock:

Avoiding the deadlock is an indiscriminate case of multi reentrant flow line systems (MRF), which is called as the Free Choice Multi Reentrant Flow Line systems (FMRF). In this, as tasks have multiple resource choices and hence the decision on routing must be made. This results into deadlock avoidance for MRF [11]. Circular wait condition of the resources in the system supports the critical siphons and subsystem for FMRF. Formulation of a matrix is efficient to compute the objects for avoiding the deadlock. Maximum work in progress (MWP) is the dispatching policy for avoiding deadlock in FMRF systems [10].

The above discussion is valid if the following assumptions are maintained:

(i) No resource is fails during a mission.

(ii) A resource is always completes its current task before starting a new task.

(iii) Each resource performs a single task at a time.

(iv) After the completion of task, the resource is ready for a new task.

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(v) Each task requires one resource for the execution.

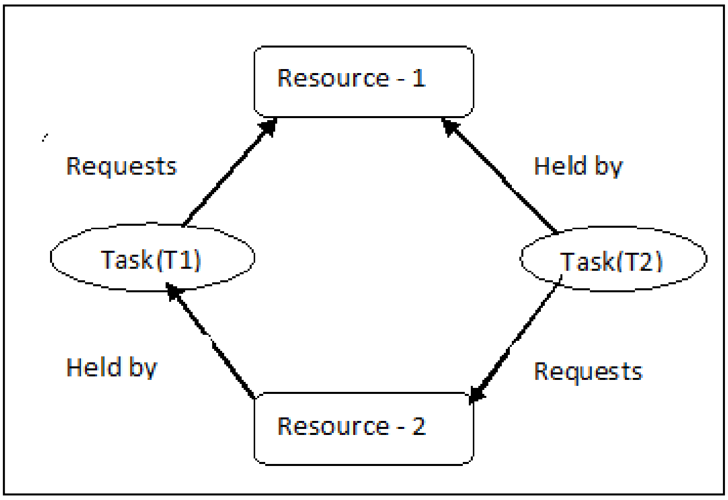

Figure-3: state diagram of circular wait condition.

The simple circular wait (SCW) conditions are preemptive circular waits, which do not contain other circular wait condition. All the CWs are needed to be monitored and identified to activate the rules of deadlock structures. As per the assumptions mentioned above, a dead lock condition occurs if there is a dynamic selection of resources. Greedy resource algorithm modifies the resource assignment matrix M as follows.

If each task is having a choice of resources to use then define a dynamic priority assignment (DPA) matrix with the entry is in position (i; j) that is in between '0' and'1'. This describes the efficiency with which resource j executes the task i, with '0' entry that resource j cannot perform task i. The matrix shows that Task (T1) may be performed with either Resource-1 or Resource-2, in contrast to the matrix M, where multiple 1's in a row defines that all the resources are required for that task [1][13]. The algorithm search for an ideal resource for a particular task and if it doesn't find a resource, it waits for a suitable and available resource for that particular task. Therefore, depending on the DPA matrix, at each step the resource matrix M is modified to have 1's in the entries equivalent to the maximum values of the DPAM in each row.

IV.SIMULATION AND RESULTS

The simulation of proposed IDMP algorithm is done by using NS2 software and it provides the performance evaluation of the algorithm. It also provides the comparison of Multi-level, FCFS, DMP and IDMP in terms of throughput and average transmission delay. Simulation results are presented for both real-time data and all types of data traffic. Table-I shows the simulation parameters and their respective values.

Table-I: Simulation parameters and respective values	
Parameter	**Value**
Transmission range	500m
Area	7*7grid
Queue	Ready queue
Background data traffic	CBR
Initial energy	100 J
Topology	Flat-grid
Length of queue	100
MAC Protocol	802_11
No. of nodes in DMP	43
No. of nodes in IDMP	162

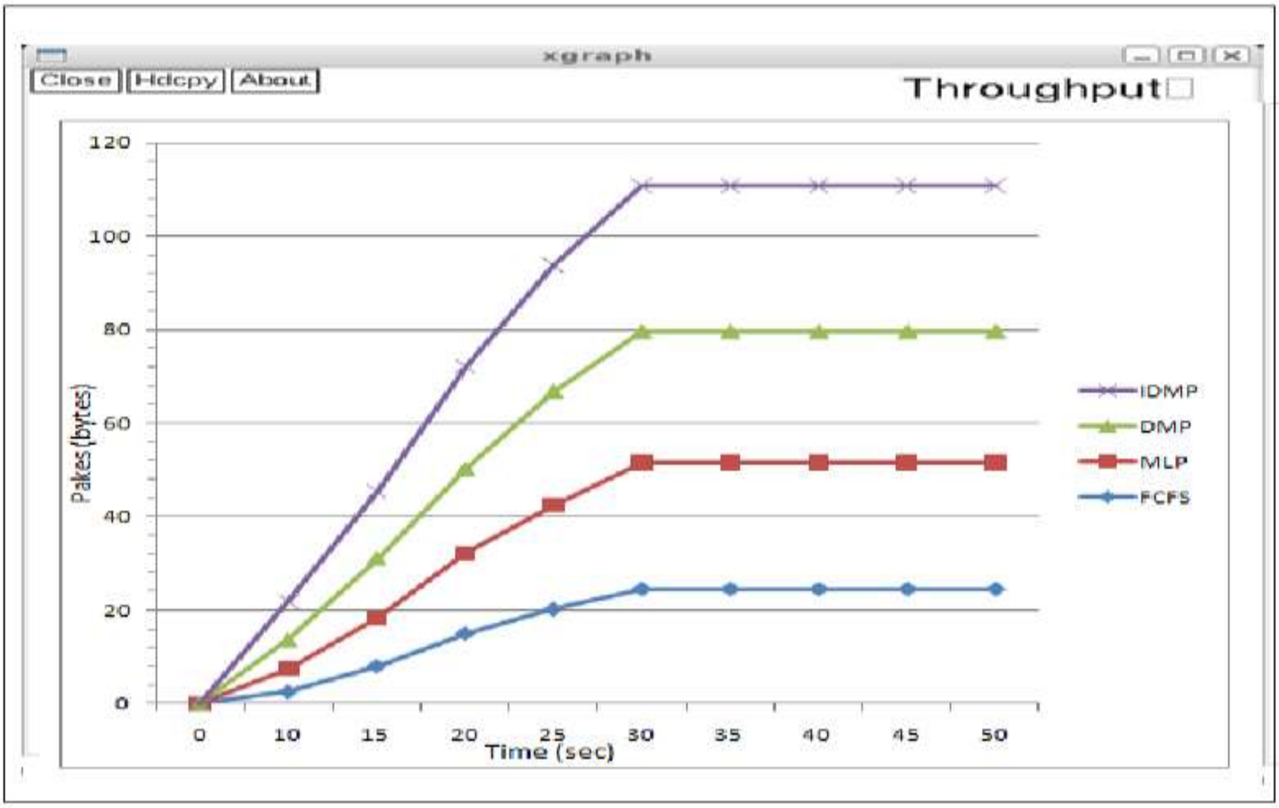

Figure-4: comparison of IDMP throughput with other schemes

During the comparison of simulation results as shown in Figure-4 for different scheduling schemes, it is observed that the highest throughput is offered by IDMP packet scheduling algorithm. Least throughput is offered by FCFS scheduling algorithm. It is also observed that the throughput is maintained constant after certain point.

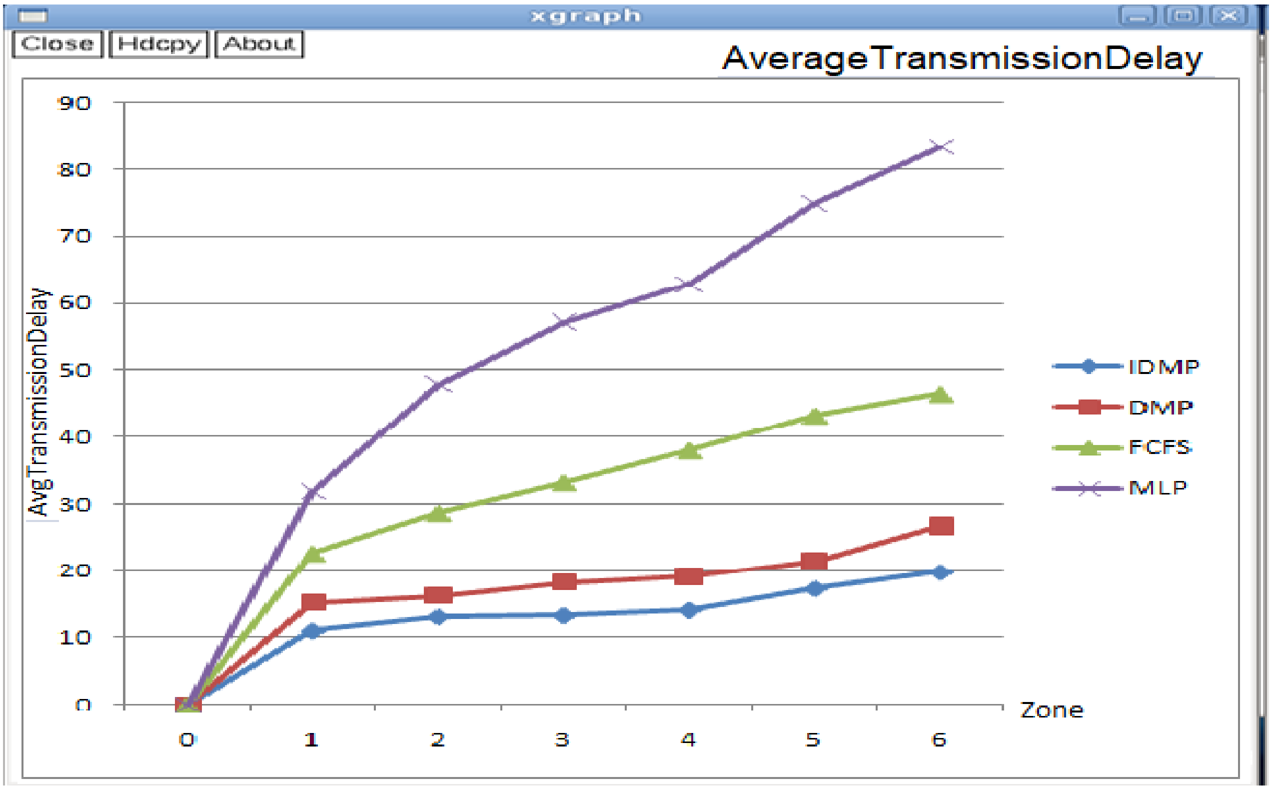

Figure-5: comparison of average transmission delay of IDMP with other schemes

During the comparison of simulation results as shown in Figure-5 for different scheduling schemes, it is observed that the largest transmission delay is offered by Multilevel Priority packet scheduling algorithm. Least average transmission delay is offered by IDMP scheduling algorithm. It is also observed that the average delay offered by DMP scheduling algorithm is better than FCFS scheduling and MLP scheduling algorithms.

Table-II : Performance metrics of different scheduling schemes based on simulation results

Parameter	FCFS	EDF	MLP	DMP	IDMP
Energy saving (joules)	83.74	83.81	83.472	85.85	88.52
Packet delivery factor	33.845	74.42	76.282	44.5	79.806
Delay (ms)	25.2	26.57	29.632	28.51	22.68

Table-II shows the performance of different scheduling algorithms for various parameters like Energy saving, packet delivery and transmission delay. It is indicating that highest energy is saved in IDMP and DMP scheduling schemes. It is also showing that IDMP and MLP scheduling algorithms are better in packet delivery factor. Transmission delay is lowest in IDMP, DMP and FCFS.

V.CONCLUSION

In this paper, we proposed a Improved Dynamic Multilevel Priority (IDMP) packet scheduling algorithm for Wireless Sensor Networks (WSNs). The algorithm uses assignment of preemptive task priority and circular wait conditions which avoids the deadlock. It ensures minimum transmission delay for the highest priority data packets by maintaining proper context of low priority data. The results obtained by simulation shows that the proposed IDMP packet scheduling algorithm has enhanced performance than the existing scheduling algorithms such as FCFS, Multilevel and DMP in terms of the average transmission delay and throughput.

REFERENCES

[1] Karim.L, Nasser.N & Salti T.E, (2011), 'Efficient Zone-based Routing Protocol of Sensor Network in Agriculture Monitoring Systems', International Conference. Communication, Information Technology, pp. 167–170.

[2] Ali, M. Shoukath. "Priority Based Packet Scheduling Scheme in Wireless Sensor Networks.", IJARF, Volume 3, Issue 8, August 2016.

[3] Anastasi.G, Conti.M & Di Francesco.M, (2009), 'Extending the Lifetime of Wireless Sensor Networks Through Adaptive Sleep', IEEE Transaction. Industrial Informatics, Vol. 5, No. 3, pp. 351–365.

[4] Ali, M. Shoukath & Singh, R.P. " QoS-aware protocol using priority packet scheduling scheme for wireless sensor networks.", IJARBEST, Volume 3, Issue 4, April 2017.

[5] Liu.F, Tsui.C & Zhang.Y.J, (2010) 'Joint Routing and Sleep Scheduling for Life time Maximization of Wireless Sensor Networks', IEEE Transaction Wireless Communication, Vol. 9, No.7, pp. 2258–2267.

[6] Ali, M. Shoukath & Singh, R.P. "A Study on Game Theory Approaches for Wireless Sensor Networks.", IJEAT, Volume 6, Issue 3, February 2017.

[7] Nidal Nasser,Lutful Karim & Tarik Taleb (2013), 'Dynamic Multilevel Priority Packet Scheduling Scheme for Wireless Sensor Network', IEEE Transactions on Wireless Communications, Vol.12, No.4, pp.1448-1459.

[8] jalal ahmad, Syed & Ali, M. Shoukath & Noor Mohammad, Shaik., *Multimedia Transmission Over Mobile Adhoc Networks (QoS)*.(Lambert Academic Publications, 2017).

[9] Mizanian.K, Hajisheykhi.R, Baharloo.M & Jahangir.A.H, (2009), 'A Real-Time Scheduling Policy and Communication Architecture for Large Scale Wireless Sensor Networks', in Proc. Communication Network Research Conference.

[10] Ali, M. Shoukath, sai ramji, harsha & yugendher reddy. "VDAAESA: VLSI Based Design and Analysis of Advanced Encryption Standard Algorithm.", IJAREEIE, Voulme 6, Issue 10, October 2017.

[11] Prasanna Ballal, Abhishek Trivedi & Frank Lewis (2008), 'Deadlock Avoidance Policy in Mobile Wireless Sensor Networks with Free Choice Resource Routing', International Journal of Advanced Robotic Systems, Vol. 5, No. 3, pp. 279-290.

[12] Y. Liu, I. Elhanany, and H. Qi, "An Energy-Efficient Qos-Aware Media Access Control Protocol For Wireless Sensor Networks," IEEE International Conference on Mobile Adhoc and Sensor Systems, Nov. 2005.

[13] H. Momeni, M. Sharifi, and S. Sedighian, "A new approach to task allocation in wireless sensor actor networks," in Proc. 2009 International Conf. Computational Intelligence, Commun. Syst. Netw., pp. 73–78.

[14] A. R. Swain, R. C. Hansdah, and V. K. Chouhan, "An energy aware routing protocol with sleep scheduling for wireless sensor networks," in Proc. 2010 IEEE International Conf. Adv. Inf. Netw. Appl., pp. 933–940.

[15] M. Peng and W. Wang, "An adaptive energy saving mechanism in the wireless packet access network," in Proc. IEEE WCNC, Las Vegas, NV, Apr. 2008, pp. 1536–1540.

[16] R. Yu, Y. Zhang, Z. Sun, and S. Mei, "Energy- and QoS-aware packet forwarding in wireless sensor networks," in Proc. IEEE ICC, Glasgow, U.K., Jun. 2007, pp. 3277–3282.

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