

Parallel Load Sharing Technique Used To Increase the Life Time of Wireless Sensor Network

Mr. Abidali G Surati [1], Ms. Rupali R Jagtap[2]
[1,2]Department of Electronics and Telecommunication
Annasaheb Dange College of Engineering & Technology, Ashta, Sangli, Maharashtra, India.

Abstract:- Wireless Sensor Networks are low power networks which have many small nodes.In wireless sensor network inherent limited energy resource is the major drawback. To maximize the lifetime of the sensor node it is preferable to distribute the energy dissipated throughout the wireless sensor network in order to minimize maintenance and maximize overall system performance. In this paper we introduce parallel load sharing technique to increase the life time of all the nodes in a way to get maximum efficiency from the network.

Keywords:- *Lifetime, load sharing, routing, wireless sensor network.*

*****

1. Introduction to Wireless Sensor Network.

The popularity of Wireless Sensor Networks (WSN) has increased tremendously in recent time due to growth in Micro-Electro-Mechanical Systems (MEMS) technology. WSN has the potentiality to connect the physical world with the virtual world by forming a network of sensor nodes.

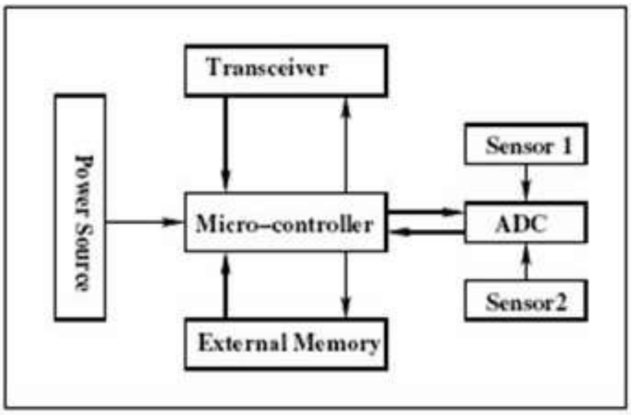


Figure:1 Architecture of wireless sensor node

Here, sensor nodes are usually battery-operated devices, and hence energy saving of sensor nodes is a major design issue. To prolong the network's lifetime, minimization of energy consumption should be implemented at all layers of the network protocol stack starting from the physical to the application layer including cross-layer optimization [9].

A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. Since large numbers of sensor nodes are densely deployed, neighbor nodes may be very close to each other. Hence, multihop communication in sensor networks is expected to consume less power than the traditional single hop communication. Furthermore, the transmission power levels can be kept low, which is highly desired in covert operations. Multihop communication can also effectively overcome some of the signal propagation effects experienced in long-distance wireless communication.

Wireless Sensors Networks are self-governing systems composed of sensor nodes. Nodes are the building blocks of Wireless Sensor Networks (WSN) and are very low cost low power computers that can monitors one or more sensors. These nodes are usually built up of memory elements, sensors and a small battery. These sensor nodes have computational and limited range receiving and transmitting capabilities. In order to specify the path for thedata transmission, these nodes have to make a mutual coordination with its nearest neighbor. These nodes behave like a router for transceiving information. These power supplied to an individual node completely depends upon the small battery of limited energy inside it. Placements of nodes in improper places and difficulty in changing or recharging batteries have made researchers to do investigations on reduction of energy consumption [10].

The following Figure 2 presents the Mica2 sensor node, which is the most popular research platform at the moment. As you can see, the main components of a typical sensor node include an antenna and a radio frequency (RF) transceiver to allow communication with other nodes, a memory unit, a CPU, the sensor unit (i.e. thermostat) and the power source which is usually provided by batteries. The operating system running on sensor nodes is called TinyOS and was initially developed at the University of California, Berkeley. TinyOS is designed to run on platforms with limited computational power and memory space. The programming language of TinyOS is stylized C and uses a custom compiler called NesC. Though it may work on other platforms, the supported platforms are Linux RedHat 9.0, Windows 2000, and Windows XP.

 ISSN: 2321-8169
1017 - 1022

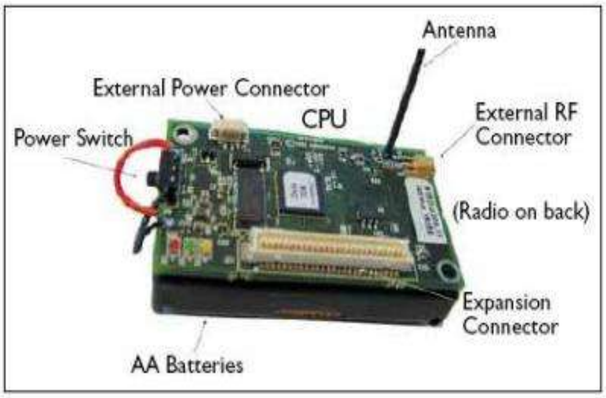


Figure.2:Mica2 sensor node.

2. MAJOR RESOURCES OF ENERGY WASTE IN WSN

Energy is a very scarce resource for such sensor systems and has to be managed wisely in order to extend the life of the sensor nodes for the duration of a particular mission. Energy consumption in a sensor node could be due to either “useful” or “wasteful” sources. Useful energy consumption can be due to transmitting or receiving data, processing query requests, and forwarding queries and data to neighboring nodes. Wasteful energy consumption can be due to one or more of the following facts. One of the major sources of energy waste is idle listening, that is, (listening to an idle channel in order to receive possible traffic) and secondly reason for energy waste is collision (When a node receives more than one packet at the same time, these packets are termed collided), even when they coincide only partially. All packets that cause the collision have to be discarded and retransmissions of these packets are required which increase the energy consumption. The next reason for energy waste is overhearing (a node receives packets that are destined to other nodes). The fourth one occurs as a result of control-packet overhead (a minimal number of control packets should be used to make a data transmission).Finally, for energy waste is over-emitting, which is caused by the transmission of a message when the destination node is not ready. Considering the above-mentioned facts, a correctly designed protocol must be considered to prevent these energy wastes [5].

3.ROUTING CHALLENGES & DESIGN ISSUES IN WSN

Wireless sensor network have large number of application. While designing of various protocols, many factors affect the performance of WSN. Here we have discussed design issues & routing challenges that affect the routing process in WSN [13].

Node deployment: Node deployment in WSNs is application-dependent and can be either manual(deterministic) or randomized. In manual deployment, the sensors are manually placed and data is routed through predetermined paths. However, in random node deployment, the sensor nodes are scattered randomly, creating an adhoc routing infrastructure.

Energy consumption without losing accuracy: Sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment. As such, energy-conserving forms of communication and computation are essential. Sensor node lifetime shows a strong dependence on battery lifetime**.** In a multihop WSN, each node plays a dual role as data sender and data router. The malfunctioning of some sensor nodes due to power failure can cause significant topological changes, and might require rerouting of packets and reorganization of the network.[13] [5].

Data reporting method: Data reporting in WSNs is application-dependent and also depends on the time criticality of the data. Data reporting can be categorized as either time-driven, event driven, query-driven, or a hybrid of all these methods. The routing protocol is highly influenced by the data reporting method in terms of energy consumption androute calculations.

Fault tolerance: Some sensor nodes may fail or be blocked due to lack of power, physical damage, or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network.

Scalability: The number of sensor nodes deployed in the sensing area may be on the order of hundreds or thousands, or more. Any routing scheme must be able to work with this huge number of sensor nodes. In addition, sensor network routing protocols should be scalable enough to respond to events in the environment.

Network dynamics: In many studies, sensor nodes are assumed fixed. However, in many applications both the BS or sensor nodes can be mobile [13][6]. As such, routing messages from or to moving nodes is more challenging since route and topology stability become important issues,

Transmission media: In a multihop sensor network, communicating nodes are linked by a wireless medium. The traditional problems associated with a wireless channel (e.g., fading, high error rate) may also affect the operation of the sensor network In general, the required bandwidth of sensor data will be low, on the order of1–100 kb/s. Related to the transmission media is the design of MAC. One approach to MAC design for sensor networks is to use time-division multiple access (TDMA)-based protocols that conserve more energy than contention-based protocols like carrier sense multiple access(CSMA) (e.g., IEEE 802.11). Bluetooth technology [13] [7] can also be used.

Connectivity: High node density in sensor networks precludes them from being completely isolated from each other. Therefore, sensor nodes are expected to be highly connected. This, however, may not prevent the network topology from being variable and the network size from shrinking due to

 ISSN: 2321-8169
1017 - 1022

sensor node failures. In addition, connectivity depends on the possibly random distribution of nodes.

Coverage: In WSNs, each sensor node obtains a certain view of the environment. A given sensor's view of the environment is limited in both range and accuracy; it can only cover a limited physical area of the environment. Hence, area coverage is also an important design parameter in WSNs.

Data aggregation: Since sensor nodes may generate significant redundant data, similar packets from multiple nodes can be aggregated to reduce the number of transmissions. Data aggregation is the combination of data from different sources according to a certain aggregation function (e.g., duplicate suppression, minima, maxima, and average). This technique has been used to achieve energy efficiency and data transfer optimization in a number of routing protocols. Signal processing methods can a lso be usedfor data aggregation.

Quality of service: In some applications, data should be delivered within a certain period of time from the moment it is sensed, or it will be useless. Therefore, bounded latency for data delivery is another condition for time-constrained applications. However, in many applications, conservation of energy, which is directly related to network lifetime, is considered relatively more important than the quality of data sent.

3.PARALLEL LOAD SHARING TECHNIQUE

A. Objective of Parallel load sharing

The main objective of parallel load sharing is to overcome the drawbacks of Algorithms such as link state, proposed by Dijkstra. Parallel Load sharing routing technique is introduced to increase the lifetime of a wireless sensor network. The Proposed algorithm is the modified version of previous algorithm, which was used to select the low cost path in a network, to save the energy of nodes by changing the route of data transmission with the respect to power resources of each node.

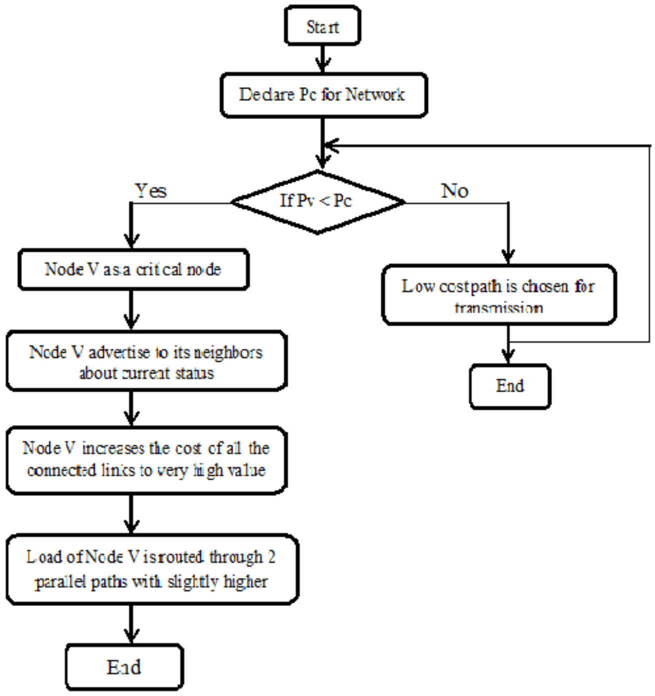
Algorithms such as link state, proposed by Dijkstra, are used for WSN to define a low cost path for transmission of packets. A wireless sensor network is made of small low power sensors or nodes. A major issue in using Dijkstra algorithm is that it does not consider the power resources of a network. It always searches to find a routing path with lowest possible cost to reduce the transmission time.

It sometimes results in unjustified distribution of load. Some nodes that are attached to low cost paths are distributedwith heavy loads as compared to other nodes. This results in a rapid consumption of energy resource for such nodes. If a node consumes all the available energy it is considered as dead and results in isolation of all the other nodes that are connected to network via this node. This severely effects the lifetime of overall network [12].

B. Proposed Algorithm:

Parallel load sharing technique overcomes the issues of link state algorithm. This algorithm basically works on low cost path algorithm & also saves the power of nodes by sharing the load between two lowest cost paths. First it compares the power of each node with threshold power. If the power of the node found below threshold value then that node is declared as a critical node. This algorithm then finds two parallel paths with slightly higher costs to share the load of critical node.

Flowchart:



Pv = Power of node V

Pc = Threshold power or critical power

Figure 3: Flowchart of proposed algorithm.

4. TRANSMISSION BEHAVIOR OF THE NETWORK

WSN may consist of thousands of nodes. For simulation purpose we considered network of 14 nodes. Here node 9 is a source node whereas node 0 is a destination node. The cost is assign to each link. Figure 4 shows the network.

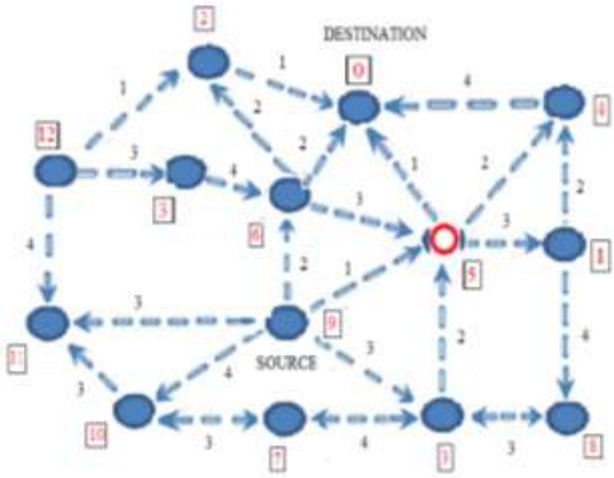


Figure 4: Transmission through node 5.

A. Lifetime of a network without load sharing.

The figure 5.1 shows the transmission behaviour of a network without load sharing algorithm such as link state routing algorithm proposed by Dijkstra. Here node 9 is a source node & node 0 is a destination node, according to the Dijkstra algorithm source node searches for low cost path for transmission. There are many paths available to reach the node 0. The cost of link (9 to 5) is 1, cost of link (9 to 6) is 2, cost of link (9 to 3) is 3 & the cost of link (9 to 10) is 4. So almost of packets are sent via node 5 to node 0 as the cost of link (5 to 0) is 1.

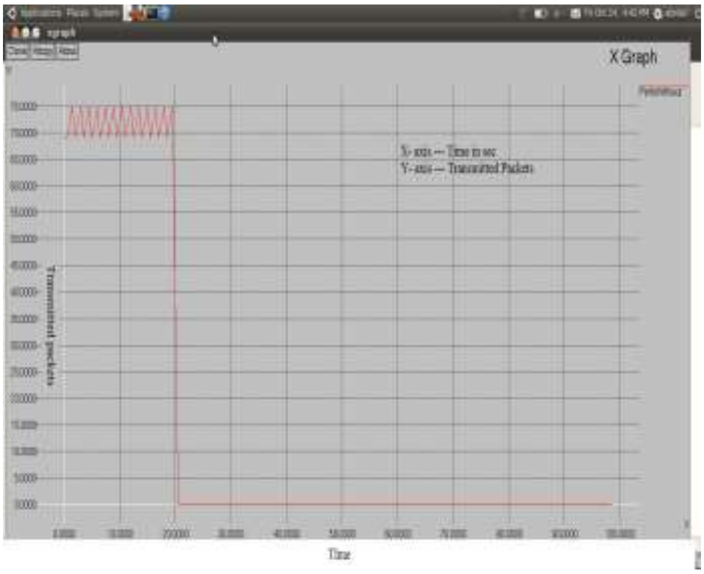


Figure 5:Life time of a network without load sharing technique.

As all the packets are transmitted through node 5, the power of node 5 (the power of the battery used in the node) decreases rapidly until it becomes zero and the node 5 becomes dead, as shown below in figure 6. Other nodes that are connected to network via node 5 also get isolated. This causes transmission to stop.We can see the network's output graphically, as shown in figure 5. A transmission is continued as long as node 5 is active.

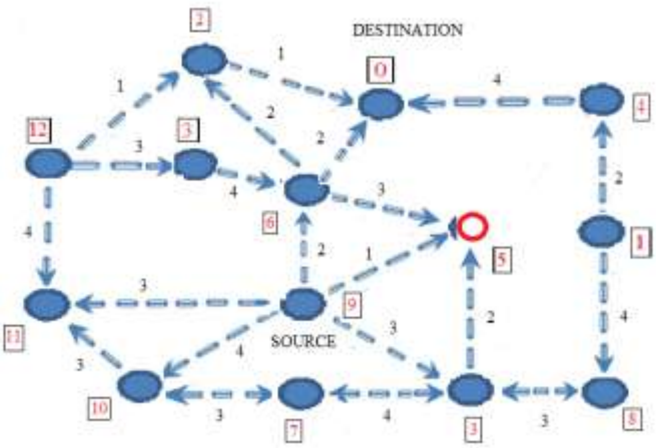


Figure 6: No transmission through node 5.

B. Transmission behavior with efficient load sharing

We can increase the life time of the above network by using efficient load sharing technique. As we know that node 0 receives packet through the node 5 because of low cost path that results in reduction in power of node 5. As the power of node 5 becomes less than threshold power it increases the cost of all the connected links to a very large value as shown in fig 7. Now the node 5 is used in power saving mode.

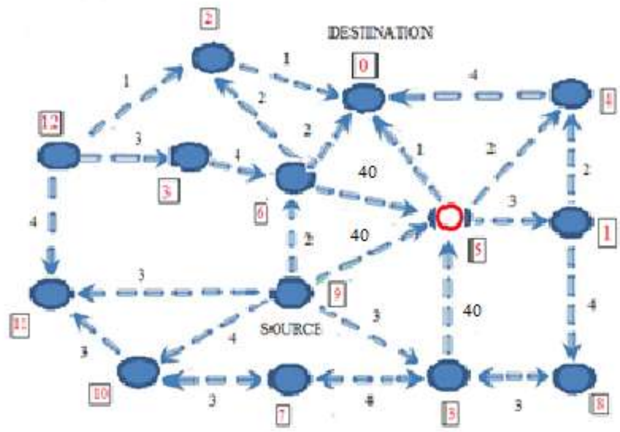


Figure 7: Transmission through node 6.

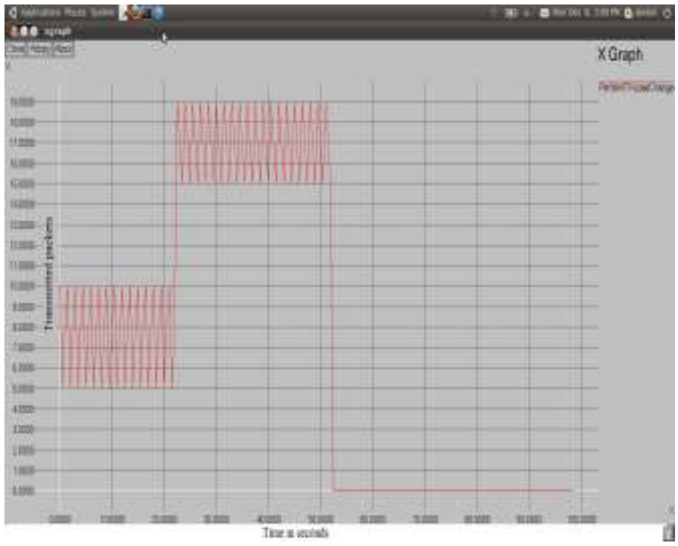


Figure 8: Transmission behavior at node 6.

Figure 8 shows the transmission behaviour at node 6. At the start the transmission rate of node 6 is low because at this time most of the packets are routed through node 5. As the node 5 enters in power saving mode most of the packets are routed through node 6 which increases transmission rate of node 6. As the power of node 6 reaches to threshold value, node 6 enters in power saving mode & used only when there is no substitute path available.

C. *Transmission behavior with parallel load sharing*

In figure 7 we can see that node 6 carried almost all the load of node 5 as node 5 is in power saving mode, because the cost of the link (6 to 0) is 2 which is the lowest cost as compared to other link connected to node the node 6. As node 6 carries high amount of load, according to parallel sharing technique node 6 searches 2 lowest paths to reach the destination i.e. node 0.

To reach node 0 from node 6, node 6 has two low cost paths which are from node 6 to 0 with link cost 2 & from node 6 to o via node 2 with link cost 3. (addition of link cost from node 6 to node 2 & from node 2 to node 0). In this way the load of node 5 which is in power saving mode is shared not only with node 6 but it is shared between node 6 & node 2 to complete the transmission from source to the destination so that the life time of the node 5 increases & addition to that no extra load on node 6 to save the energy of node 6 shown in figure 9 & 10.

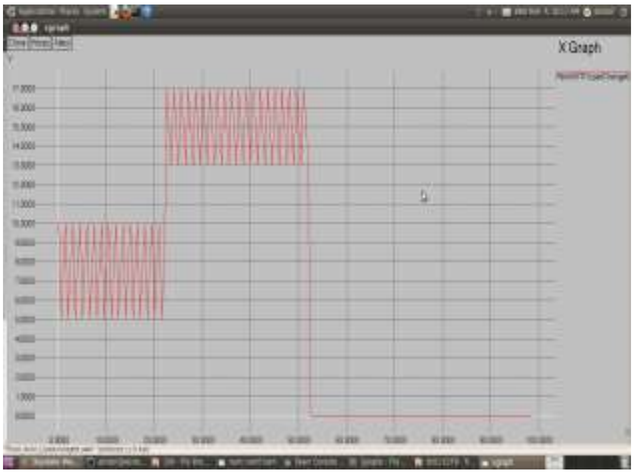


Figure 9: transmission behavior at node 6 with parallel sharing with node 2.

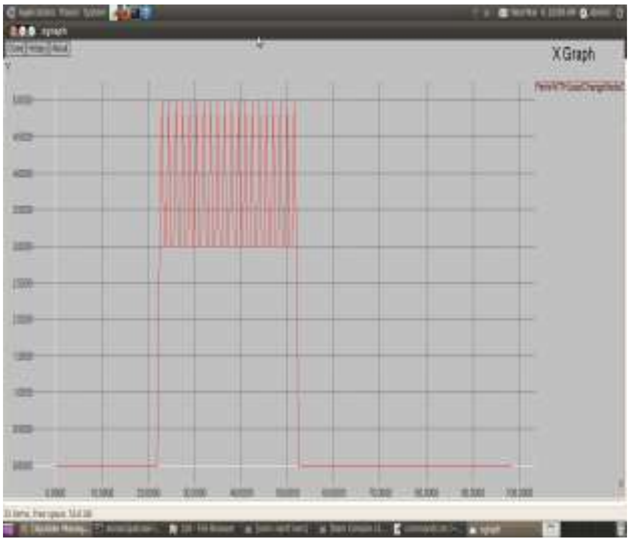


Figure 10: transmission behavior at node 2 with parallel sharing with node 6.

If we compare the figures 8, 9 & 10 we can see that with efficient routing technique node 6 carries almost all load of node 5 whereas with parallel sharing technique the load of node 5 is shared between node 6 as well as node 2.As the load is shared between two parallel paths, the life time of each node increase as their energy level get maintained above the critical power. If parallel paths are not available then load can be shared by single node only. The life time of node 5 with parallel sharing get increased as shown in figure 11 below.

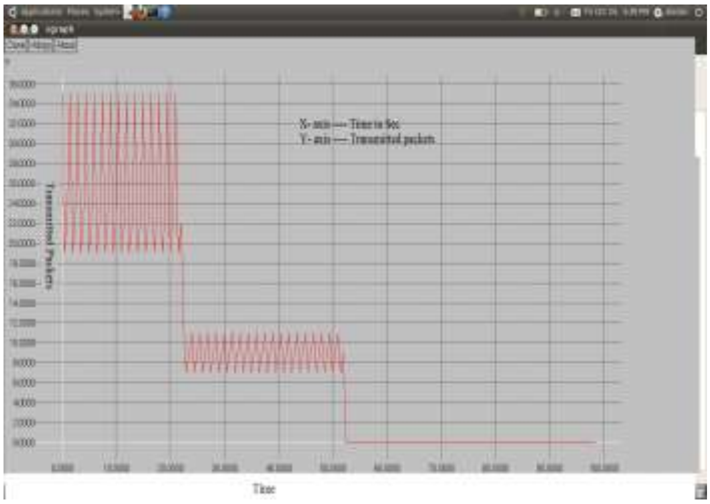


Figure 11: lifetime of node 5 with parallel sharing

4. CONCLUSIONS

In this paper we have presented parallel sharing technique which is used to increase the lifetime of wireless sensor network by sharing the load of nodes between parallel paths. Their main purpose is to increase the life time of the wireless sensor network & to save the power of nodes.

5. ACKNOWLEDGMENT

Many people have contributed to the success of this paper. Although a single sentence hardly suffices, first we would like to thank Almighty God for blessing us with His grace.

I express my sincere thanks to Prof. Ms. Rupali R Jagtap Department of E&Tc, ADCET for providing their valuable assistance to carry out this paper.

I take this opportunity to extend my gratitude to our beloved Principal Prof. Dr. A.M.Mulla for allowing us to carry out this paper.

REFERENCES

[1] Feng Wang, Jiangchuan Liu, “Networked Wireless Sensor Data Collection Issues, Challenges, and Approaches” IEEE communications surveys & tutorials, vol. 13, no. 4, fourth quarter 2011.

[2] Parul Kansal, Deepali Kansal, Arun Balodi, “compression of various routing protocols in wireless sensor network”,

ISSN: 2321-8169
1017 - 1022

International Journal of Computer Applications (0975 – 8887)Volume 5– No.11, August 2010.

[3] Sourabh Jain, Praveen Kaushik, Jyoti Singhai, "Energy efficient maximum lifetime routing for wireless sensor network", International Journal Of Advanced Smart Sensor Network Systems (IJASSN), Vol 2, No.1, January 2012.

[4] Hyung-WookYoon, Bo-Hyeong Lee, Tae-Jin Lee, MinYoung Chung,"Energy efficient routing with power management to increase network lifetime in sensor networks", ICCSA 2004, LNCS 3046, pp. 46–55, 2004._c Springer-Verlag Berlin Heidelberg ,2004 .

[5] Zahra Rezaei, Shima Mobininejad,"Energy saving in wireless sensor networks", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.3, No.1, February 2012.

[6] Sudhir G. Akojwar, Rajendra M. Patrikar," Improving Life Time of Wireless Sensor Networks Using Neural Network Based Classification Techniques with Cooperative Routing", international journal of communications", Issue 1, Volume 2, 2008

[7] S.Anandamurugan, C.Venkatesh,"Increasing the lifetime of wireless sensor network by using AR algorithm"*IJCA Special Issue on "Mobile Ad-hoc Networks MANETs, 2010.*

[8] Y.Thomas Hou,Yi Shi,Jianping Pan, Scott F. Midkiff, "Maximizing the lifetime of wireless sensor network through optimal sinle session flow routing", IEEE transactions on mobile computing, vol. 5, no. 9, september 2006

[9] Jason Lester Hill,"System Architecture for Wireless Sensor Networks",university of california Berkeley,Spring 2003.

[10] I.F. Akyildiz, W.Su, Y. Sankarasubramaniam, E. Cayirci," Wireless sensor networks: a survey", Elsevier Science B.V ,2002.

[11] Want R, Farkas K.I, Narayanaswami C,"Energy Harvesting and conversation,"*IEEE Pervasive Computing vol 4,issue I ,January – March 2005.*

[12] Asjad Amin, Waqar Mehbob, Arslan Haider Ranjha, Hasnain Abbas, Nadeem abbas, Waqas Anjum,"Efficient load sharing Routing algorithm to increase lifetime of wireless sensor network", IEEE 2011.

[13] Jamal N.Al-Karaki, Ahmed E.Kamal, "Routing techniques in wireless sensor network" , IEEE wireless communication Dec. 2004.