REVIEW ON LOAD SHARING & ENERGY SAVING TECHNIQUES USED TO INCREASE THE LIFE TIME OF WIRELESS SENSOR NETWORK

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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 various load sharing & energy saving techniques 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***

I. INTRODUCTION

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.

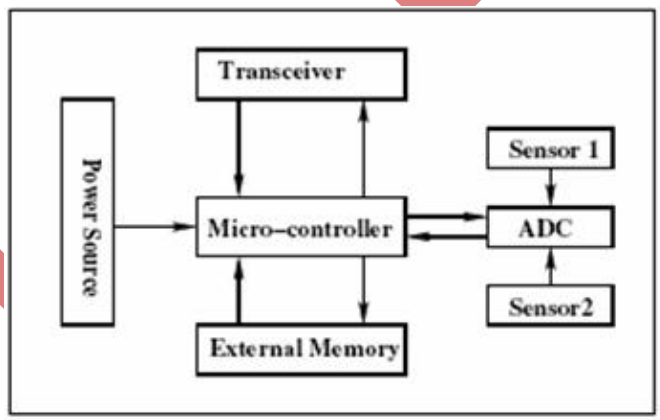

Figure: 1 architecture of wireless sensor node

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 deployedeither 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 sensornetworks is expected to consume less power thanthe traditional single hop communication. Furthermore,the transmission power levels can bekept low,

which is highly desired in covert operations.Multihop communication can also effectively overcome some of the signal propagationeffects 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 arevery low cost low power computers that can monitors one ormore sensors. These nodes are usually built up of memoryelements, sensors and a small battery. These sensor nodeshave computational and limited range receiving andtransmitting capabilities. In order to specify the path for thedata transmission, these nodes have to make a mutualcoordination with its nearest neighbor. These nodes behavelike a router for transceiving information. These powersupplied to an individual node completely depends upon thesmall battery of limited energy inside it. Placements of nodesin improper places and difficulty in changing or rechargingbatteries have made researchers to do investigations onreduction of energy consumption [10].

II. 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, andforwarding queries and data to neighboring nodes. Wasteful energy consumption can be due toone 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 forenergy waste is collision (When a node receives more than one packet at the same time, thesepackets are termed collided), even when they coincide only partially. All packets that cause thecollision have to be discarded and retransmissions of these packets are required which increasethe energy consumption. The next reason for energy waste is overhearing (a node receivespackets that are destined to other nodes). The fourth one occurs as a result of control-packetoverhead (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 messagewhen the destination node is not ready. Considering the above-mentioned facts, a correctlydesigned protocol must be considered to prevent these energy wastes [5].

In this paper we have discussed various algorithms & techniques to increase the lifetime of network to get maximum efficiency from the network.

III. LOAD SHARING & ENERGY SAVING TECHNIQUES

A. Aggregation Routing Algorithm

S.Anandamurugan and C.Venkatesh suggest in [7] that WSN consists of some resource rich mobile relay nodes and a many number of simple undynamic nodes. The mobile relays have high energy than the undynamic nodes. The mobile relays can dynamically move around the entire network and help relieve sensors that are highly burdened by heavy network traffic, thus improving the lifetime first analyze the performance of a large dense network with one mobile relay and show that network lifetime improves over that of a purely undynamic network by up to a factor of five. Also, the mobile relay needs to stay only within a two hop radius of the sink, then construct a AR (Aggregation Routing) Algorithm which gives a network lifetime close to the maximum

limit. The benefit of this algorithm is that it only requires a minimum number of nodes in the network to be known of the location of the relay.It can at least improve the network lifetime in a randomly deployed WSN.

AR Algorithm with limited nodes

Parameters:

P: the current aggregation node

q: the current static relay node

r: the distance between p and the sink is r+2

ST: the straight line connecting the sink and the mobile node.

Algorithm:

Switch (k: the index of M_k where p€ M_k)

Case1, 2, 3:

Call method AR:

Case 4,...z-1:

If $d(p,p_0)=k-1+r$

If the packet is generated in Q_{s-1} and it has travelled $\$_k$ in M_k

Find a neighbour in M_{k-1} whose distance to the sink is k-2+r and send the packet to it.

elseif the packet has reached line SK

Find a neighbour in M_{k-1}whose distance to the sink is k-2+r and send the packet to it.

else

Find a neighbour who is closest to line SK and whose distance to the sink is k-1+r and send the packet to it.

elseif p is on the line SK

Find a neighbour in SK whose distance to the sink is k-1+r and send the packet to it.

else

Find a neighbour who is closest to line SK and has the same distance to the sink, send the packet to it.

Case z:

If $d(p,p_0)=k-1+r$

Find a neighbour in SK whose distance to the sink is k-2+r and send the packet to it.

else

Find a neighbour in SK whose distance to the sink is k-1+r and send the packet to it.

Case z+1,...,R:

Find a neighbour who is closest to the sink, send the packet to it.

The result is presented in the figure 2 also improvement in power saving. In this, we consider 26,000 nodes; the power taken by the existing system was 18,500. But in the present system are only 13,000. It represents 45% improvement in power saving.

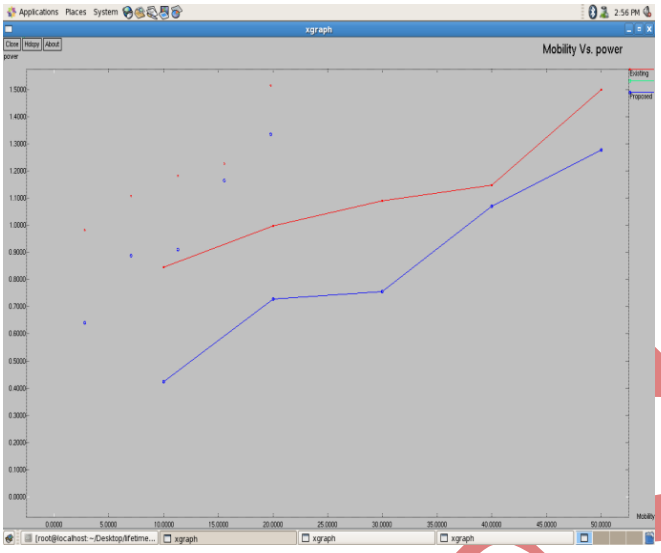

Figure 2: no. of nodes v/s power consumption

B. Energy Efficient Routing with Power Management

Hyung-WookYoon, Bo-Hyeong Lee, Tae-Jin Lee, and MinYoung Chung [4] have proposed that a routing mechanism to prolong network lifetime, in which each node adjusts its transmission power to send data to its neighbors. This model of energy efficient routing with power control and present an algorithm to obtain the optimal flow solution for maximum network lifetime.

Algorithm:

In order to obtain the optimal feasible flows that are concurrent, the maxflow algorithmis used [4][8]. In the max flow algorithm, node *i* is divided into two subnodes (i_i and i_o)

connected by an internal link (see Fig. 3). If node *i* generates information and transmitsit to node *j*, then we assume that it is generated at subnodei_i and is transmitted tosubnodei_o, $j_i$and j_o. So every directional link (*i*, *j*) connecting node *i* and *j* shouldbe replaced by a directional link (i_o, j_i). Accordingly, the capacity of the internal link(C_{i_i,i_o}) is defined as:

$$C_{i_i,i_o} = \min_{i \in N} \left(1, \frac{E_i}{e_0 \cdot \left(\max_{j \in Z(i)} \frac{d_{i,j}}{d_0} \right)^{\alpha} \cdot T_i} \right).$$

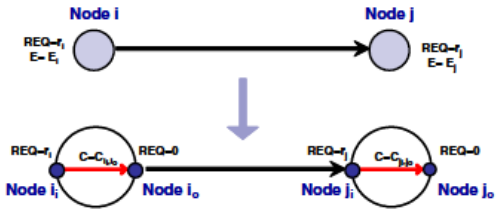

Figure 3: Transmission of a node capacitated network to link node capacitated network.

Then transform a node-capacitated network to a link-capacitated network as shown in Fig.3. All information generated by a sensor node is transmitted via links under capacityconstraints. In other words, while network is not partitioned, all information generatedin the sensor network can be transmitted to the central unit.A set of flows satisfying thiscondition is called feasible. Proposed algorithm is to find feasible flow on each link and to maximizenetwork lifetime. The proposed algorithm consists of two parts. First,link capacity *Ci*is computed then use the maxflow algorithm to determine the flows along the links. Next, the maximum feasible time is obtained by binary search. The algorithmterminates when the difference between the feasible and non-feasible network lifetime is within a tolerance.

C. *Neural Network Based Classification Techniques*

Sudhir G. Akojwar, Rajendra M. Patrikar[6] proposed use of classification techniques using neural network to reduce the data traffic from the node and thereby reduce energy consumption. The sensor data is classified using ART1 Neural Network Model. Wireless sensor network populates distributed nodes. The cooperative routing protocol is designed for communication in a distributed environment. In a distributed environment, the data routing takes place in multiple hops and all the nodes take part in communication. This protocol has been designed for wireless sensor networks. This ensures uniform dissipation of energy for all the nodes in the whole network. Directed diffusion routing protocol is implemented to carry out performance comparison.

Wireless sensor network is highly data centric. Datacommunication in WSN must be efficient one and mustconsume minimum power. Every sensor node consists ofmultiple sensors embedded in the same node. Thus everysensor node is a source of data. These raw data streams cannotbe straight away communicated further to the neighboringnode or the base station.

These sensor data streams need tobe classified. A group of sensor nodes forms a cluster. Eachnode transfer data to a cluster head and then cluster headaggregates the data and sends to base station. Henceclustering and classification techniques are important and cangive new dimension to the WSN paradigm. Basically,classification system is either supervised or unsupervised,depending on whether they assign new inputs to one of aninfinite number of discrete supervised classes or unsupervisedcategories respectively.

ART1 and Fuzzy ART areunsupervised neural network models which are used forclassification of sensor data. ART1 model is used forclassification of Binary valued data. While Fuzzy ART modelcan be used for analog data, wherein the input data is fuzzyvalued.

D. *Efficient Load Sharing Routing Algorithm to Increase lifetime of Wireless Sensor Networks.*

Asjad Amin, WaqarMehbob, ArslanHaiderRanjha, Hasnain Abbas, Nadeemabbas, WaqasAnjum have proposed in [12] this algorithm an efficient load sharing routing technique to increase the life time of all the nodes in away to get maximum efficiency from the network. The routingalgorithms such as link state which are used for wireless sensornetworks prefer to choose a low cost path to decrease thetransmission time but they do not consider the power of nodesfor transmission which sometimes result in reduction of alifetime of a network.

Algorithms such as link state, proposed by Dijkstra, areused 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 Dijkstraalgorithm is that it does not consider the power resources ofa network. It always searches to find a

routing path withlowest possible cost to reduce the transmission time. Itsometimes results in unjustified distribution of load. Somenodes that are attached to low cost paths are distributed withheavy loads as compared to other nodes. This results in arapid 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 areconnected to network via this node. This severely effects thelifetime of overall network.

Algorithm:

Pv = power of node v

Pc = critical power (threshold)

D (v) = cost from source s to node v

C (v, w) = cost of link from v to w

N = Set containing all the nodes of network

M= Set containing all the nodes processed by the Algorithm for all nodes v in network N

if (Pv< Pc)

for all neighbors w of v

C(v,w) = 40// set cost of link to a very large value

else

C (v,w) = original link cost from v to w

M = {s}

For all nodes v in network N except s

If v is adjacent to s

D (v) = C (s,v)

else

D (v) = ∞

While (M != N)

find a minimum D(W) for all w in (N – M)

M = M + {w}

For each v in (N –M) and adjacent to w, Calculate

D (v) = Min (D (v), D (w) + c (w, v))_

This modified Link state algorithm increases the life time of Wireless sensor network by defining power saving mode. A small increase in transmission time is the only drawback of efficient load sharing routing algorithm.

IV. CONCLUSIONS

In this paper we have presented various techniques that are used to increase the lifetime of wireless sensor network which includes AR algorithm, neural network based techniques, energy efficient routing with power management & efficient load sharing techniques. Their main purpose is to increase the life time of the wireless sensor network.

V. ACKNOWLEDGMENT

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