Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 5, May 2015, pg.1 – 7

RESEARCH ARTICLE

Mobility of Nodes In Wireless Sensor Network Based On Reduced Packet Loss With Maximum Clusters

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Abstract— Nowadays it is a known thing that wireless sensor network is one of the wide growing field in which the sensor nodes are deployed in order to receive and forward the collected from other nodes in the network. The concept of mobility of nodes is bit disadvantageous. Because they will consume more energy in order to transmit the data to the base station if it is located far from the nodes. In this paper the mobility of nodes is considered which mainly works on cost value in terms on energy. Thus it is possible to form more number of nodes in the network. In every cluster, cluster head will transmit the data from nodes to base station which is away from the nodes of the network.

Keywords— Wireless Sensor Network; Clusters; Energy Efficiency; Mobility; PDR

I. INTRODUCTION

This paper describes achieving minimal energy consumption for wireless sensor network using distributed network protocol significant reductions in energy consumption can be achieved if wireless networks are designed specifically for minimum energy. In order to maximize the total battery life of a wireless network, we must minimize the energy consumption of the entire network. In many WSN applications, the deployment of sensor nodes is performed in an ad hoc fashion without careful planning and engineering. Once deployed, the sensor nodes must be able to autonomously organize themselves into a wireless communication network. Sensor nodes are battery-powered and are expected to operate without attendance for a relatively long period of time network and also for the successful operation of the network. Though the nodes are expected to be static throughout, the mobility of the sensor nodes gives rise to some more sophisticated applications like better environment monitoring and tracking. The nodes will collect the data from surroundings [5][13].

The sensor nodes are energy constrained. And it is feasible to renew the battery of the sensor nodes due to hostile environment of the deployed sensor nodes. Hence the protocols and algorithms designed for such networks need to be energy efficient also [3][13][14].

A Wireless sensor network (WSN) consists of a large number of battery-powered, resource-constrained wireless sensor nodes, which might be randomly deployed in sensor network for sensing and collecting the data from surroundings.

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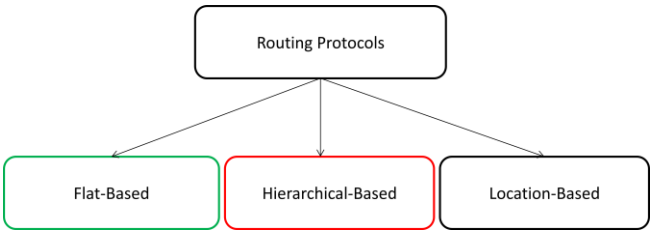
The sensed data are routed from a sensor node back to the sink either through multi-hop or direct communication architecture. The sink may communicate with base station or satellite via single-hop or multi-hop ways.

II. RELATED WORK

There are many protocols are discovered in wireless sensor network. Among them some of the routing protocols are discussed here.

Network Structure Categorization



We mainly come across three types of routing protocols. Those are –

1. Flat-Based
2. Hierarchical-Based
3. Location-Based

Here we are concentrating mainly on hierarchical routing protocols in which higher energy nodes are used for transmission of messages. Whereas lower energy nodes are used for only sensing of data in the network.

Hierarchical routing protocols are two-layer protocols which mainly increases lifetime of the nodes of the network.

Low Energy Adaptive Clustering Hierarchy (LEACH):

This routing protocol initially divides the network into clusters[8]. Then a node will be selected as the cluster head. It is the job of cluster head to take care of entire network and also manage the nodes of the network. The head will receive the data from the nodes and passes it to target that is the Base Station. It performs pre-processing of the data at cluster head.

This protocol is not suitable for larger network. Because there is direct communication involved between the cluster head and the sink i.e target node.

Sensor Protocols for Information via Negotiation (SPIN):

This protocol makes use of three types of messages. Those are ADV, REQ and DATA messages[1][2]. At the beginning the node that has data to sent broadcasts the ADV message. Once the node which is in need of that message will receive the broadcasted message and then replies back using REQ message.

Once the node that receives the REQ message from its neighbor will send the packet using DATA message.

The SPIN family of protocols is designed based on

- Sensor nodes operate more efficiently and conserve energy by sending data that describe the sensor data instead of sending all the data.
- To overcome the energy and bandwidth wastage, this was incurred in Flooding and Gossiping.

Energy Balanced Routing Protocol (EBRP):

It is a stateless routing protocol, which can be used to route data based on the residual energy of the nodes[15]. This protocol divides the network into different energy bands and then constructs routing paths. This protocol is more suitable to wireless sensor networks that generate a lot of traffic as it achieves nearly uniform load distribution across all the nodes.

The higher energy nodes are in a better position to handle more traffic than the lower energy nodes. By dividing the entire network into energy bands we make sure that the lower energy nodes can be identified thereby making it easy to offer them more protection.

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III. PROPOSED PROTOCOL

In proposed protocol the mobility of the nodes is considered. Every node in the network is given with pre determined amount of energy for the purpose of transmission of message. All the nodes are considered to be mobile where as the base station is made static. In existing protocols it was bit difficult to form larger number of clusters. Where as in proposed one this has been overridden.

Energy of all the nodes is considered as one of the parameter to decide which node is to be elected as the cluster head. So the node which is having highest energy will be selected as head of the cluster. If the energy of all the nodes is almost same then we will consider a parameter distance. The node which is near to the base station from every cluster is selected as the cluster head for that particular cluster.

If nodes begin with E_o

Cluster-head nodes	**Non-cluster-head nodes**
$E_i(t) \approx E_o - X$	$E_i(t) \approx E_o$

$$E_{total} \approx E_o(N-kr) + (E_o-X)kr$$

Where k is system parameter

Eo is node initial energy

Eo-X is energy left after transmission

Phases of protocol

The proposed protocol consists of five phases

1. Form the virtual grids and deploy the nodes
2. Nodes gathering to form clusters
3. Elect cluster head based on high energy
4. Transmit the data
5. Re-form the clusters

Formation of virtual grids and deploy the nodes:

We partition the whole sensor field into grids of cells. In each cell, the node with the most residual energy takes turn to be the cell head, responsible for aggregating its own data with the data sensed by the other sensor nodes of the cell, and then transmitting it out.

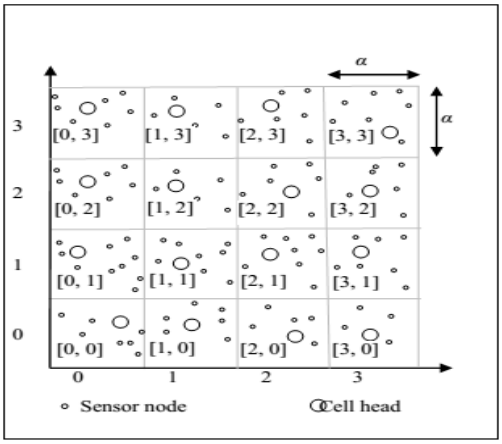

Fig 1. Virtual grid formation

We construct a grid-based infrastructure by partitioning the whole sensor field into a grid of cells. Each cell has a head, the one with most residual energy of the cell, responsible for aggregating and disseminating data.

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Nodes gathering to form clusters:

Once the grids are formed next step is to form the clusters in the network. The clusters are formed based on a threshold value. This value indicates the maximum number of nodes to be present in every cluster.

The algorithm is as follows:

Step 1: Provide grid information as input to form clusters.
Step 2: Fix the number of nodes for every cluster and form clusters based on critical value. i.e threshold.
Step 3: Once the clusters are formed check the number of nodes in every cluster and decide whether they are less or greater than critical value.
If less or greater than the critical value declare it as a cluster and go to step 5 else go to step 4.
Step 4: Now start adding the other nodes in the network in order to make the cluster valueless Or equal to critical value. Once the condition satisfied declare it as a cluster and go to step 5.
Step 5: Once all the grids are scanned and clusters are formed completely go to step 6 else go to step 3.
Step 6: Stop the process.

Elect the cluster head based on energy:

Since we are dealing with mobility of the nodes it is understood that the nodes are mobile. Hence every time the message is transmitted the nodes may move from one position to another. Thus the available energy of a node is considered. The node which is having less energy cannot be selected as cluster head because the cluster head has to do most of processing. The cluster node should always be provided with more energy than threshold value. Also it should not be far away from the base station.

Input: less_dist, high_energy

Output: selection of cluster head

Begin

high_energy=0, less_dist=0

*for*each cluster *do*

id_num=O;

Begin

*for*each sensor node in the cluster *do*

Begin

find the position of the sensor node

if the position does not fall outside the cluster

then

if sensor node energy>high_energy *then*

if basestation distance from the node <less_dist

Begin

high_energy=sensor node energy

less_dist=distance between the sensor node and the basestation

id_num=sensor node identification number

End

End

Sensor node with id_num becomes the cluster head.

End

End

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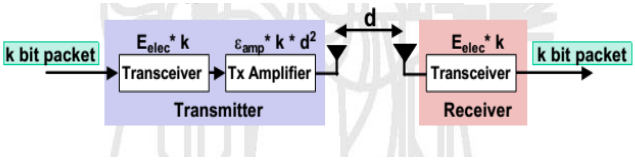
Transmit the data:



In order to transmit k-bit message over distance d, energy used is-

$E_{Tx}(k,d) = E_{Tx\text{-}elec}(k) + E_{Tx\text{-}amp}(k,d)$

$E_{Tx}(k,d) = E_{elec} * k + €_{amp} * k * d$

In order to receive the message the energy consumed is-

$E_{Rx}(k) = E_{Rx\text{-}elec}(k)$

$E_{Rx}(k) = E_{elec} * k$

In this paper we are making use of TDMA based data transmission[6][8]. Cluster head uses multi hop data transmission technique. Nodes of the cluster will send the data to the cluster head. Now it's the responsibility of cluster head to pass the message to the base station at regular interval of time.

Re-form the clusters:

Once the base station receives the data from the entire cluster heads now its upto base station and nodes of the clusters to elect the cluster head and re-form the clusters if needed further communication. Again re-forming the cluster is based on energy along with distance parameter.

RESULTS AND DISCUSSION

In order to perform the simulation here we considered 1600 x 1200 mtr.sqr for the network deployment. In simulation results we can observe the increased throughput along with optimum energy utilization for data transmission.

The below figures shows energy consumption.

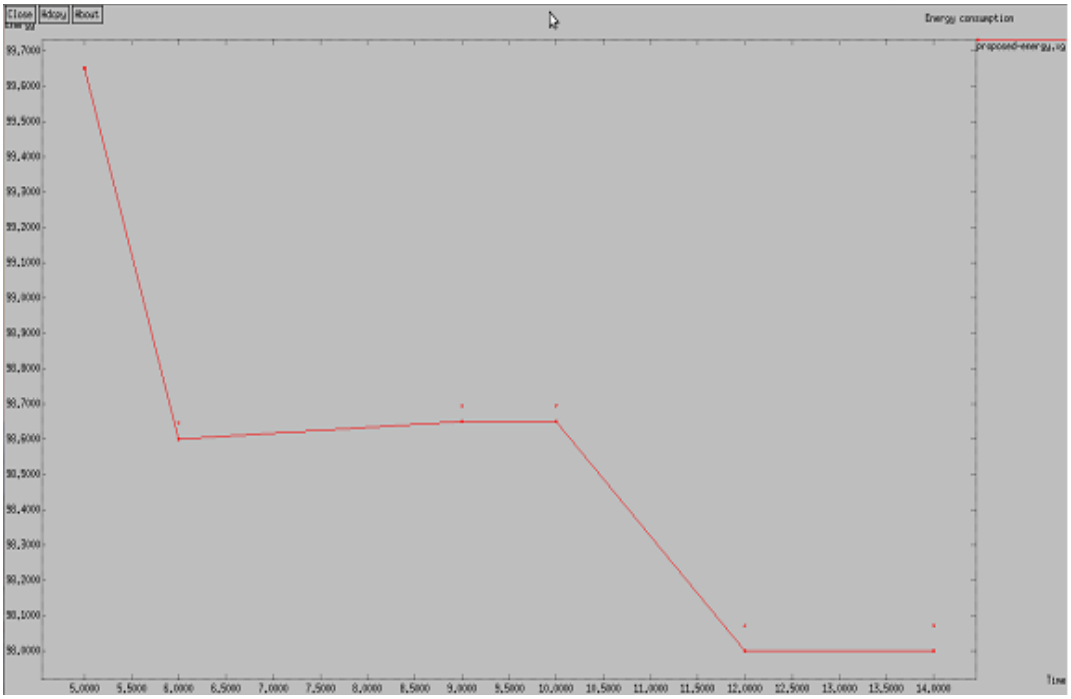


Fig 2. Energy graph of entire network

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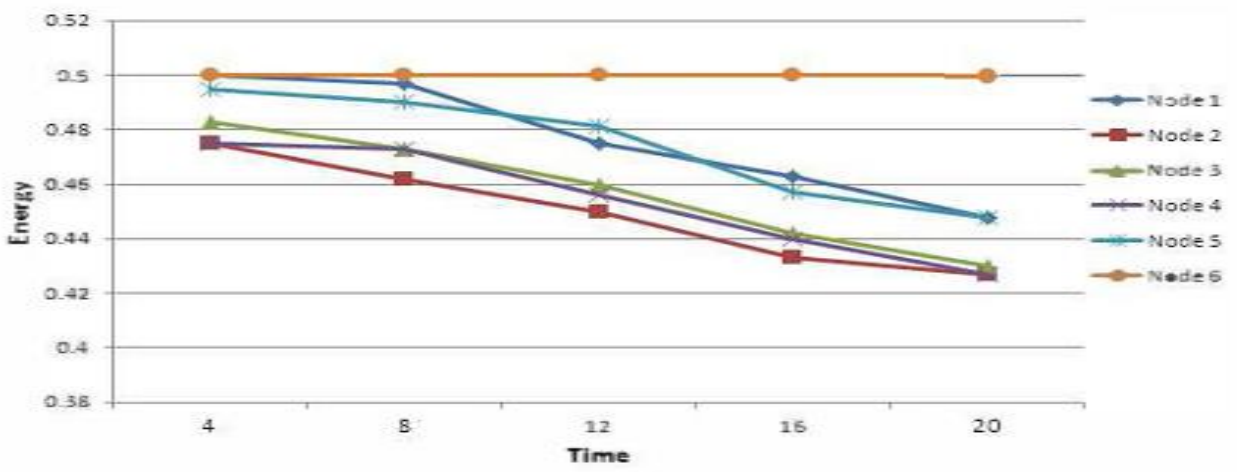

Fig 3. Energy graph for some nodes

The below figure shows the packet delivery ratio achieved in the simulation process. Here the number of packets dropped is significantly reduced as compared to existing systems.

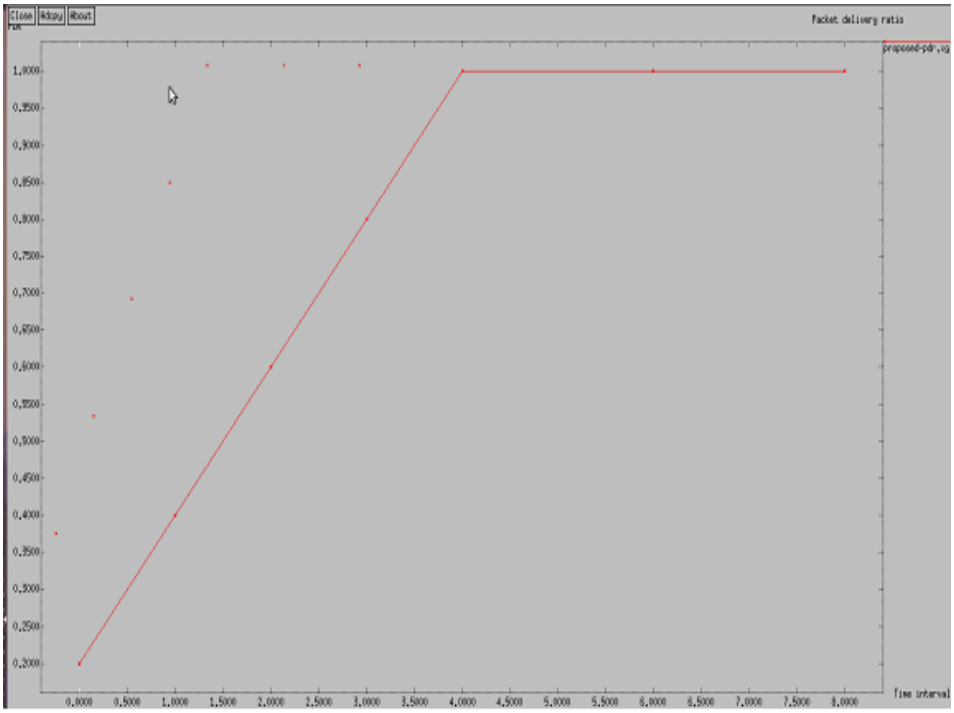

Fig 4. Packet Delivery Ratio

CONCLUSION

In this paper we are proposing a protocol which considers mainly the mobility of the nodes in the network. Since we are passing the information from one node to its neighbor node using one hop distance, the amount of packet drops reduced greatly. The nodes deployed in the network will consume less energy as compared to other nodes which are static. Also the packet drops is significantly reduced. Hence PDR ratio is achieved good. The protocol can be further implemented in order to make the base station also mobile. Even it is possible to identify the number of clusters deployed dynamically in the network in future work.

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