Energy Consumption Reduction and Improve the Lifetime of Network while Continuous Data Gathering In WSN

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Abstract-*Energy is a factor in wireless sensor network (WSN) which we can`t ignore. One principal method for saving vitality is wise arrangement of sensor hubs i.e. sensor nodes inside the system region with the goal that vitality stream stays adjusted all throughput i.e. efficiency of system. The network lifetime is a crucial performance to assess information gathering wireless sensor networks (WSNs) where battery-controlled sensor hubs occasionally sense nature and forward gathered examples to a sink hub. In this paper, we propose a logical model to get the whole system lifetime from system introduction until it is totally impaired. In particular, we hypothetically estimate the traffic load, energy consumption, and lifetime of sensor nodes during the entire network lifetime. This paper focus on deigning of network based on different parameters, used to minimize the energy consumption and increasing lifetime of network, and an explanation about location based routing protocol.*

Keywords-Energy, lifetime, multi-hop, routing, wireless sensor networks

I. INTRODUCTION

Structure of a wireless sensor network has a set of sensing devices whose work is to collect data from a sensor broadcast area. Sensor nodes show their performance based on computation capability, memory space, communication bandwidth, etc. The notability of Wireless Sensor Networks has increased tremendously due to the wide potential of the sensor networks to connect the physical and illusive world. It is difficult to work in a network if energy is finished. That is why reducing energy consumption is must.

Furthermore improving the operational lifetime of a sensor network is essential. So in designing WSN, lifetime is fragile issue so we need to be careful about it. These sensor nodes sense the data in allocated bandwidth and periodically send that sense resulting data to the sink. In the field of wireless sensor network geographic routing protocol is considered as good tool for the finder and researcher where node gets the location based on position [2].

The nodes near to the sink need to transfer the data packets from other nodes; they exhaust their energy quickly, leading to an energy hole around the sink. So that complete wireless sensor network fail to transmit data packet.
Basic requirements to be follow in WSN:

- Scalability- WSN must be capable of easily expanded or if there is any demand.
- Stability- WSN must have value on trust and stable to provide the output.
- Sensibleness- WSN should react quickly in the desired condition in a positive way.
- Power efficiency- WSN must be power efficient.

Fig. 1 shows the percentage of energy consumption by various actions performed by a sensor node during its working. From the Fig. 1, we can notice that communication is the action which takes 50% of energy. For communication coverage area should be maximum where network connectivity will be maintained [3].

II. RELATED WORK

Aspect of energy is becoming crucial day by day in every need of human life, hence it is necessary to save it. In this they report an overview of variety of technologies in WSN, standards used by it, its application in various areas, characteristics of network design, and development. They also studied a real time implementation. Possible evolutions and trends are shown.

This force to study IEEE 802.15.4 technology, which empower many applications of WSNs [3]. This leads to give the motivation to work on WSN which is widely spreading in information gathering. Explanation about routing protocols used in WSN is discussed in [5].

For different application and network topologies variety of routing protocols can be used. After deciding routing protocol study of data collection is important and that is explained in [6]. How data collection process can get affected by different parameters are shown here. Network

model designing can reduce the enhance or reduce the parameters of WSN, so it should be noted that how we are designing the network. Clustering and positioning of nodes we can discuss in [7] & [8].

Objectives of this paper are as follows:

- To develop an analytic model to estimate the traffic load, energy consumption, and lifetime of sensor nodes in a data-gathering WSN.
- In this designing of network is based on clustering of whole network by using geographic routing protocol for data transmission.

III. NETWORK MODEL

A data-gathering WSN network is considered here. This network is based on clustering format. It is divided in to 19 small clusters included in big area. In each cluster there are 5 nodes are surrounded with base station node. Network radius and transmission range values are taken here. Sensor nodes are uniformly distributed with node density in the network area.

Nodes in a particular cluster send the data to its base station node periodically, and then this data is forwarded to main base station. By doing such arrangement we can improve lifetime of network and traffic on each node will be decrease. For routing the data geographic routing protocol is used and it s used for large networks in practice. This protocol needs positioning information of nodes for transmission of data and so it is mainly used in multi-hop wireless sensor network.

A. Radio Model

We have assumed the same radio model which has been used in earlier works. For the scenarios described in this project work, both the free space and the multi path fading channel models were used depending on the distance between the transmitter and the receiver. If the distance is less than a threshold, the free space model is used; otherwise, the multi path model is used.

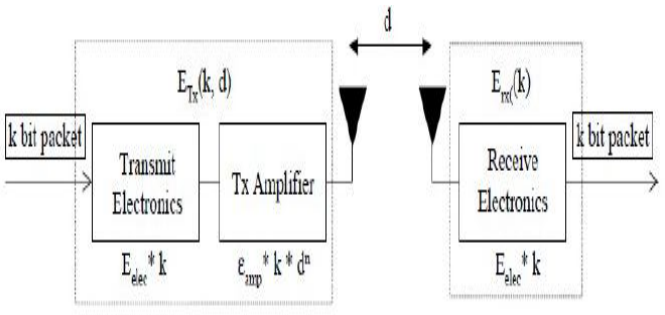

Fig. 2. Radio model

According to the radio model, energy consumptions for transmitting and receiving k bits of data are shown in (1) and (2), respectively, i.e.,

$$E_t = \begin{cases} kE_{elec} + k\varepsilon_{fs}d_2, & d \le d_0 \\ kE_{elec} + k\varepsilon_{amp}d_4, & d > d_0 \end{cases} \quad (1)$$

$$E_r = kE_{elec} \quad (2)$$

Where Eelec is a transmitting circuit loss and d0 is the threshold distance which is used for transmission. Equation (1) are used for free space channel and the multipath fading channel model, which model will be used is given by the distance d. when transmission distance d is larger than the threshold distance d0, multipath fading channel model could be used; else, free space channel model will be used. □fs and □amp denote the energy for power amplification in the two models, respectively. □ is the data transmission rate of each sensor node. For idle listening, the energy consumption rate of the sensor nodes is denoted by Eidle.

ALGORITHM DESCRIPTION OF GEOGRAPHICAL AND ENERGY AWARE ROUTING (GEAR)

In sensor networks, efficient and scalable protocols are necessary and which is very challenging task due to the limited energy and high requirement of dynamic. Geographic routing protocols based on local information only and thus are efficient in WSN. In process of this protocol nodes first needs to know the location of their neighbors in order to forward packets. Advantage to use this protocol is that it conserves energy and bandwidth.

This protocol is always works on assumption that the node knows the geographical location of the destination node. This helps to route the message to one of its neighbors that is geographically closest to the destination node. A node who want to send a message get the address of the destination. When it prepares the message, it calculates the distance from itself to the destination. Next, it calculates distance from each of its neighbors to the destination. The greedy approach is use to shorten the distance to be traveled. Therefore, the node considers only those neighbors that are closer to the destination than itself [11]. As our network is evenly distributed throughout the area so load of the data will not be concentrate at only one place. And hence traffic can be minimize by great extent.

Fig. 3. Shows the working of geographic protocol which is explained above in the algorithm.

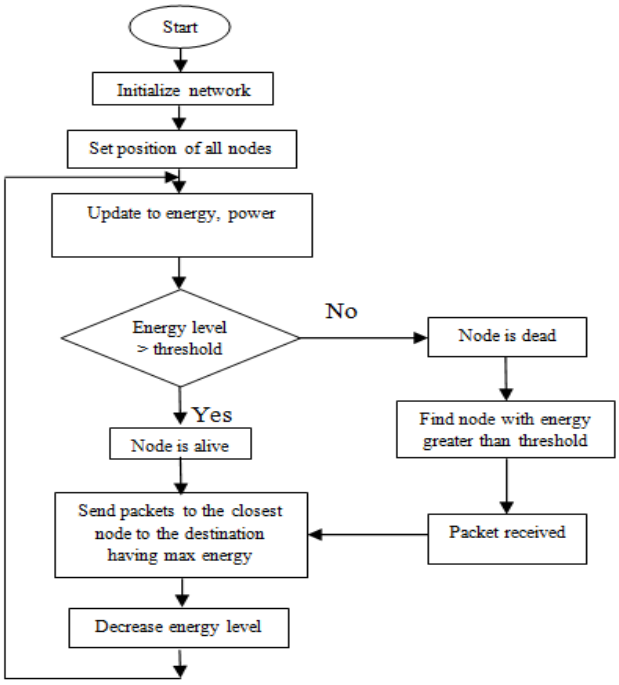

Fig. 3. Flow chart

Fig. 3 shows the flow chart operation of network topology and geographic routing protocol is explained. For starting of process first we have set up the clusters. After that based on the energy of nodes of cluster, cluster head will be selected, and this will forward the data to the main sink node.

Nodes which are of very low energy after doing lots of transmission it loses its energy hence consider as dead node. Now this node can`t transmit the data. According to this whole transmission takes place until all nodes die.

Table I. Parameter setting

Parameters	*Values*
Network area (m)	1000*1000
No of nodes	95
Location of main sink node	at center
Cluster radius	100m
Routing protocol	Geographic
Packet size	8192 bits
Initial node energy	1 J
Data rate	1kbps

IV. EXPERIMENTAL RESULTS

In this section, analytical results we are presenting by using MATLAB software. By using MATLAB it is easy to develop the model and simulation can be perform in a precise manner. Firstly we have considered the network model on which simulation is performing, with the help of this traffic load and energy consumption of the network is estimated.

Network model

We have designed WSN which can be used in large area and those who want to use geographic routing protocol. In first scene nodes are spread in a big area. This big area is divided in to many clusters whose radius is of 100m. This network is big because the locations of base stations we have allotted are not near to the main base station. Network is comprised in a 1000*1000(m) area. Packet size is of 8192 bits with the data rate of 1Mbps. Here initial energy of node consider is of 1 J. Main sink node is located at the center part of the network. Transmission of data is done by using equation (1) and (2) which are energy equations.

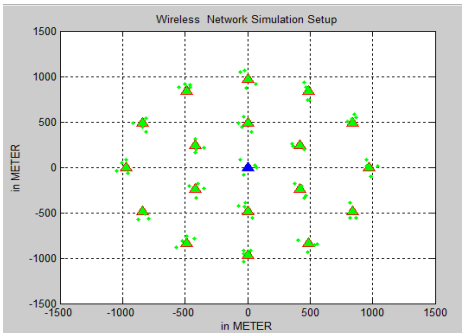

Fig. 4. Wireless network simulation setup

Data Amount(Traffic)

Fig. 5. Shows the data amount i.e. traffic of the node. As shown transmission range of node plays important role in data traffic. Sensor nodes which close to sink has maximum traffic compared to those which are far from sink node, and hence it will gradually decreases as the distance increases. Our model is quite good at estimating traffic load of the network.

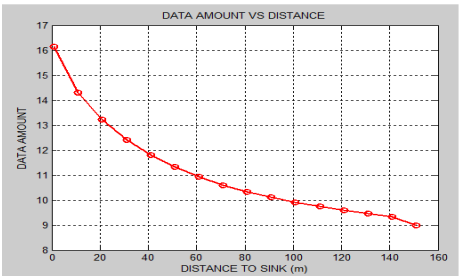

Fig. 5. Data amount at of a node

Energy consumption of a network

Fig. 6. Shows that how much energy is consumed by the network based on the distance from sink node. In this project we have taken 5 iteration hence for 5 iteration we got the result. This parameter shows us that how the energy is being consumed according to the distance between the nodes. This parameter is necessary to get the idea that how at different levels we consume energy. At the starting when all nodes are alive energy consumption of whole network is less and as the number of rounds increases the consumption of energy also increases till the all nodes die.

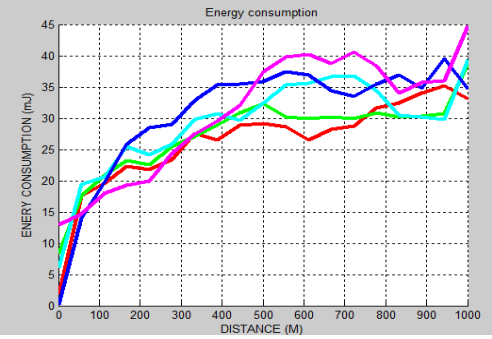

Fig. 6. Energy consumption of a network

Lifetime of a network

Network lifetime parameter shows the duration in which the network is operational. It means that it is able to perform a dedicated task. This is the maximum duration in which deployed sensors have the capability of monitoring the phenomenon of interest. During this wireless sensor network will be fully operative. From this graph we get that we are at good enough lifetime for network to work, and it is almost constant shows that it is not degrading even if the nodes die. Other nodes can work easily in the absence of dead nodes.

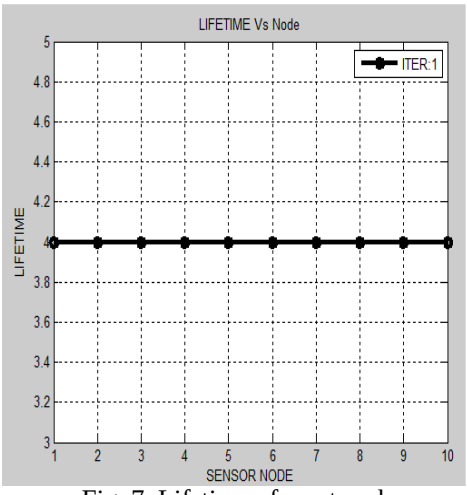

Fig. 7. Lifetime of a network

V. CONCLUSION

In this paper, we have developed a model which can be used for the reduction in energy consumption. Here, we have proposed a clustering scheme, using GEAR protocol for WSNs to estimate energy efficiency and network lifetime. We have developed an analytic model to estimate the traffic load, energy consumption, and lifetime of sensor nodes in a data-gathering WSN. Data traffic of individual node depends on its distance from main sink node. Therefore, the procedure used in the proposed (GEAR) first calculates the average distance of all the neighbors of transmitting node and checks their energy levels. Finally, it selects the neighbor which is alive (i.e. having energy level above the set threshold) and having the maximum energy plus whose distance is equal to or less than the calculated average distance among its entire neighbors. In future work we can apply this method for a specific application and according to that get the efficient parameters.

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