Development of Longer Lifetime WSN Network using Hybrid Routing

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Abstract - The energy conservation of the sensor node is directly affected the way information transmitted to the base station or server. The less energy consumed by the node to transmit information larger the lifetime of the node. The transmission of information is considered as routing methods. Energy is the most prominent factor in wireless sensor networks because all the sensors are battery operated and the consumption of energy is inversely proportional to the lifetime of the sensor node. In this paper a more efficient energy efficient routing technique is proposed for the wireless sensor network. The energy of data aggregation in hybrid routing is kept lower to enhance the lifetime of the wireless sensor network (WSN). The proposed approach having better lifetime as well as throughput.

Keywords - WSN, Energy Efficient clustered Routing, Lifetime, Throughput.

I. INTRODUCTION

Wireless Sensor Networks(WSN) have gained world-wide attention in recent years due to the advances made in wireless communication, information technologies and electronics field.

The concept of wireless sensor networks is based on a simple equation: Sensing + CPU + Radio = Thousands of potential applications. It is an “In situ” sensing technology where tiny, autonomous and compact devices called sensor nodes or motes deployed in a remote area to detect phenomena, collect and process data and transmit sensed information to users. The development of low-cost, low-power, a multifunctional sensor has received increasing attention from various industries. Sensor nodes or motes in WSNs are small sized and are capable of sensing, gathering and processing data while communicating with other connected nodes in the network, via radio frequency (RF) channel.

WSN term can be broadly sensed as devices range from laptops, PDAs or mobile phones to very tiny and simple sensing devices. At present, most available wireless sensor devices are considerably constrained in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons. That’s why most of the research on WSNs has concentrated on the design of energy and computationally efficient algorithms and protocols, and the application domain has been confined to simple data-oriented monitoring and reporting applications. WSNs nodes are battery powered which are deployed to perform a specific task for a long period of time, even years. If WSNs nodes are more powerful or mains-powered devices in the vicinity, it is beneficial to utilize their computation and communication resources for complex algorithms and as gateways to other networks. New network architectures with heterogeneous devices and expected advances in technology are eliminating current limitations and expanding the spectrum of possible applications for WSNs considerably.

A wireless sensor network consists of spatially distributed autonomous sensors those cooperatively monitor the physical or environmental conditions such as temperature, sound, vibration, motion, pressure or pollutants. The WSN is built of ’’nodes”- from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. A structure of a WSN is shown in Figure 1.1.

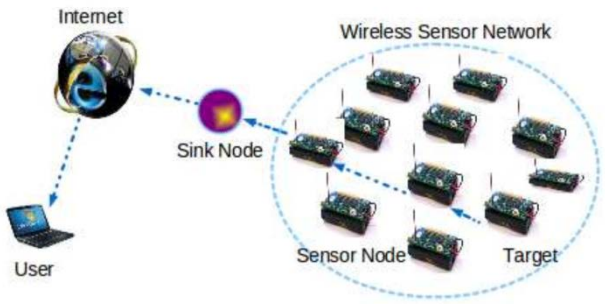

Figure 1.1 Wireless Sensor Network.

In sensor networks where the environment is needed to be remotely monitored, the data from the individual sensor nodes is sent to a central base station (often located far from the network), through which the end-user can access data.

II. EFFICIENT ROUTING SCHEMES

Since the sensor nodes are battery powered having limited energy capacity, energy is a big challenge for the network designers in hostile environments. For example, in a battlefield, it is almost impossible to access the sensors and

recharge their batteries. Also, when the energy of a sensor reaches a certain threshold, it may become faulty and may not be able to function properly, which can have a major impact on the network performance. Thus, routing protocols designed for WSN should be as energy efficient as possible to extend the lifetime of the sensors and hence prolong the network lifetime while guaranteeing decent overall performance.

The energy constraints of sensor nodes raise challenging issues on the design of routing protocols for WSNs. Proposed protocols aim at load balancing, minimizing the energy consumed by the end-to-end transmission of a packet and avoiding nodes with low residual of energy. The classification of energy efficient routing protocols generalizes the one given: data centric protocols, hierarchical protocols, geographical and opportunistic protocols. We now describe each category in more details.

a. Data centric protocols

These protocols target energy saving by querying sensors based on their data attributes or interest. They make the assumptions that data delivery is described by a query driven model. Nodes route any data packet by looking at its content. Mainly, two approaches are there for interest dissemination. The first is SPIN where any node advertises the availability of data and waits for requests from interested nodes. The second is Directed Diffusion (DD) in which sinks broadcast an interest message to sensors, only interested nodes reply with a gradient message. Hence, both interest and gradients establish paths between sink and interested sensors. Many other proposals have being made such as rumor routing, gradient based routing, COUGAR, CADR. for a comprehensive summary.

b. Hierarchical protocols

Clustering protocols have been developed in order to improve scalability and reduce the network traffic towards the sink. Cluster based protocols have shown lower energy consumption than flat protocols despite the overhead introduced by cluster construction and maintenance. One of the pioneering hierarchical routing protocol is LEACH.

c. Geographical protocols

Many non geographical routing protocols suffer from scalability and efficiency restrictions because they depend on flooding for route discovery and updates. Geographical protocols take advantage of nodes location information to compute routes. An energy-aware protocol called GEAR consisting of two phases. In the first phase, the message is forwarded to the target region. In the second phase, the message is forwarded to the destination within the region.

d. Opportunistic protocols

The crucial idea of opportunistic routing is to exploit 1) the broadcast nature and space diversity provided by the wireless medium or 2) node mobility. Two subclasses of opportunistic routing distinguish here:

- Medium broadcast nature and space diversity based protocols: These techniques maintain multiple forwarding candidates and judiciously decide which sets of nodes are good and prioritized to form the forwarding candidate set.
- Mobility based protocols: By introducing mobility in WSN, network lifetime can be extended. Indeed, mobile nodes can move to isolated parts of the network and hence connectivity is again reached. Several works merging routing and mobility have demonstrated that this class of routing protocol exhibits smaller energy consumption when compared to classical techniques.
- Mobile relay based protocols: these techniques have been introduced in the context of opportunistic networks where the existence of an end-to-end routing path is not usually ensured.

e. Multipath protocols

Multipath routing protocols use multiple paths to forward data packets to the sink. Thus, they alleviate congestion in comparison with singlepath routing protocols. For instance, targets low interferences. It combines cluster-based routing and multipath routing. Each path routing just passes through cluster heads. Consequently, interferences caused by intermediate nodes are avoided.

e. LEACH

The main objectives of LEACH, was to find a way to low consumption of energy in the cluster and to improve the life time of WSN.

LEACH adopts a hierarchical and adaptive approach to organize the network into a set of clusters, managed by selected CHs.

III. PROPOSED METHODOLOGY

The wireless sensor network a subset of mobile ad-hoc network has lot of challenges to reduce the energy consumption of sensor nodes or wireless nodes to live longer in network and keep communicating with the network.

Here we have to work out main areas by which a node can live longer and i.e. either make batteries (source of energy) equipped with nodes having larger in size or the material

having larger charges saving capability but this approach having limited capabilities because the larger battery size make sensor node more bulk which is not feasible in any case, and to finding out the material has larger charge storing capability is also tough task to do.

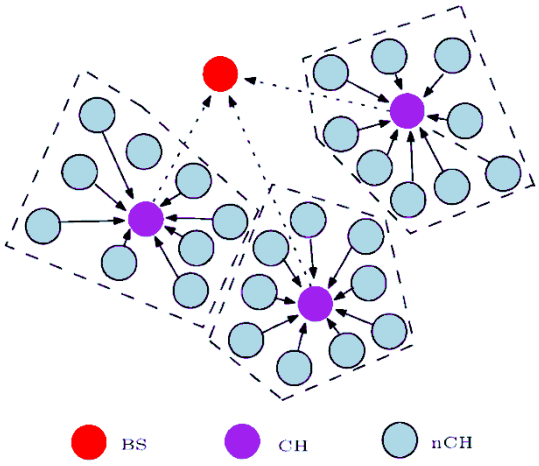

Figure 3.1: Network Diagram of Proposed Methodology with Hybrid Routing

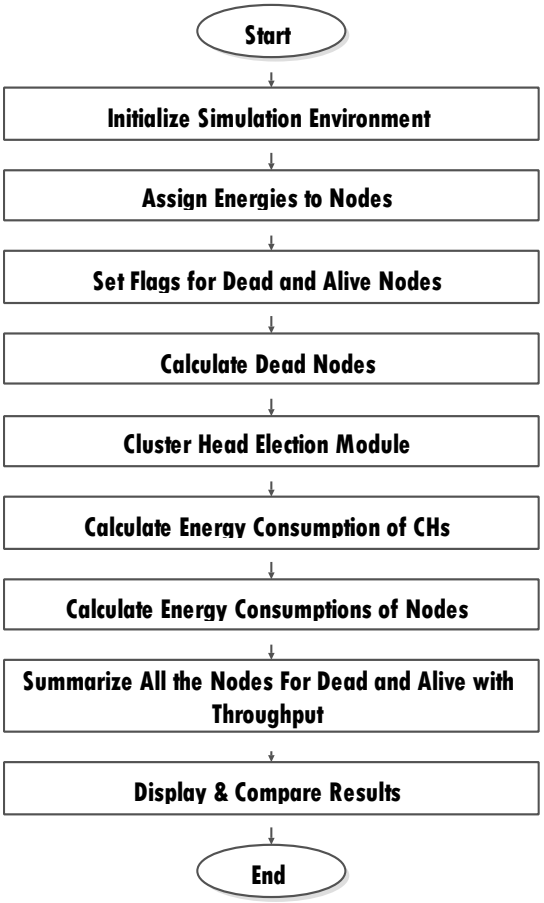

Figure 3.2: Flow chart of Proposed Routing Scheme

Here we are making changes in one of the routing protocol i.e. LEACH, where changes are being made in the information aggregation energy. The proposed approach is to have the lower data aggregation energy and the energy can be conserve for such frequent changes in the network. The proposed diagram of network is presented in Figure 3.1.

Table 1: Network Simulation Parameters

Operation	Energy Consumed
Transmitter / Receiver Electronics	*Eelec = Etx = Erx = 50nJ/bit*
Data aggregation energy	*EDA = 1/20-nJ/bit/signal*
Transmit amplifier (if d to BS < do)	E_{fs} *= 10pJ/bit/4m*^{2}
Transmit amplifier (if d to BS > do)	E_{mp} *= 0.0013pJ/bit/m*^{4}

Instead doing above things another method is to make transfer of information on network more efficient. For this many routing protocols has been given as discussed.

The above mentioned proposed routing strategy is implemented and its step by step execution is shown in Figure 3.2 flow chart.

IV. SIMULATION RESULTS

Wireless Sensor Network (WSN) is having lots of research areas to work on and here we have chosen routing protocol to make network lifetime more than the previous work. The simulation performed on Hybrid Routing which is based on reducing the data aggregation energy.

The simulated outcomes are in terms of number of alive nodes and number of dead nodes versus number of transmission rounds and throughput curve.

In the previous work lifetime of the network with MODLEACH is calculated up to 2490 transmission rounds.

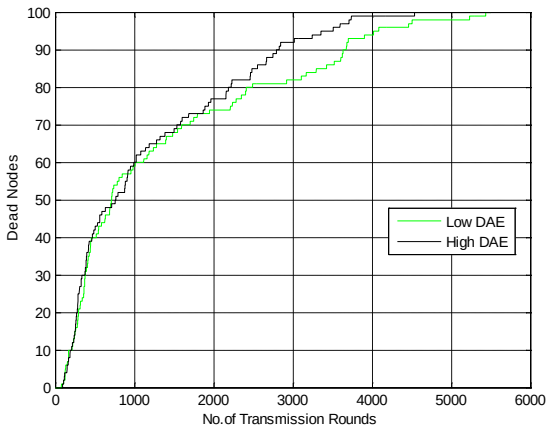

Figure 4.1: Network lifetime in terms of dead nodes versus no. of rounds.

If the network sustain for more number of rounds means lifetime of the network is going better. In proposed approach the lifetime of the network increased up to 4532 rounds in 400x400 network with data aggregation energy which is greater than the previous work and throughput is $6.868x10^4$. Table 2 shows comparison of the network lifetime with existing work.

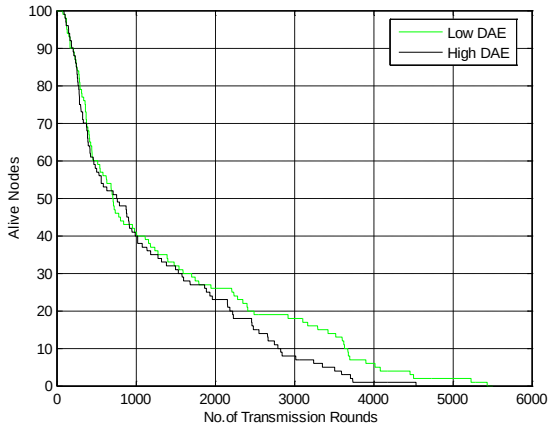

Figure 4.2: Network lifetime in terms of alive nodes versus no. of rounds

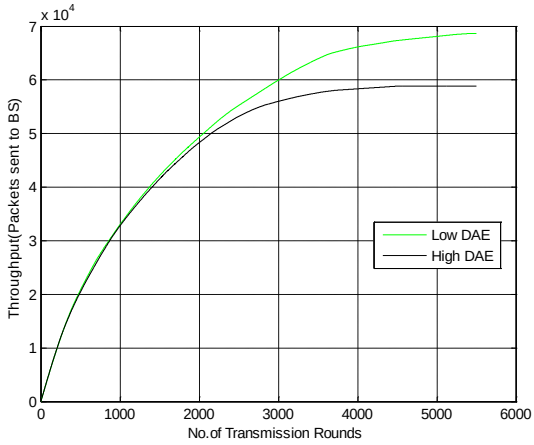

Figure 4.3: Throughput versus no. of rounds

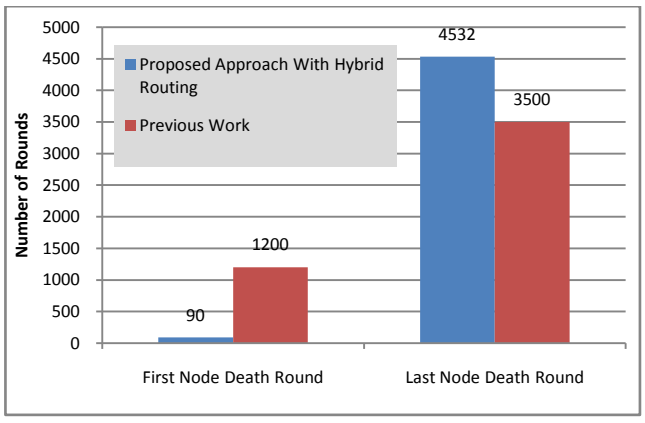

Figure 4.4 Performance Comparison of Previous and Proposed Work Lifetime

The dead nodes versus no. of transmission rounds graph is shown in the Figure 4.1 and alive node versus no. of transmission rounds graph is shown in Figure 4.2 the Throughput is also shown in the Figure 4.3. The results are given for 400x400 network size and the network lifetime is also shown for other network sizes in Table 2.

Table 2: Comparison of Proposed and Existing Work

Routing Technique	**Network Size**	**Number of Nodes**	**First Node Death Round**	**Last Node Death Round**
Proposed Approach With Hybrid Routing	***400x400***	***100***	***90***	***4532***
Previous Work	400x400	100	1200	3500

V. CONCLUSION AND FUTURE SCOPE

The wireless sensor network (WSN) is need to be sustain longer to stay with the network, and from the proposed methodology and its simulation results analyzed that with the lower data aggregation energy of information in the Hybrid Routing will have longer network lifetime which is higher than the existing methodologies. During simulation of proposed methodology number of dead nodes versus transmission rounds are calculated and the same for alive nodes and throughput i.e. packets send to base station also calculated for different data aggregation energy and found longer network lifetime (the sensor nodes survived to more number of transmission rounds) with better throughput. With the analysis of other network like network area, initial energy etc. researcher will make out something more robust routing protocols which have lower energy consumption and higher network lifetime.

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