Energy Efficient SEP Routing in WSN with Different CH Election Scheme

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Abstract - wireless sensor nodes is their inherent limited energy resource. Besides maximizing 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. Any communication protocol that involves synchronization of peer nodes incurs some overhead for setting up the communication. In this paper improved efficient energy efficient routing protocol is proposed for the WSN. The probability of cluster head selection in Multi-Hop Stable Election Protocol(MH-SEP) is kept lower to optimize the lifetime of the sensor network. The proposed methodology gives better lifetime as well as throughput. The lifetime is increased to 3129 transmission rounds and throughput is about 7.55x10^4.

Keywords - Wireless Sensor Network, Multi-Hop SEP, Routing Protocol, Throughput.

I. INTRODUCTION

Recent advancement in micro-electronics technology facilitated sensor designers to develop low price, low power and small sized sensors. Thousand of sensor are deployed in order to achieve high quality network. In the recent few years WSNs has emerged as an important technology for monitoring physical environment. WSNs consist of large number of sensor nodes which are small in size, inexpensive and battery powered. These WSNs can be used in various applications such as Military surveillance, environment monitoring, border protection, health care monitoring, weather monitoring. These applications require data without delay and energy consumed by them should be small. WSNs are deployed in harsh environment. Since it is not possible to replace or charge battery of sensor nodes, So it is desirable to design communication protocols such that energy source is used effectively and the delay in the network in minimum. Sensor nodes senses the environment, gathers the data from its surrounding(computation) and communicates it to the base station(BS).Out of the three tasks communication takes large amount of battery power of a sensor node, so the major concern is the communication task. We have to minimize the communication cost in order to save battery power.

Wireless sensor networks[1] consists of a thousands of sensor nodes which are deployed randomly environment or space. In sensor network there is a BS(base station) which is located far away from the sensor field. Sensor nodes sends the sensed data to the BS. For sending the sensed data to BS directly a lot of energy is consumed. So it is desirable to develop some protocols to minimized this communication cost. Energy conservation and maximization of network lifetime are the key challenges in the design and implementation of WSNs.

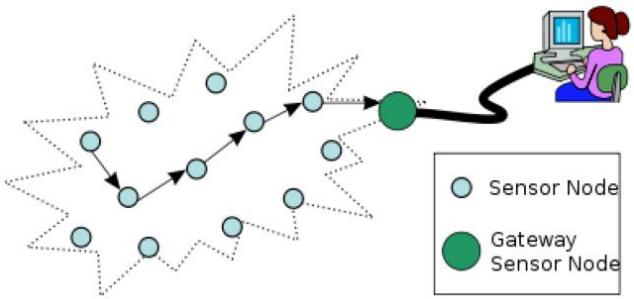

Figure 1.1: Wireless Sensor Network

Architecture of Sensor Node:

Every sensor node mainly consists of four components. They are sensing unit, transceiver, processing unit and power source. some sensor nodes also consist of optional components like location finding system, power generator and mobilizer. The sensing unit generally consist of sensor and ADC(Analogue and digital converter).The ADC converts the analogue data to digital data so that node can process it before transmitting the data.

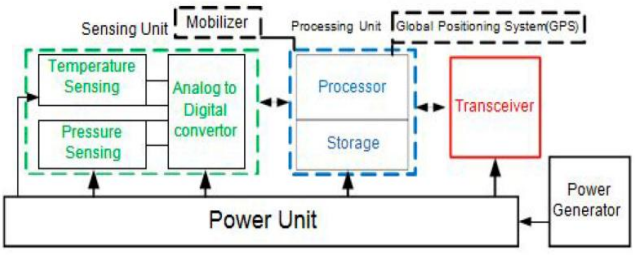

Figure 1.2: Sensor Node's Architecture

Transceiver connects the node to the network. The processing unit consists of processor and memory. This unit is responsible for managing the task of sensor unit. Mobilizer is used to enable node movement.

II. VARIOUS ROUTING TECHNIQUES

Challenges encountered as a result of constrained energy supply and bandwidth in WSN when managing the network necessitates the need for development of energy awareness protocol at all levels of networking protocol stack. To present efficient power management in WSN, researches have been focus on areas such as system-level power awareness like radio communication hardware, low duty cycle work and energy-aware MAC protocol [7]. Also, it was observed that the network layer offers a better means through which reliable relaying of data and energy-efficient route setup within a network can help to maximize the network lifetime.

It should be noted that routing in WSN has much distinguishable features compare to contemporary communication and ad hoc networks [7]. These features are as follows:

- WSN cannot be built with global addressing (internet protocol address) scheme due to the enormous number of sensor nodes;
- There is significant redundancy in generated data because several sensors may gather the same data within a specified field. These redundancy bits need to be removed to increase the bandwidth utilization and also reduce energy consumption in the network;
- Transmission power of the system, processing capacity and storage are constraint factors to be considered when managing a WSN.

Clustered Architecture:

Hierarchical or cluster based routing methods are well known routing methods with a special advantage related to scalability and efficient communications. Hence, they are used for energy efficient routing in wireless sensor networks. In hierarchical routing, higher-energy nodes can be used to process and send the information, whereas low-energy nodes can be used to perform the sensing in the vicinity of the target. The creation of clusters and the assignment of special tasks to cluster heads contribute to the overall systems scalability. Nodes within a cluster lower the energy consumption by performing data aggregation and fusion, lowering the number of transmitted messages to the base station, thus prolonging network lifetime. Hierarchical routing is mainly comprised of two levels: one for the selection of cluster heads and the other for routing.

A clustered architecture consists of a cluster head, or Personal Area Network coordinator, which organizes sensor nodes, communicates for them to the BS and typically interfaces with another network. This structural design is well suited when data fusion is necessary. The cluster head fuses data gathered by member nodes and transmits the resulting information to the base station. A design of a clustered architecture is shown in Figure 2.1 In order for clustered networks for achieving the self-organization, the cluster formation and election process must be an autonomous, distributed procedure. This is achieved during network layer protocols, such as Low-Energy Adaptive Clustering Hierarchy (LEACH). [8,9]

A set of protocols for complete implementation of a layered architecture is described as a Unified Network Protocol Framework (UNPF). Three operations are integrated into the protocol structure of UNPF: network initialization and maintenance, Medium Access Control (MAC) and routing protocols. The BS broadcasts an identifying beacon on a common control channel. All nodes which receive the beacon broadcast their signal at their low power setting along with their own identification. Those nodes that the BS can directly communicate with form layer one. All nodes then transmit a beacon signal again. Nodes that receive this beacon again broadcast their signal at their low power setting along with their own identification. Therefore, the nodes of layer one establish layer- two nodes by recording the identification of the nodes with which they can communicate. The iterations continue until all nodes are identified with a layer. Thereafter, a periodic beacon refreshes the architecture. [8]

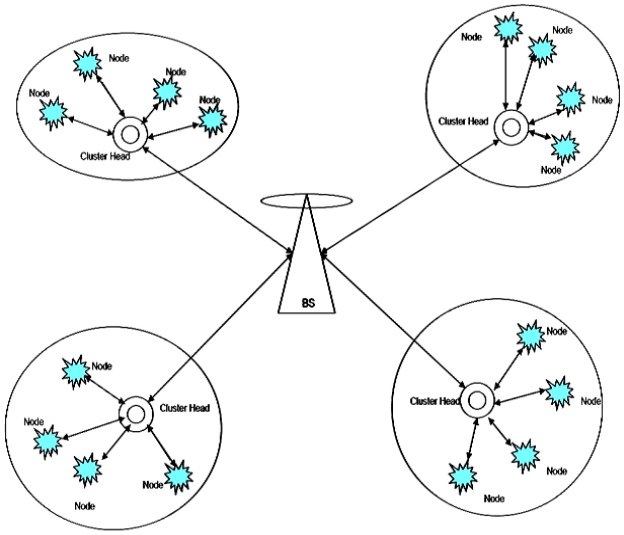

Fig. 2.1. Clustered Architecture Illustrating data aggregation.

III. PROPOSED METHODOLOGY

Wireless Sensor Network has been designed to monitor physical or environmental condition and many research works has been done on this topic. But power supply in this model of network makes problem. Because of using battery as a power ,the probability that network die will increase. Therefore should try to not waste energy, in the aim of increasing network's life time.

The idea of MH-SEP is proposed for solving the problem of power in WSN.

In this theory, network harvest power from environment and use this power instead of battery. The aim in MH-SEP network is not keeping network alive longer, but because there are enough energy in this theory the goal changes to maximizing the workload.

The purpose of this thesis is following in some steps: _rst of all review literature about the group of energy-aware routing algorithms in WSN and more deeper be involved in the algorithms that are specified to support energy harvesting technology. In the next step should choose some candidate routing algorithms from the category of MH-SEP routing algorithms base on their evidence in literature. After selecting the candidate we have to design and implement a simulator to simulate the given algorithms in different scenario. With the help of some analysis metrics, at the end, we should highlight the behavior of our candidate in different simulation condition.

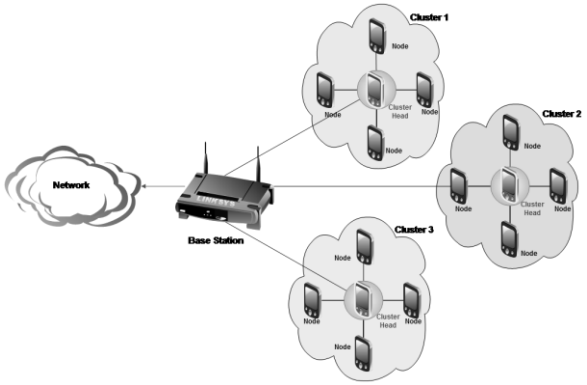

Fig. 3.1 Network Diagram of Proposed Methodology with MH-SEP

Here we are making changes in one of the routing protocol i.e. distributed energy efficient routing (SEP), 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 Fig. 3.1.

The above mentioned proposed routing strategy is implemented and its step by step execution is shown in below steps which are as follows:

a) Start the program.

b) Initialization environmental variables (with Different CH Selection Probability)

c) Generation of wireless sensor network model

d) Set loop for the number of rounds

e) Set number of alive nodes at the beginning of network

f) Check number of dead nodes

g) Select the cluster heads

h) Calculate energy consumptions to transfer data between cluster head (CH) to Base station (BS) and nodes (N) to cluster head (CH)

$$E_{avg} = \frac{E_t\left(1 - \frac{r}{r_{max}}\right)}{n}$$

$$Cluster\ Head\ Probability\ Threshold\ \ p_i = \frac{PnE_NE_r}{E_tE_{avg}}$$

$$Cluster\ Head\ Energy\ Consumption = D\ [E_{tx} + E_{agg} + (E_{amp} \times L^{2\ or\ 4})]$$

Where, r *= Current Round*

r_{max} *= Total Number of Rounds*

p_i = *Cluster Head Threshold*

P *= Probability of Selection*

n *= No. of Nodes*

E_n *= Node Energy*

E_R *= Round Energy*

E_t *= Total Energy*

E_{avg} *= Average Energy*

E_{tx} *= Transmit Energy*

E_{agg} *= Aggregation Energy*

E_{amp} *= Amplification Energy*

L *= Distance between Transmitting Node and Cluster Head*

i) Check alive nodes after data transfer

j) If alive nodes are > 0 then Go back to Next Round (step c)

k) If alive nodes are = 0 then calculate Throughput of the network

l) Compare and display results

m) End of program

Table I: Network Simulation Parameters

Operation	Energy Dissipated
Transmitter / Receiver Electronics	Eelec = Etx = Erx = 50nJ/bit
Data aggregation energy	EDA = 5nJ/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

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 Stable Election Protocol (SEP) 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 low energy adaptive clustering hierarchy (LEACH) is calculated up to 2490 transmission rounds.

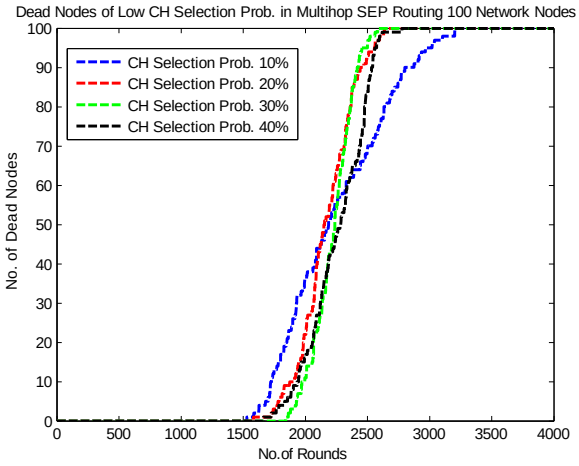

Fig. 4.1 Dead Nodes vs No. of Rounds

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 3099 rounds in 100x100 network, 2826 rounds in 134x134 network, 2521 rounds in 150x150 network and 2867 rounds in 200x200 network which is greater than the previous work. Table II shows comparison of the network lifetime with existing work.

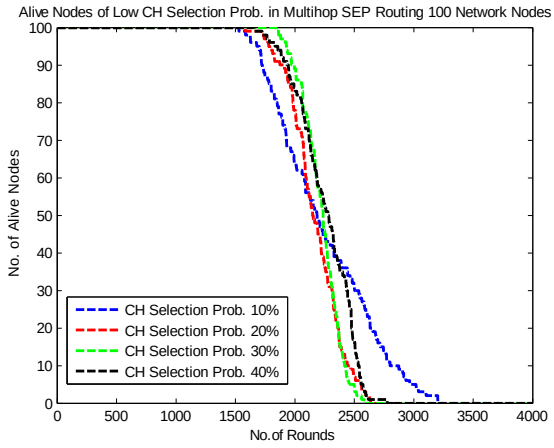

Fig. 4.2 Alive Nodes vs No. of Rounds

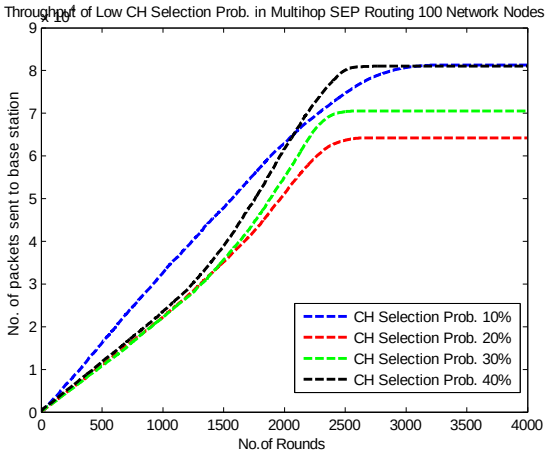

Fig. 4.3 Throughput vs No. of Rounds

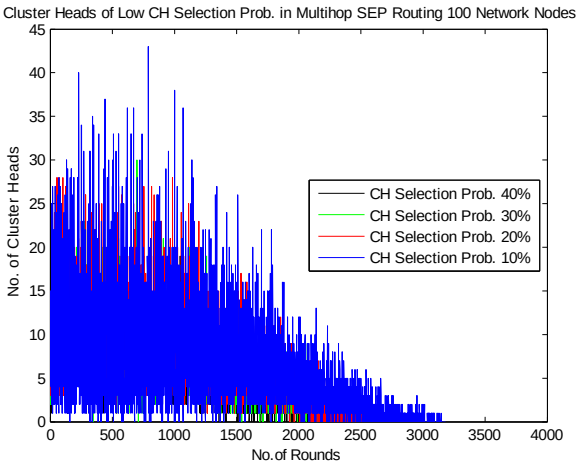

Fig. 4.4 Number of Cluster Head versus no. of rounds

The alive nodes versus no. of transmission rounds graph is shown in the Fig. 4.1 and dead node versus no. of transmission rounds graph is shown in Fig. 4.2 the Throughput is also shown in the Fig. 4.3 and number of cluster head selection in Fig. 4.4.

V. CONCLUSION AND FUTURE SCOPE

In Wireless Sensor Networks(WSNs), energy consumption and delay guarantee issues are of major consideration in developing efficient routing schemes and from the proposed methodology and simulation results analysis it is clear that with the lower cluster head selection probability in the multi-hop Stable Election Protocol (MH-SEP) routing will have longer network lifetime which is higher than the existing methodologies. During simulation of proposed methodology number of dead nodes vs transmission rounds are analysed and the same for alive nodes and throughput i.e. packets send to base station also calculated for lower cluster head selection probability and found longer network lifetime(the sensor nodes survived to more number of transmission rounds) with better throughput. In the upcoming era of technology researcher will work out by adopting hybrid routing methodologies

with proposed work of this paper will definitely lower energy consumption and increases network lifetime.

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