Design of an Efficient Algorithm to Enhance Life time in Wireless Sensor Networks

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Abstract- **A wireless sensor network (WSN) is a network consisting of wireless computing devices called sensors that sense environmental conditions like motion, sound, etc in an area. These networks collect the information from the environment and send it to the sink node. And these sensor nodes typically combine wireless radio transmitter, receiver and limited energy, restricted computational processing capacity and communication band width. The proposed algorithm used to select the cluster heads for transmission of data in the wireless sensor networks. The fitness function proposed in this algorithm to consider both the distance of the nodes from the base station and their energies and the network simulator NS-2 is proposed for simulation. The results show that the proposed protocol results in 4% of energy consumption and prolonged network lifetime compare to the existing which energy consumption is 8% and high energy consumption of the wireless sensor network.**

Index Terms- **Wireless Sensor Network, Data aggregation, CH selection, Fitness Function.**

I. INTRODUCTION

WSN consists of low cost, little devices called sensor nodes and are in nature self-organizing ad-hoc systems. The sensor nodes are considered as either routers (address) or computer-host(port), which has three components i.e., a CPU, a radio transceiver and a sensor array. It is a collection of sensing devices that can communicate wirelessly. Each device can sense, process, and talk to its peers. The job of the sensor network is to monitor the physical environment, gather and transmit the information to the sink node through other sensor nodes. The main disadvantages of WSNs are: all the sensor nodes have been considered as small objects and the data communication between every sensor node is maximum. Sensor nodes generate more transmissions and thereby consume more energy to transmit the desired data. Hence, the amount of data transmission needs to be minimized to consume limited energy and make best use of the available resources. This plays an important role in extending of network lifetime and bandwidth utilization. This can be achieved through energy based data aggregation.

The network simulator NS-2 is useful to model the communication layers of ad-hoc network. Section 2 contains the related approach to solve the energy consumption problem in WSNs, and Section 3 describes the implementation. Finally simulation results and conclusions are presented in Section4 and 5 respectively.

II. RELATED WORK

Many earlier studies contribute in presenting algorithms where the costs, including receiving and transmitting between CHs and BS, are reduced and the network lifetime is increased. There have been numerous routing protocols that have appeared in WSNs. Extending of network period and information measure utilization becomes critical. This is achieved through the existing technique, routing protocol technique called destination sequenced distance-vector routing (DSDV). In the existing technique, initially sensor nodes performs data gathering from environment and sends the data to neighbor nodes and send to the base station . In the existing technique, the energy utilization is not efficient and it does not concentrate on energy consumption. The first low-energy adaptive clustering hierarchy i.e. LEACH was proposed by Heinzelman et al[1]. It is a hierarchical and self-organized cluster-based approach. The area whose information has to be transmitted i.e. the area under monitoring where the sensor nodes are deployed is subdivided randomly into several clusters. Jenn-Long Liu and ChinyaV.Ravishankar[1] proposed a genetic algorithm-based (GA-based) adaptive clustering protocol with an optimal probability prediction to achieve good performance in terms of lifetime of network in wireless sensor networks. Kalpakis[3] and Jin proposed the MLDA (Maximum Lifetime Data gathering Algorithm) to find edge capacities that allows maximum transmission. [2] A cluster-based heuristic algorithm which extended MLDA to CMLDA, where nodes are grouped into several pre-defined sized clusters and multi-level hierarchical

clustering algorithm and described Adaptive Self Configuring sensor Networks Topology. [3]An early implementation of GA algorithm is Tur-gut work which applied the GA concept to improve mobile ad-hoc network clustering. The proposed algorithm is the same as most of the GA based protocols in that it presents a fitness parameter that decides the destiny of an individual. The proposed ACO algorithm differs from other ACO algorithms because of two main aspects. One is the ACO algorithm uses two types of pheromones to find the coverage cover efficiently in heterogeneous WSN and the other is introduction of low power state.

III. SYSTEM ANALYSIS AND DESIGN

In this paper, created the initial population of sensor nodes moving from 0th position to their respective position (x-axis and y-axis) and hello packet transmission to get energy value each node. Second step is to form seven clusters and a base station node, the CH's are chosen from each cluster based on their energy levels and fitness value of the sensor nodes (connectivity formula) and in the third step, we have used data aggregation at cluster head(CH) and cluster head rotation in network to reduce energy consumption. And in the fourth step data travel from cluster head to base station(BS).

The proposed algorithm is shown in the following.

Begin

Step1: Initialization of sensor nodes and hello packet transmission to get energy level of nodes.

Step2: CHs selection and computing fitness of each individual for the best CHs selection. Final CH selection is done based on fitness function.

Step3: Data aggregation from cluster members to cluster head.

Step4: After CH selected in each cluster transmission starts in each cluster, where CH collects data from its respective cluster members (CM's), finally data is transmitted from CH to base station.

End

1. Initialization of nodes

In this process, initial population of sensor nodes moving from 0th position to their respective position (x-axis and y-axis). And hello packet transmission has been sent to all cluster members which is in the network to get energy levels of each node.

2. Fitness function and Cluster head selection

The fitness function is the main part of a proposed Algorithm. A new fitness function has been designed for the evaluation of the fittest cluster head.

$$F = \frac{\sum E \times \sin(nA)}{\sum Ech \times \sum Dch}$$

$\sum E$ = Total energies of alive nodes.
nA = Number of alive nodes.
$\sum Ech$ = Total energies of cluster head.
$\sum Dch$ = Total distance of selected cluster head.

According to this fitness values, the fittest cluster member is used for the selection of cluster heads in the network for the current generation. The next step is to select the cluster heads from the best cluster members. An optimum number of cluster heads has been selected on the basis of maximum energy values.

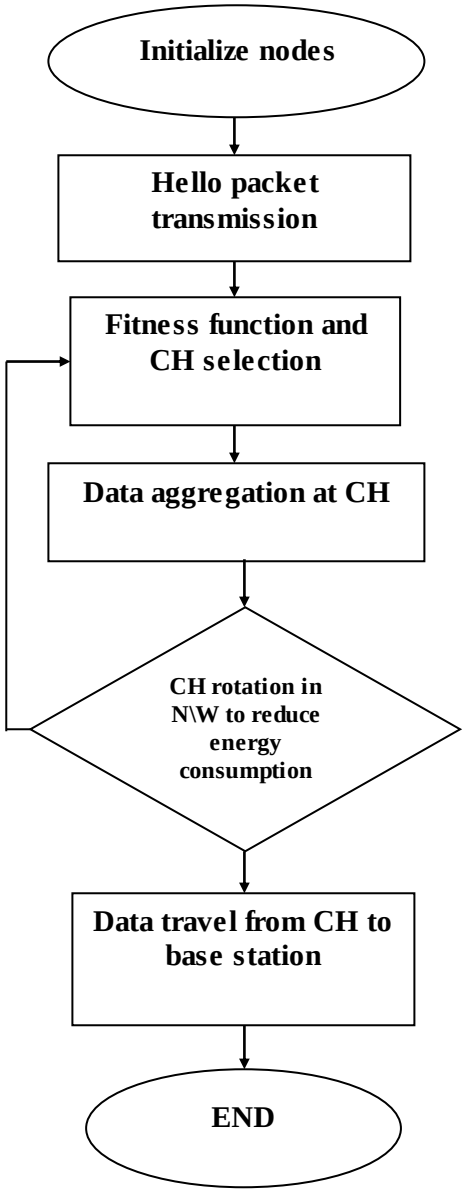

Fig.Data flow diagram

3. Data aggregation and CH rotation in network.

In this approach, the purpose of data aggregation is to collect the highly critical data supplied by the sensors and to forward the data to the sink. Each group of sensors has a cluster head node that aggregates data from its respective cluster members and sends it towards the base station (BS) as a representative sample of its cluster. And after that transmission for the next transmission cluster head rotation will be done, in this case which has the higher fittest value will be selected as CH of the cluster members.

4. Data transmission from CH to base station

In this process data collected from the cluster members at clusters head is transmitted to the base station.

IV. SIMULATION RESULTS

Simulation parameters

The evaluation project through NS-2.33 (NS-2), on Ubuntu operating system. Network Simulator Version 2 is an open-source event driven simulator. It is most useful to research in computer communication networks. NS2 includes animation tool such as wireless sensor network animator (NAM). It uses OTCL language for creating sensor nodes environment and plotting the XY graph based on analysis.

Performance metrics

The performance is evaluated mainly, according to the following metrics. Table 1 summarizes the simulation parameters used.

1) **Average Packet Delivery Ratio:** It is the ratio of the number of packets received successfully and the total number of packets transmitted.

2) **Throughput:** The number of packets received by the base station successfully.

The following table summarizes the simulation parameters used.

Table 1: SIMULATION PARAMETERS

Number of nodes	81
Routing protocol	AODV
MAC	802.11
Traffic source	CBR
Transmit power	10000.031622777w
Packet size	50
Initial energy	100 J
Data rate	11Mb
Area size	919 X 604
Simulation time	61.8sec

V. RESULTS AND ANALYSIS

In this experiment, two performance metrics are used to compare the performance of our protocol.

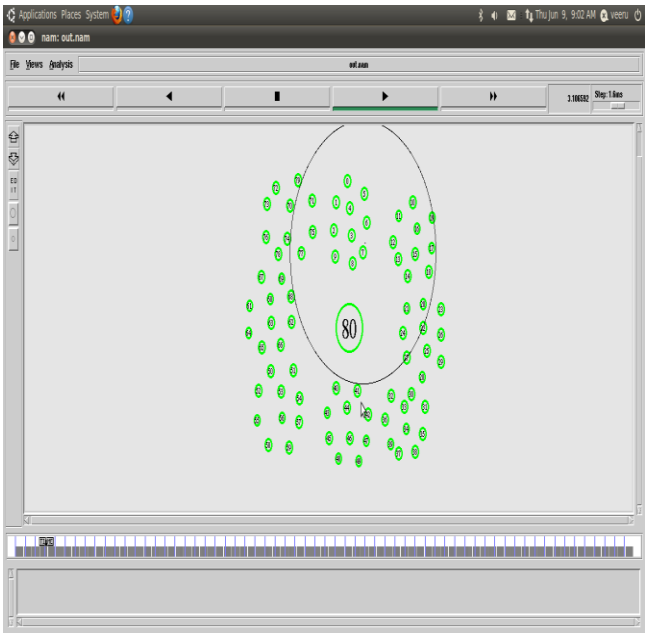

Figure 1. Shows the cluster formation and hello packet transmission."Hello packet sent to get the energy level of the nodes".

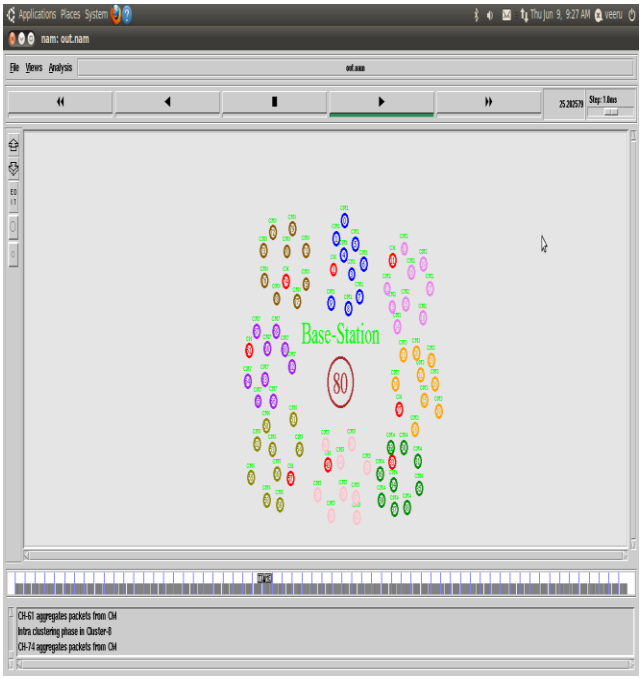

Figure 2. Shows the cluster head selection for all cluster based on energy level.

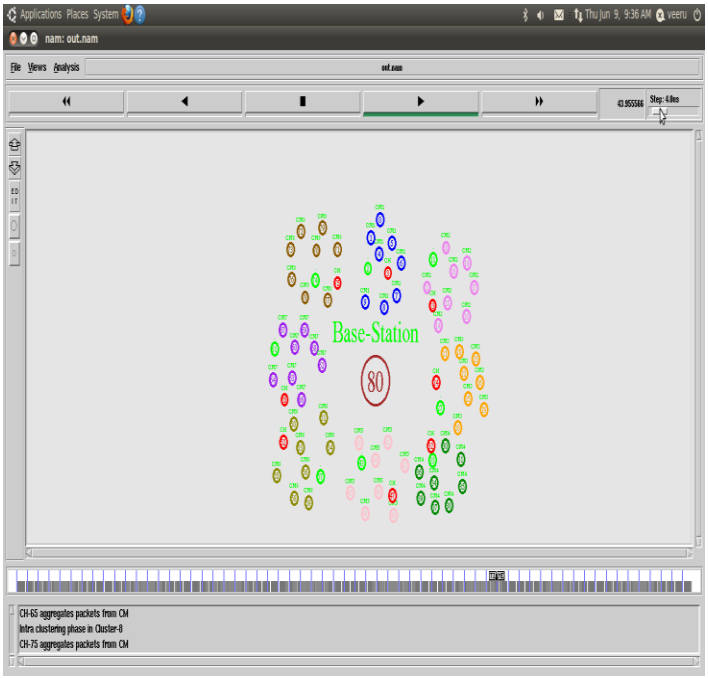

Figure 4. Shows the dynamic change of the CH in the cluster.

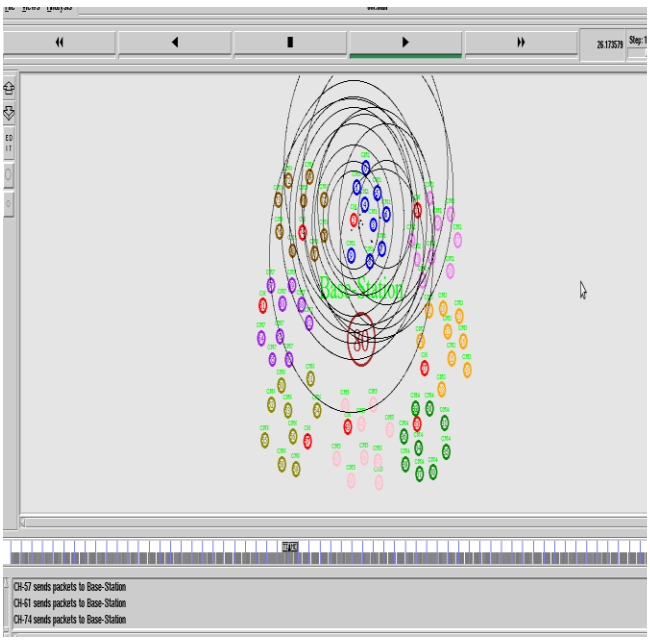

Figure 3. Shows the data aggregation at the CH from the cluster members CMs.

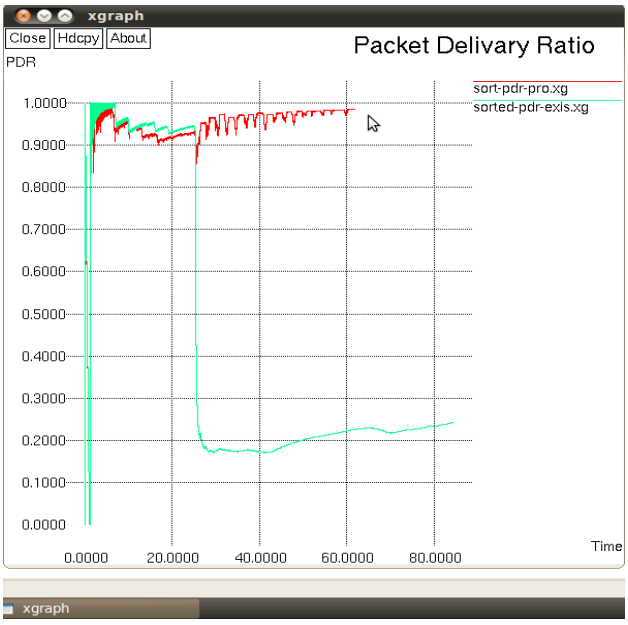

Figure 5. Shows the packet delivery ratio of dynamic selection of CH with time v/s no. of packets (Kbit/s).

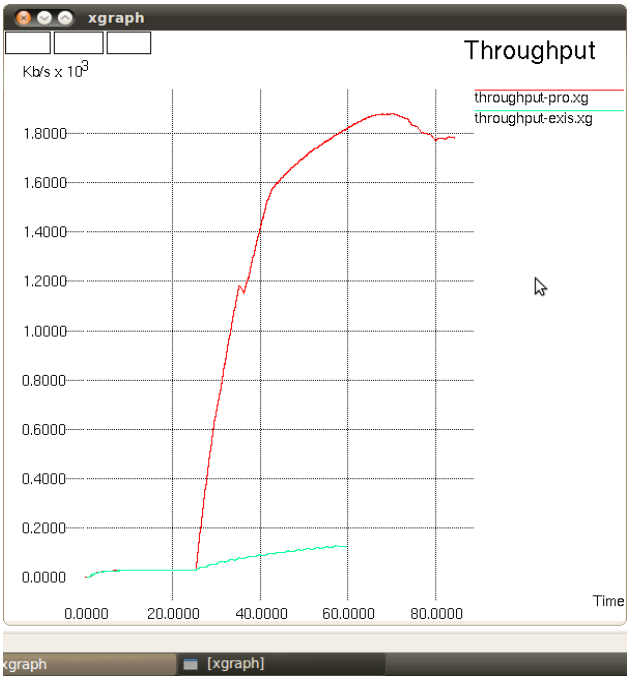

Figure 6. it can be seen that the throughput of the existing protocol(green) is less than our proposed(red) dynamic selection of the cluster head ,hence less energy consumption in dynamic selection-CH of the proposed method with time v/s no. of packets(Kbit/s).

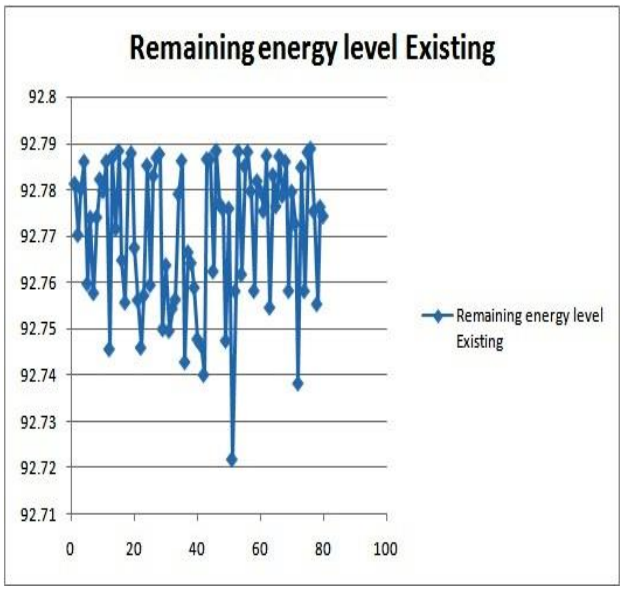

Figure 6. Shows energy level in Joules V/S nodes of the existing protocol.

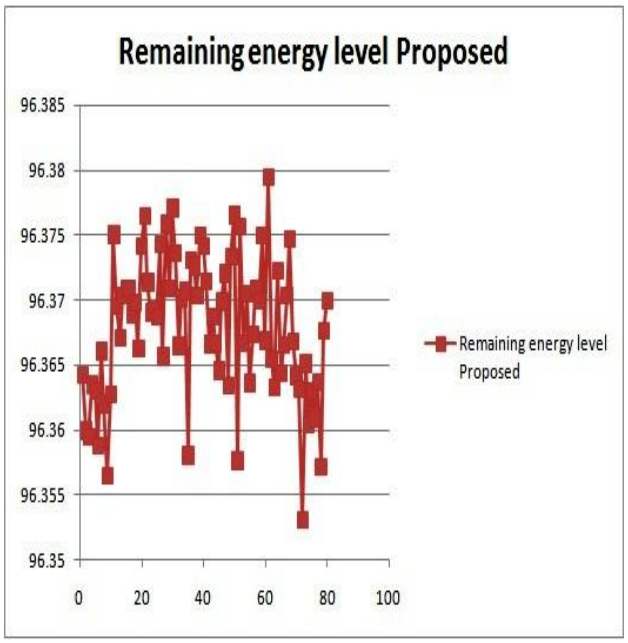

Figure7. Shows energy level in Joules V/S nodes of the proposed protocol.

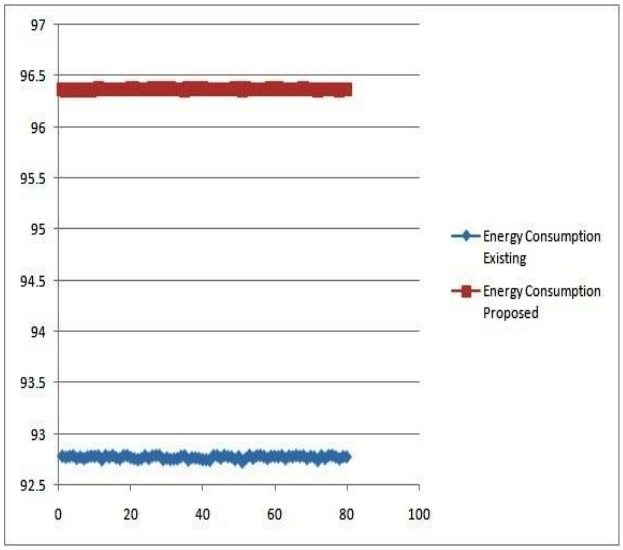

Figure 7. Shows the energy level of the proposed protocol is always higher than the existing which means proposed protocol consumes the less energy to compare existing.

VI. CONCLUSION

This paper proposes, all sensor nodes are consider as little objects and therefore the data communication between each of the sensor nodes is maximum and utilization of energy is more. In order to overcome these issues, an energy efficient cluster based algorithm, which is the combined with the genetic algorithm clustering technique, is used to increase the life span of the network. As the selection of CH is static throughout the simulation

process, a Dynamic Selection-CH technique has been implemented, to make cluster head selection as dynamic. Hence, simulation results shows that the Dynamic Selection-CH has less energy consumption and high throughput in comparison with current and proposed techniques based on the performance metrics and packet delivery ratio.

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