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ENERGY OPTIMIZATION OF HYBRID BASED H-HEED PROTOCOL IN INTER-CLUSTER BASED NETWORKS

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Abstract— ***Energy consumption is one of the main issues in wireless sensor networks. It is the important factor which determine the lifetime of a sensor network which is driven by battery. Sometimes the energy optimization become complicated in wireless sensor networks because it is not only involved the issue of energy consumption, but the prolonging of battery life as much as possible. The optimization of energy can be done with the awareness of energy as design aspects. Different types of algorithms and protocols were developed to minimize the energy consumption of the network sensor. In this paper, the author proposed and algorithm that computes the performance of the sensor network with H-HEED protocol. The lifetime of a sensor network can be increased by making the proposed algorithm; the proposed protocol applied on the application layer and the network protocols of the TCP/IP model.***

Keywords— ***WSN, HEED, LEACH, H-HEED, DDR.***

I. INTRODUCTION

Wireless sensor network (WSN) is a network of small light weighted wireless nodes which are highly distributed and deployed in large numbers. Wireless sensor networks monitor the system or environment by measuring physical parameters such as humidity, pressure and temperature [10]. Wireless sensor networks provide an economic approach for the deployment of the control devices and distributed monitors and avoid the expensive wired system. A wireless sensor network (WSN) can be defined as a network consists of low-size and low-complex devices called as sensor nodes that can sense the environment and gather the information from the monitoring field and communicate through wireless links; the data collected is forwarded, via multiple hops relaying to a sink (also called as controller or monitor) that can use it locally, or is connected to other networks [6].The sensor nodes are usually scattered in a sensor field as shown in Fig. 1

A wireless sensor network consists of a large number of nodes spread over a particular area. A sensor node

generally consists of memory, a processor, sensors, actuators and they do have communication ability. Through a wireless medium, the sensor nodes are allowed to communicate with each other's. The wireless medium may either of radio frequencies, infrared have no wired connection [9]. These nodes are deployed in a randomly and to make an ad-hoc network communicate among themselves. If the node is not able to communicate with other through direct link, i.e. they are out of coverage area of each other; the data can be sending to the other node by using the nodes in between them.

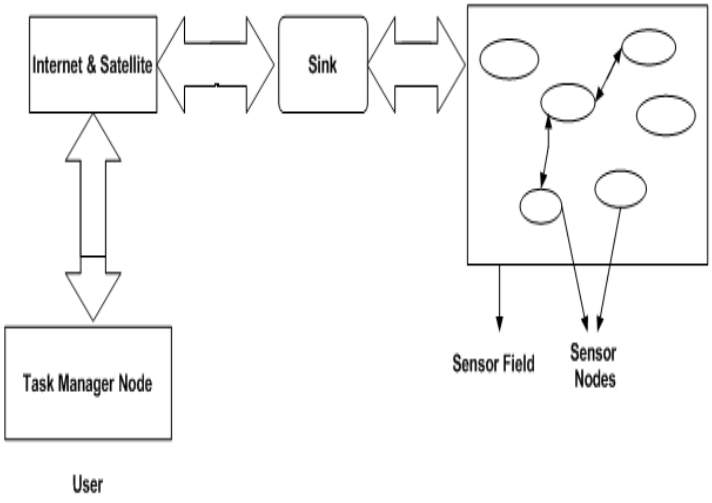

Fig. 1: Sensor nodes scattered in a sensor field

To make energy efficient wireless sensor networks following efforts are applied:

- To gain proper utilization of the benefits of deploying grid in the network.
- To reduce number of hops during transmission by utilizing dual radio based sensor nodes.
- A novel caching technique is used to increase the efficiency and to reduce the obsolete network which enhances the network performance.
- To optimally utilize the limited cache memory, a cache invalidation scheme is developed which removes the obsolete entries from it.

II. LITERATURE REVIEW

Narottam Chand described cooperative caching scheme ZCS to improve performance the performance of wireless sensor networks. In this scheme, in a zone nodes share their data which shows limited nodes problems and limited query latency at a node to prolong lifetime of wireless sensor networks. A cache discovery Process, distance based admission control, consistency check and utility based cache replacement policy is include by ZCS scheme.

To improve hit ratio replacement policy is also used. Wireless sensor networks (WSNs) have gained tremendous attention in recent years due to their numerous applications. Due to the limited energy resource, energy efficient operation of sensor nodes is a key issue in wireless sensor networks. Cooperative caching which ensures sharing of data among various nodes reduces the number of communications over the wireless channels and thus enhances the overall lifetime of a wireless sensor network.

S. Jerusha et.al presented new cluster technique by modified K-mean clustering. This scheme is used to improve lifetime performance and avoid network traffic. Information gathering in Sensors is easily achieved by enabling GPS. The sensor nodes are aware of its own position also. Clustering of nodes by using modified k means clustering algorithm can minimize the residual energy and maximize the performance.

Ravi Kishore Kodali, Naveen Kumar Aravapalli discussed Two-Level, Three-Level and Four-Level LEACH protocols. These Levels enhances energy efficiency and the lifetime of the network. The Time Division Multiplexing approach had deployed in the LEACH protocol for experimental purposed and increase the network throughput.

Nabil Ali Alrajeh, Shaullah, Jaime Lloret, Jonathan Loo presented about different possibilities to enable energy harvesting in wireless sensor network. In this way, the lifetime of sustainable WSN can be increased to a great extent to achieve all goals of sensors deployment. In this paper, author presented in detail a secure routing protocol for wireless sensor network, which is based on cross layer design and energy harvesting technique.

III. ENERGY CONSUMPTION ISSUES IN WSN

These protocols and algorithms have the special features of microprocessor and transceivers to minimize the sensor node energy consumption.

H-HEED Protocol

H-HEED Protocol basically a network layer or routing layer protocol. H-HEED (Heterogeneous Hybrid Energy Efficient Distributed) is the modified version of the HEED protocol in terms of heterogeneity. Here the cluster head is selected based on the fraction of residual energy to the maximum energy possessed by the sensor nodes. Head to head communication takes place and different energy levelled networks have been created. The energy efficiency has been verified in terms of the energy required for the transmission and reception of the data.

Main steps of H-HEED algorithms are:

Step1: Assigned a cluster number to all the nodes between all the clusters.

***Step2*:** Find the cluster center of each cluster.

Step3: For each node, find the closest to the node is called cluster center. Assign the node to the cluster whose center is closest to it.

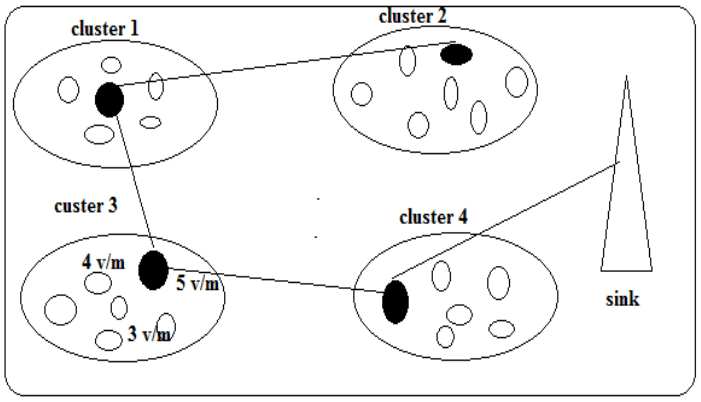

Fig. 2 Communication between sink and CH

Step4: Re-compute the cluster centers with the new assignment of nodes.

Step5: Repeat Steps 3 and 4 till clusters do not change or for a fixed number of times [15].

IV. PROPOSED SOLUTION

The essential operation in sensor node clustering is to select a set of cluster heads from the set of nodes in the network, and then cluster the remaining nodes with these heads. Cluster heads are responsible for coordination among the nodes within their clusters and aggregation of their data and communication with each other and/or with external observers on behalf of their clusters. But this H-HEED protocol has lack of time support and scalability issues and therefore, Density controlled Divide- and –Rule (DDR) based technique has been suggested [9] but this protocol never discussed the network lifetime and stable time period. Here, in the proposed research a hybrid approach is used to deploy the H-HEED and DDR together for extend the network lifetime and delay related issues which has not been discussed by the earlier approaches.

PROPOSED MODEL

In the proposed model, A WSN Cluster based network is created and arrange the sensor nodes in that manner, where graph G(V, E) in which V is the set of all the nodes in the network and E consists of edges presented in the graph. An edge e = (u, v) , e$\in$ E exists if the Euclidean distance between node u and v is smaller than r , where r is the radius of the coverage of nodes and assumed all links in the graph is bidirectional, and the graph is in a connected state. Given a node i, time t is recorded since it receives the broadcasted message for the first time, and t = 0. Here, the above said approach has been applied on the DDR technique and assumed that the performance of the network may be good than the earlier said protocol.

For the purpose of simulation the network is maintained within the following constrains [8]:

1. Sensor nodes are distributed over a large area and may or may not have a layout in distribution.

2. The distance between two nodes is not greater than the communication range of the nodes and does not interfere with the formation of the network.

3. Individual nodes do not communicate to the base unit instead in a neighborhood a single node acts as an agent between the nodes and the base unit.

4. A mobile base unit is responsible for retrieval of data.

5. Number of sensor nodes is limited and known, for larger number of nodes the heuristics will have to be updated.

V. IMPLEMENTATION OF PROPOSED MODEL

Network Simulation is a simulator which is an event based. The network simulator is discrete event packet level simulator. A very large number of different kinds of protocols application of different types of applications and packets are covered by it. In this paper, the author is implementing the proposed model by deploying 40 nodes and each node selecting cluster head from each of the group.

TABLE I SIMULATION PARAMETERS OF NS2 SIMULATOR

Parameters	Values
Area(x, y)	(800, 800)
Channel	Wireless
Propagation ground	Two way channel
Antenna	Omni directional
Queue length	50
IEEE Standard	802.11
No. of nodes	40
Protocol	H-HEED Protocol

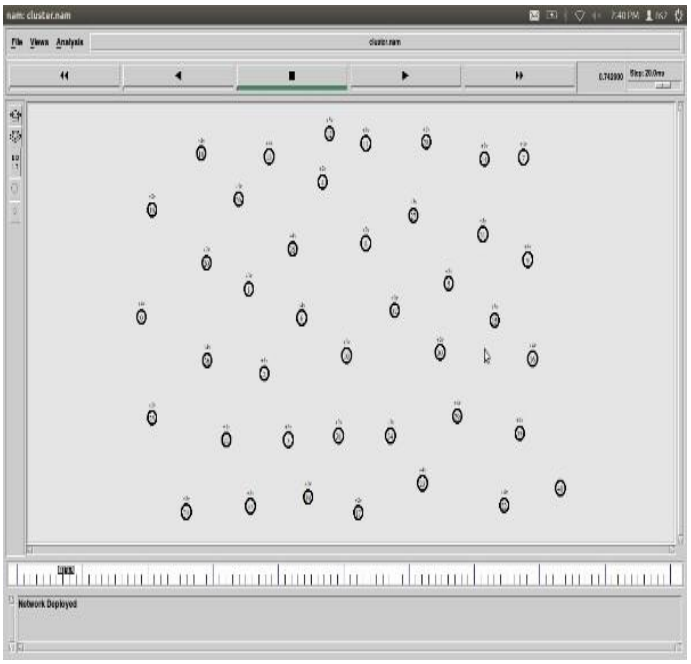

Fig. 3 Network deployment

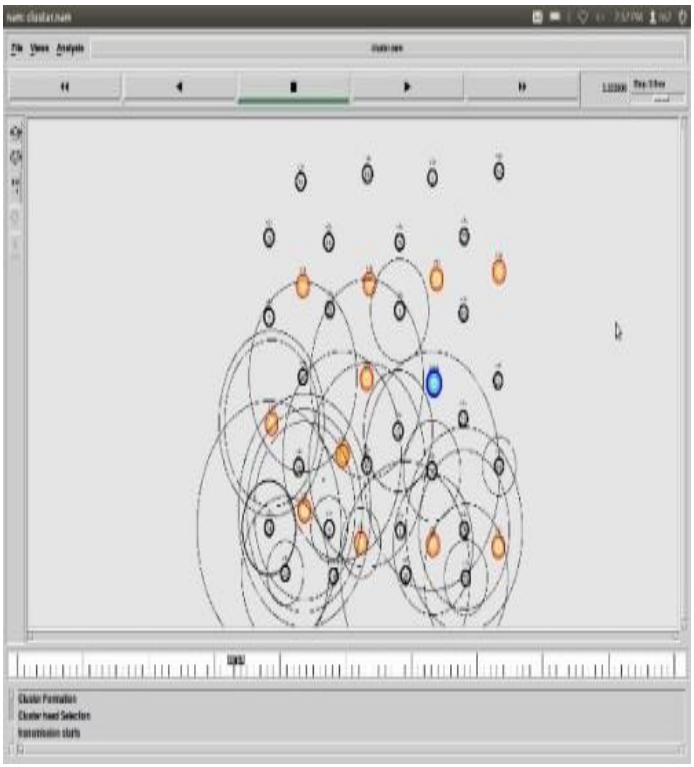

Fig. 4 CH-CH communication and formation of cluster

VI. RESULT DESCRIPTION

A. Energy Graph

This parameter is to be used to check out the lifetime of the network. If the energy consumption is higher, that node will be go out of power soon and the network lifetime will be decreased which will have adverse effect on the network. Energy consumption here shows the total energy consumption by the nodes that are intermediate nodes from source to destination nodes. Energy Consumption is very essential parameter that can show the capacity of nodes that participates in the network.

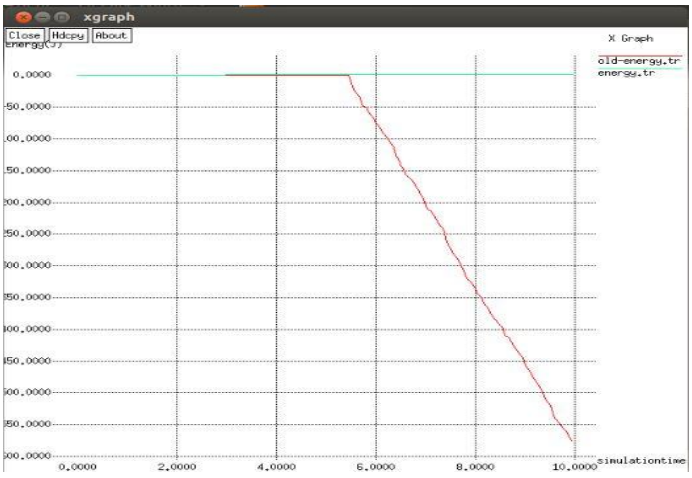

Fig. 5 Energy Consumed of WSN

In Table II, the author analyze that the erngy consumption of our proposed work is very less. In the previous work the energy consumption is high i.e. it consumed upto 80% of toatal enrgy of the network and this proposed work consumed 20% of the network. This percentage is also less as DDR technique is apply in clustering and it is always skipped in previous work.

TABLE II ENERGY COMPARISON

Energy Consumed (J)	Previous Work	Proposed Work	Difference
Minimum	0.8	0.0	0.8
Average	0.7	0.1	0.6
Maximum	0.9	0.2	0.7

B. Delay Graph

It is calculated by subtracting "time at which first packet was transmitted by source" from "time at which first data packet arrived to destination. It includes all possible delays caused by buffering during latency, queuing at the interface queue, retransmission delays at MAC, Propagation and transfer times.

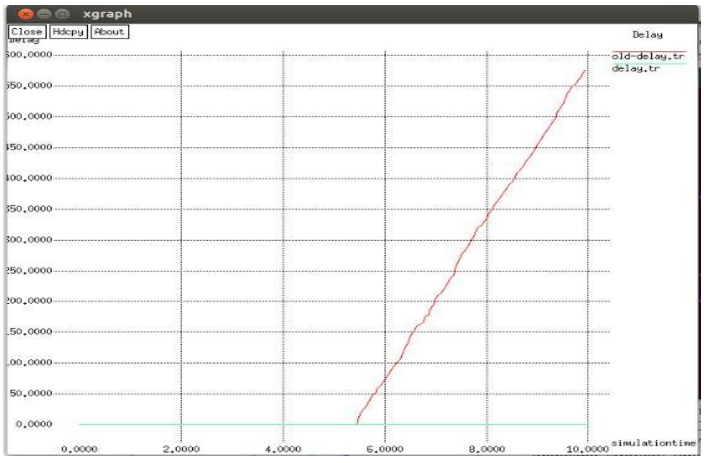

Fig. 6 Delay time of WSN

In Table III, the author measure the delay of the previous / proposed work and analyzed that the delay in the proposed work is less and that's why the consumption of the energy is also less. If the author analyze the difference from the table then the highest delay of the previous work is high i.e. 0.5 ms and the highest energy of the proposed work is 0.002 i.e. very less to compare with the previous work.

TABLE III DELAY COMPARISON

Delay (ms)	Previous Work	Proposed Work	Difference
Minimum Delay	0.005	0.000	0.005
Average Delay	0.025	0.001	0.024
Maximum Delay	0.5	0.002	0.498

C. Throughput Graph

Throughput means how many packets are received on receiver end. So because of packet loss in old case less number of packets are reached at destination end and that's why it's having less throughput but in new case because of proper transmission it's having high throughput. This graph shows the overall throughput of our scenario. It counts the number of packets from each node.

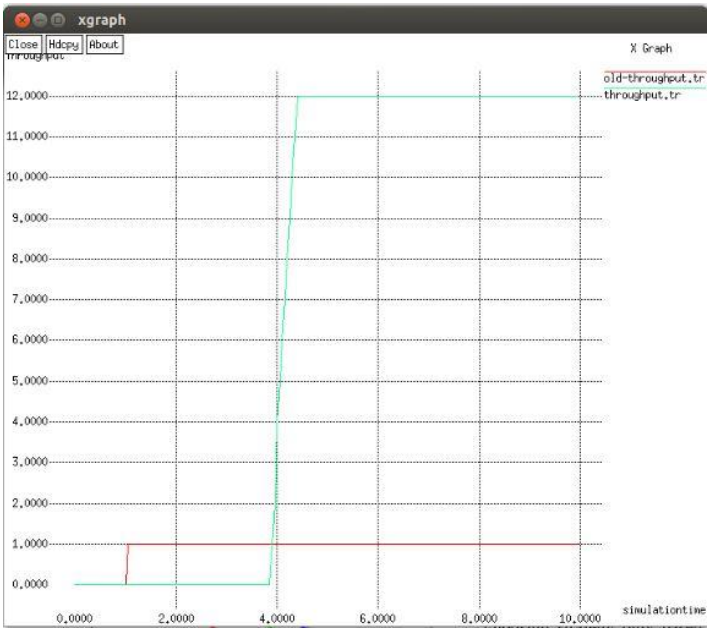

Fig. 7 Throughput of WSN

VII. CONCLUSION AND FUTURE WORK

In this paper, energy consumption and to prolong the network life time is major challenge of the wireless sensor network. The node which has the highest energy in the cluster is known as cluster head. Simulations results show that it performs better than existing protocol in terms of energy and network life time. The proposed scheme can be used in wide areas of sensor networks where energy efficiency is a critical issue. In WSN, communication is takes place between various clusters. Cluster is the group of nodes. In the future work, the authors will work on the various issues of wireless sensor network like network scalability, network performance improvement and the packet data delivery ratio and also others parameters like wide transmission range and different level of network in terms of energy.

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