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Hierarchical Energy Efficient Routing Protocol in Wireless Sensor Networks: Hybrid Energy Efficient Distributed Protocol

Shruti .S.Jadhav[1], Prof. Vaishali Bodade[2]
ME Student[1], Professor[2]
Department of Computer Engineering
Bharti VidyaPeeth College of Engineering, Navi, Mumbai, Maharashtra, India

Abstract:
Wireless sensor networks have small nodes deployed which have small batteries used for operations which consumes or dissipates more battery. As a solution for this energy efficient routing is best optimal way. An energy efficient routing protocol enhances overall performance of the nodes and there by maintains cost at minimum levels. Wireless sensor networks are very time critical some times in scenario of earthquake, volcanic eruptions as node deployed in various geographical part tend to deliver message and if some of node dies due to battery consumption can lead to heavy loss to human life's, animals and many other biotic and a biotic factors present in that location and also nearby locations. Hierarchical routing protocols are best suitable protocols in terms of saving energy in wireless sensor networks such as leach, pegasis, teen, heed. HEED plays a Hybrid Energy Efficient Distributed Role in process of data packet delivery in Devices which are highly limited battery constrained

Keywords: HEED, PEGASIS, LEACH, ADVANCED LEACH, TEEN

I. INTRODUCTION

In Wireless sensor network there are three major task:
Wireless sensor networks devices have limited energy budget to complete large task .Energy consumptions still remain the limitations. Wireless sensor networks comprise of thousands of motes which are used which are used to exchange information with the user either directly or through the external base station. Each sensor nodes send receive aggregate data from source to destination. A base station is a mobile node or may be a fixed node which has a capability of connecting the sensor network to an existing communications infrastructure or to the internet. Node performs two major task send data acting as a relay point and another is proceeding of data. [1] Sensor nodes have many applications in weather monitoring, animal capturing in zoo, disaster management. Useful energy consumption can be due to
A. Transmit and receive data
B. Processing data
C. forward this data to base station
D. Wasteful Energy Due to
1) Idle listening
2) Duplicate packet transmission
Hence controlling all above factor is not desirable what solution can play important role is use of energy efficient routing protocols which can be hybrid hierarchical less energy dissipation .

II.LITERATURE SURVEY

Sensor nodes are with limited energy budget .there is need of efficient method for designing energy efficient routing in wireless sensor network where energy, bandwidths, memory are considered strictly so as to improve performance and give out the best possible outputs in time.[4].

1. ENERGY CONSTRAINTS

- Energy is required in every mini or major operation of any type of application.
- Sensors are equipped with batteries, but these batteries do have a limited life time, e.g. in underwater scenario, there are no plug-in sockets to provide the power as per the requirement.
- The battery technology is still lagging behind the microprocessor technology. Energy-Efficient networking protocols are required now days.

2. ENERGY CONSERVATION

- Turn-off the transceiver when not required.
- Use shorter data packets for the communication.
- Multiple paths could be derived and used to reach the destination, to increase the network lifeline.
- Data should be transmitted by the source node only when the destination node is ready, so that data could be reach without error at first place.
- Avoid collisions between nodes.
- Node idle-listening and overhearing should not happen in the network working.

Multi-hop data transfer can save lots of power in the sensor network working

3. BENEFITS OF CLUSTERING IN WSN

- Grouping of similar objects or sensors in our context
  - distance or proximity
  - Logical organizing
- Topology control approach
  - Load balancing, network scalability

Types of clustering

- Static: local topology control
- Dynamic: changing network parameters
- Single hop and multi hop

Homogeneous and heterogeneous

4. ADVANTAGES OF CLUSTERING

- Transmit aggregated data to the data sink
- reducing number of nodes taking part in transmission
- Useful energy consumption
- Scalability for large number of nodes
- Reduces communication overhead for both single and multi hop

5.TYPES OF ROUTING PROTOCOLS

5.1location Based
5.2Flat Based
5.3Hierarchical

III.EXISTING METHODS

1. Hierarchical Routing Protocols
1.1LEACH

Assumptions:

- Fixed and remote base station
- Nodes homogeneous and energy constrained
- Radio channel is symmetric
- E_A-E_B=E_B-E_A

Sensing rate for all sensors fixed
Algorithm

- CH position rotated among the nodes
- energy load distributed .
- Number of active nodes in the network and the optimal number of clusters assumed *a priori*
- Nodes join a target number of CHs
- Node-CH communication-TDMA

1.2PEGASIS

- An enhancement over the LEACH protocol is a near optimal chain-based protocol
- increase the lifetime of each node by using collaborative techniques.
- allow only local coordination between nodes and the bandwidth consumed in communication is reduced
- Drawbacks:
  - assumes that each sensor node is able to communicate with the BS directly
  - assumes that all sensor nodes have the same level of energy and are likely to die at the same time
  - the single leader can become a bottleneck.
  - excessive data delay

1.3 TEEN'S

- CH sensor sends its members a hard threshold and a soft threshold.
- TEEN'S suitability for time-critical sensing applications
- TEEN is also quite efficient in terms of energy consumption and response time
- TEEN also allows the user to control the energy consumption and accuracy to suit the application.
- Reactive, event-driven protocol for time-critical applications
- A node senses the environment continuously, but turns radio on and transmission only if the sensor value changes drastically
- No periodic transmission
- Don't wait until the next period to transmit critical data

Save energy if data is not critic

Functioning

Every node in a cluster takes turns to become the CH for a time interval called cluster period At every cluster change time, in addition to the attributes, the cluster-head broadcasts to its members, a hard & a soft threshold

Hard Threshold (HT)

threshold value for the sensed attribute.
A Cluster member only reports/sends data to CH by switching on its transmitter, only if data values are in the range of interest

Soft Threshold (ST)

Small change in the value of the sensed attribute A Cluster member only reports/sends data to CH by switching on its transmitter, if its value changes by at least the soft threshold

IV.PROBLEM STATEMENT

- Understanding existing clustering algorithms and finding the problems stated and addressed
- Compare the pros and cons of each algorithm
- Simulate algorithms and compare performance with and without clustering mechanism
- Choosing the energy efficient algorithm for routing data packets in wireless sensor networks

V.PROPOSED METHODS

1. HEED (Hybrid, Energy, Efficient Distributed) Protocol

- HEED was designed to select different cluster heads in a field according to the amount of energy that is distributed in relation to a neighboring node.
- Hybrid Energy-Efficient Distributed clustering (HEED) introduced by Younis and Fahmy, is a multi-hop WSN clustering algorithm which brings an energy-efficient clustering routing with explicit consideration of energy.

Different from LEACH in the manner of CH election, [7]HEED does not select nodes as CHs randomly. The manner of cluster construction is performed based on the hybrid combination of two parameters. One parameter depends on the node's residual energy, and the other parameter is the intra-cluster communication cost. In HEED, elected CHs have relatively high average residual energy compared to MNs.

- To overcome the disadvantages of LEACH, PEGASIS, TEEN. HEED is introduced.
- Some research papers shows that HEED consumes low battery in wireless sensor networks

2. Features of HEED

- To increase energy efficiency and prolong network lifetime we can consider intra cluster communication cost as a secondary clustering parameter.
- Intra clustering communication involves communicating with other cluster heads

➢ Cost is a function of cluster properties and whether power levels are permissible for transmission within a cluster.

3. Advantages of HEED

➢ HEED distribution of energy extends the lifetime of the nodes within the network thus stabilizing the neighboring node.
➢ Does not require special node capabilities, such as location-awareness
➢ Does not make assumptions about node distribution
➢ Operates correctly even when nodes are not synchronized.
➢ Creates well distributed clusters Requires only local communication
➢ Reduces energy load
➢ Extends network lifetime
➢ The advantages of HEED are that nodes only require local (neighborhood) information to form the clusters
➢ the algorithm terminates in O(1) iterations
➢ The algorithm guarantees that every sensors is part of just one cluster, and the cluster heads are well-distributed[6].

4. Disadvantages of HEED the random selection of the cluster heads, may cause higher communication overhead for:

o the ordinary member nodes in communicating with their corresponding cluster head
o cluster heads in establishing the communication among them, or
o Between a cluster head and a base station.
➢ The periodic cluster head rotation or election needs extra energy to rebuild clusters.
➢ Communication
o Bandwidth is limited and must be shared among all the nodes in the sensor network
o Spatial reuse essential
o Efficient local use of bandwidth needed [6]

5. Implementation and Working Principle

1.HEED PARAMETERS
Parameters for electing cluster heads
a)Primary parameter : Residual energy**(E_r)**
b)Secondary parameter : Communication Cost (used to break ties)

Maximize Energy and Minimize cost

2. For Load Balancing
Cost proportional to node degree.
3. Average minimum reachable power
AMRP = Sum of all nodes minimum power to reach node Head M(number of nodes)
4. for dense cluster
Cost is inversely proportional to node degree
5. There are three phases of working
5.1 Initialization
➢ Discover neighbor with cluster range
➢ Compute initial cluster head probability
5.2 Main Processing
➢ If node receives some cluster head messages choose one head with minimum cost.
➢ If node does not have cluster head, elect to become a cluster head with $CH_{prob.}$
5.3Finalization
If cluster head is found join its cluster. Otherwise elect it to be a cluster head.

6. Procedure: screenshots of procedures and results in UBUNTU operating System and Network Simulator as main application for process

Step1: Intial nodes without clustering in Random modes in Network Simulator2 100 nodes are there.

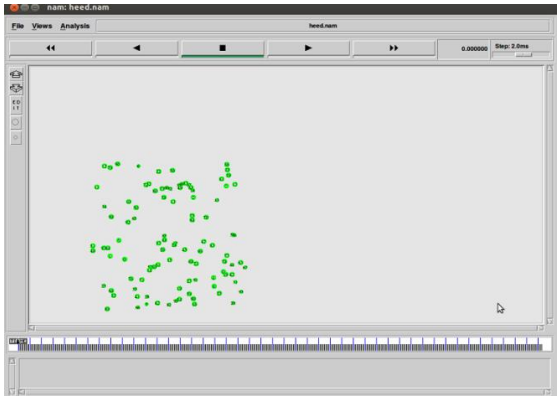

Figure .1.Random nodes in NS2 window

Step 2: Nodes started their motions

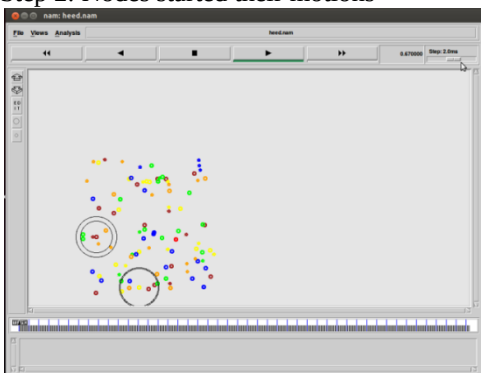

Figure.2 .Random Nodes distributions

Step.3:Progress in electing Cluster Head based on residual energy and clusters are formed accordingly and sending packets from nodes to respective their cluster Heads groups of 20 are formed.

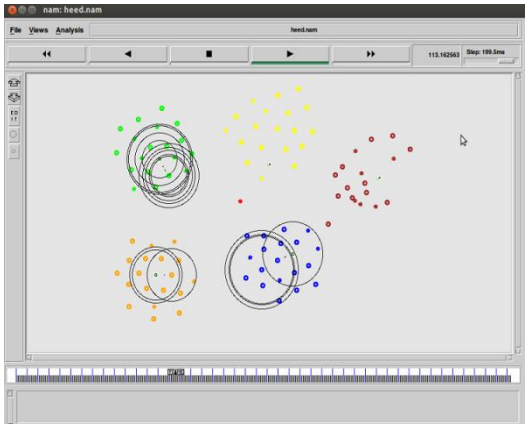

Figure.3. Nodes distributions with clusters formed and cluster head selected

Step.4: Pre final Distributions of packets from Cluster Head to Base station in red color node.

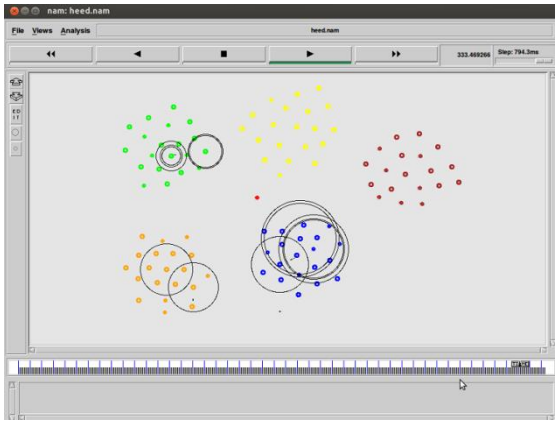

Figure.4. Nodes distributions with clusters formed and cluster head selected and about to completed process of sending and receiving the data

Step.5: nodes in well distributed manner under their own Cluster Heads and all the packets that were generated are delivered to base station

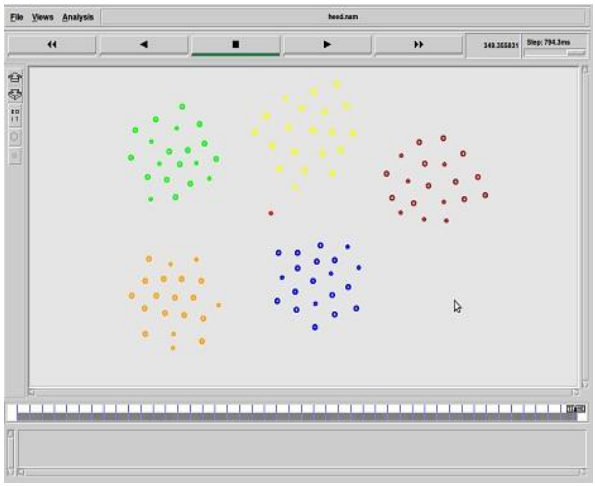

Figure.5.Cluster formed with completion of process

9.Graphs screenshots

1.Energy Graph

X axis: time

Y axis: residual energy

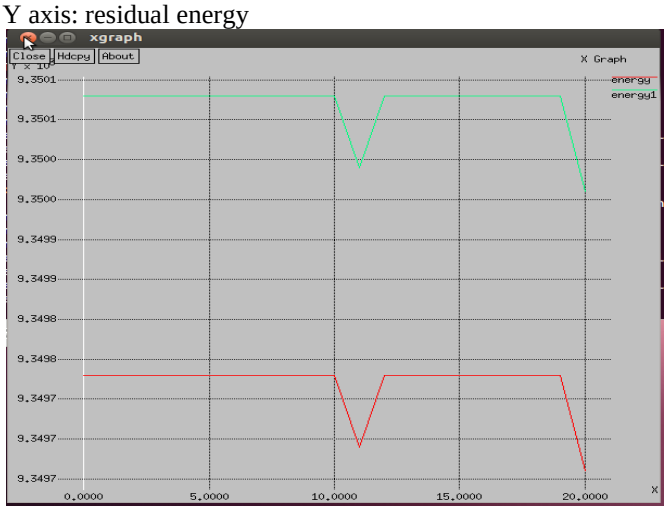

Figure.6 .Energy graph

2.Throughput

X axis: time

Y axis: throughput

Throughput = received_data*8/DataTransmissionPeriod

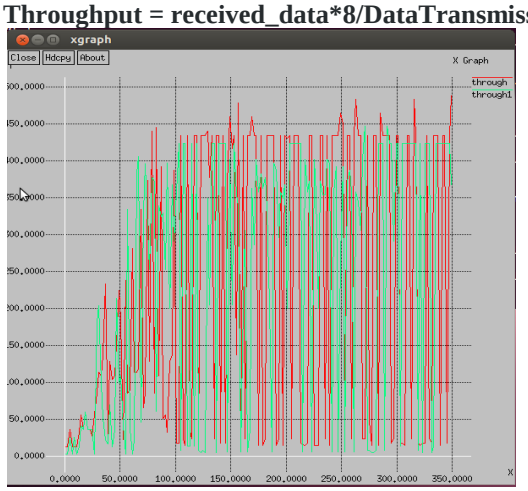

Figure.7.Throughput graph

3. Packet Delivery Ratio

X axis:time

Y axis:PDR%

packet_delivery_ratio= eceived_packets/generated_packets*100;

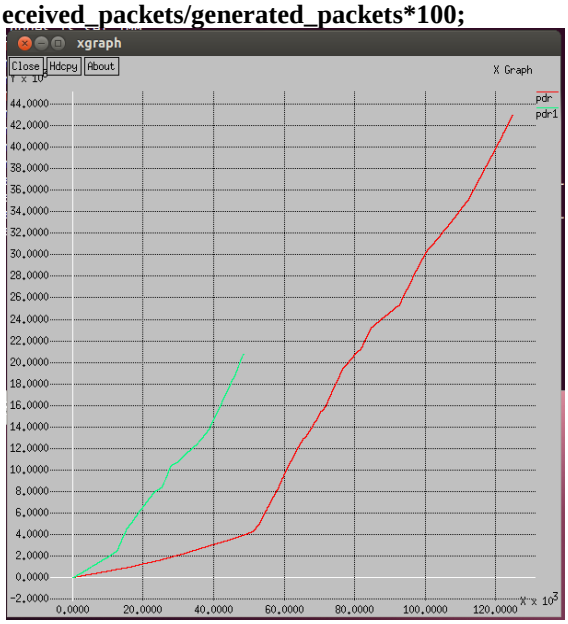

Figure. 8.PDR graph

4.RESULTS

Table.I. Proposed Method –HEED-VFF

SERIAL NUMBER	PARAMETERS	DATA RECORDED
1.	GENERATED PACKETS	43068
2.	RECEIVED PACKET	274184
3.	PACKET DELIVERY RATIO	636.63%
4.	TOTAL DROPPED PACKETS	315
5.	AVERAGE END TO END DELAY	39.7301MS

Table.2. Existing Method-HEED

Serial number	Parameters	Data recorded
1.	Generated Packets	43068
2.	Received Packet	273184
3.	Packet Delivery Ratio	536.63%
4.	Total Dropped Packets	478
5.	Average End To End Delay	44.7301MS

Requirement Analysis
Software: Oracle virtual VM BOX
Operating System: UBUNTU

VI. CONCLUSIONS

In wireless sensor networks Energy efficient algorithm should be used for real time application when there are n numbers of sensor nodes involved in communications. So as to maximize communication and there by using minimum battery of sensor nodes. LEACH and Improved version can be used but Sensor nodes dynamically form cluster. All cluster head transfer the collected information to the sink node. Hence Leach consumes battery more .The second is an enhancement over LEACH and it is near optimal chain based protocol. PEGASIS It will focus the extend the life time of network by communicate with its closest neighbor. It will avoid cluster formation and use only one node to communicate with base station instead of with multiple nodes. While connecting it transmits more battery one leader can be bottleneck. Third is TEEN Time critical data reaches the user almost instantaneously. Threshold is used and two level clusters are formed hard and soft which consumes more battery and hence there is ambiguity between data packet. It will also enhance the efficiency of wireless sensor networks. AMBIGUITY AND TRANMISSION COST ARE disadvantages. Hence HEED plays major roles as there are many advantages and disadvantages of various above protocols, HEED is more efficient in terms of all the parameters like energy, cluster hierarchy, cluster stability, cluster head formation, Packet Delivery ratio, end to end delay, total dropped packets HEED

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