Enhanced Energy Conserving Improved and Balanced LEACH for Heterogeneous Wireless Sensor Networks

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Abstract- **Wireless sensor networks consists of thousands of tiny, low cost, low power and multifunctional sensor nodes where each sensor node has very low battery life. Main goal is to conserve the transmitted energy from various sensor nodes. Various energy efficient algorithms have been designed for this. LEACH uses distributed cluster formation & randomized rotation of the cluster head to minimize the network energy consumption. Our paper propose an algorithm which is the enhancement of existing improved and balanced LEACH. It reduces the energy consumption by using various energy bank acts as saving or energy nodes. This energy bank stores the energy after each round in both routing and clustering phase which overall increases the life time of the network. In this approach, enhancement of IB-LEACH is done and results are compared through MATLA. Thsese results shows that enhanced IB-LEACH provide better approach than existing ones.**
Keywords: Adhoc, Wireless, IB-LEACH, Sensor nodes, Clustering, Simulation

1. INTRODUCTION

WSANs consist of low power microscopic sensors having wireless communication capability. Small nodes called as sensors, these networks provide three essential functions. Firstly they are used in real time system to monitor physical and environmental conditions such as humidity, temperature, pressure etc. secondly these networks provide reliable and efficient communication via wireless network. Third, these networks are used to monitor and control traffic conditions. It gives intelligence to the network and increases the sensing power of the network. These networks can operate on switches and monitor and other devices. Sensors of wireless networks are disturbed in an Adhoc manner. These networks have various algorithms and protocols which is having self-organizing capabilities. These sensor nodes work together to perform various tasks and then gathered information is processed to get required results.

1.1 Layered Architecture

Layered architecture of wireless sensor network consists of three layers.
1) Base Station (BS): It is a powerful base station from where other layers arrive.
2) Sensor nodes Layer: Layers of sensor nodes around BS.
3) I Layer: All nodes i-hop away from BS

Base station location is very significant and for multihop networks it is very challenging. Size of sensor nodes can be changed and these changes put a great impact on the wireless sensor networks. Various layers are used in this network. Size of sensor nodes puts the effect on resources of the network. Today sensor networks are used in all fields such as Industrial, commercial and other number of applications.
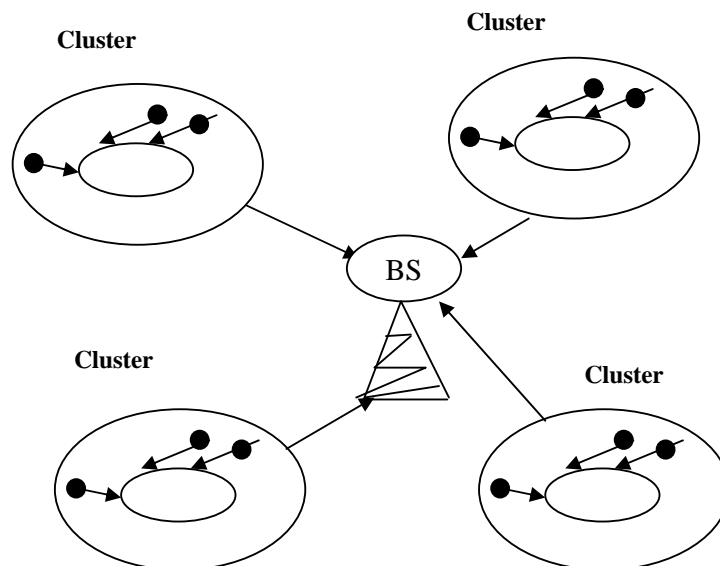
Figure1: Clustered Architecture of WSN

Characteristics of Clustered Architecture
- Organizes the sensor nodes into clusters
- Each cluster is governed by a cluster-head
- Only heads send messages to a BS
- Suitable for data fusion
- Self-organizing

1.2 Challenges of Wireless Sensor Networks

Today is the era of Wireless sensor networks, although these networks have to face lot of challenges. Various algorithms are developing day by day to enhance the speed, accuracy of the wireless sensor networks. Research is going on in this field. Here are some challenges faced by wireless sensor networks:

a) Sensor nodes are power constrained, they have very less energy and it is very difficult to reserve the energy while the nodes are transmitting the bits.
b) These networks are dynamic in nature and must be able to adapt environment changes and requirements automatically. It may be the case that sometime new nodes are inserted in the network and previous nodes are deleted from the network. With this position of the networks may change, which sometimes lead to change in position, energy, tasks and reach ability of the network.
c) These networks must be self-configured because of dynamic environment changes.
d) Global IP addressing scheme of wired networks can't be applied to wireless sensor networks.
e) Transmitted data contains redundant data as multiple sensors can send redundant data at the same time. So many protocols are used to conserve the energy level of the various sensor nodes.
f) There are so many nodes in the network, so it is very difficult to trace hundreds, thousands nodes of the networks.
g) Sensor nodes are application specific in nature. So protocols must be designed with care.

1.3 Applications of Wireless Sensor Networks

It has several applications but the most important application is traffic control and monitoring. It is also used in some other areas such as:

a) Vehicle Tracking
b) Cory Energy Monitoring
c) Glaser and CalTech
d) Node Localization
e) Military Applications
f) Commercial Applications
g) Impacting Earthquake
h) Asset Management etc.

2. ROUTING PROTOCOLS

Routing protocols provides the route to the packets. It gives the path where data can be sent with shortest path method. Data should be sent with low expense and with high accuracy. Routing protocol can be divided into two categories. First is flat routing and second is hierarchical routing. These routing depends on the structure of the network. In flat routing, there is no ay hierarchy; all the nodes play some role. In hierarchical routing, clustering method is used in which some nodes are assigned specific functionalities. A cluster is a set of geographically proximal sensor nodes in which one node acts as a cluster head. These cluster heads are further organized into hierarchical levels.

3. PREVIOUS CLUSTERING METHOD OF LEACH

The Sensor node which is having 2AA battery can last up to three years, this makes routing a challenge in wireless sensor networks. To increase the life time of the sensor nodes, clustering approach is used.
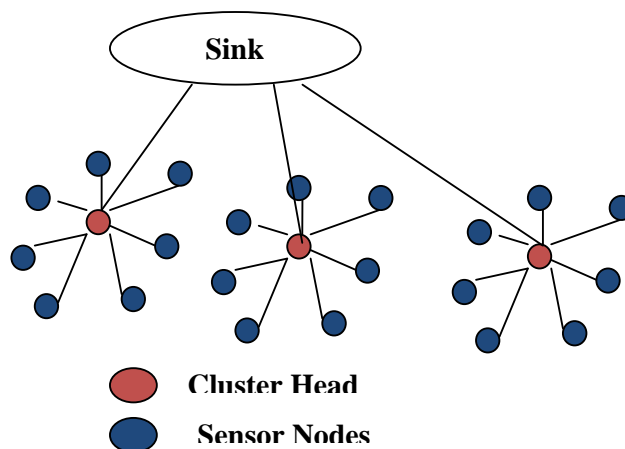

Figure2: Clustering Based on LEACH

LEACH is a hierarchical clustering algorithm for sensor networks. It has two phases. One is Cluster set up phase and other is a steady state phase. Each node start with a random number 0 and 1, if the number is less than threshold T(n), the node becomes cluster-head for current round. Cluster is the combination of various sensor nodes. In this technique cluster head is selected after every round. Residual energy is selected so that equal energy is given to all the nodes.

Every cluster head sends the data to its own cluster head with in the TDMA time schedule, so that data will be sent timely. It is transmitted in two ways. Firstly, data is transmitted to cluster head nodes in their assigned TDMA slot and in second step the data aggregation take place from cluster head to sink. The frame time for this purpose is defined as follows:

Frame Time = (CAT+S) X Ts

CAT - It is the number of time slots for data aggregation and transmission from cluster head to Base station.

S - Number of nodes during a particular round in TDMA schedule of clusters.

Ts - Time required for sensor node to transmit data frame to their corresponding cluster head.

Sensor nodes move to sleep mode after sending the data, as the sensor node are adaptable.

3.1 IB- LEACH

IB-LEACH transmitted the data through gateways. With this, capacity of the nodes increases called as life time of the sensor nodes.
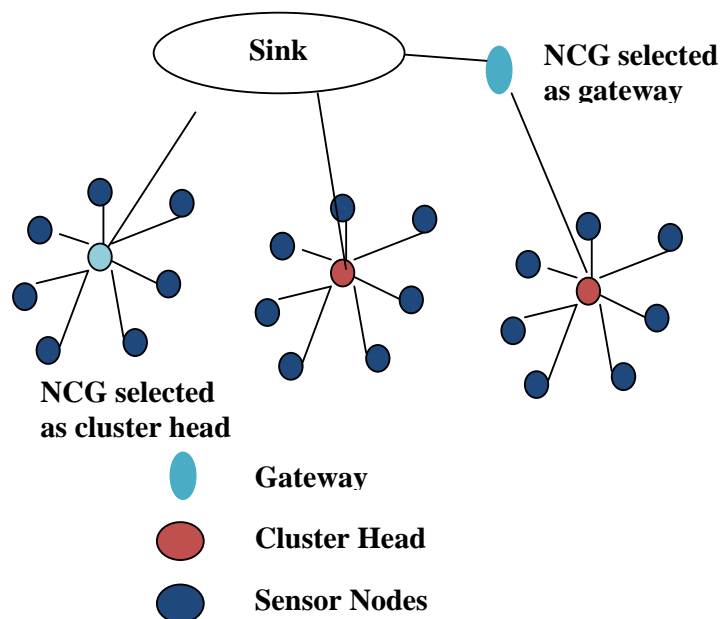
Figure 3: IB-LEACH using gateway

A Stable Election Protocol) protocol was used to improve the LEACH protocol. It provides heterogeneity in the wireless sensor networks. This protocol provides LEACH like operation but this protocol has two different level of energy. Two tier clustering is used in SEP. in this approach, cluster head election is randomly selected and distributed based on the fraction of energy of each node assuring a uniform use of the nodes energy. SEP based on weighted election probabilities of each node to become cluster head according to their respective energy. In this some NCG are selected as cluster head and others as gateways. IB-LEACH distributes the energy load evenly among various sensor nodes. IB_LEACH is a self-organizing, adaptive clustering protocol. It does randomized rotation of the high-energy cluster-head position in such a way that various sensor nodes drain the energy from a single sensor. At any time sensor nodes can elect themselves to be a gateway. Base station confirms gateway nodes whether the node elected are suitable for gateway or not. Gateway nodes or cluster head nodes broadcast their status via advertisement message (ADV) to the other sensor nodes in the network. Non gateway nodes can also elect themselves as a cluster head with a certain probability. These cluster head nodes broadcast their status via advertisement message (ADV) to the other sensor nodes in the network.

4. PROPOSED WORK

4.1 Enhanced IB- LEACH

Proposed method is the extension of existing IB-LEACH. In this method, NCG nodes are distributed based on the cluster head which reduces the energy consumption of the cluster head and thus increases the life time of the network. Results are checked through MATLAB, which shows that enhanced IB-LEACH gives better performance than the existing IB- LEACH.

4.2 MATLAB parameters

100m×100m region of 100 sensor nodes are scattered randomly. MATLAB is used to implement the simulation. Fair comparison is done by introducing advanced energy levels to LEACH and SEP nodes with same settings as in IBLEACH protocol, so as to assess the performance of these protocols in the presence of heterogeneity.

4.3 MATLAB Results: RESULTS AND DISCUSSIONS
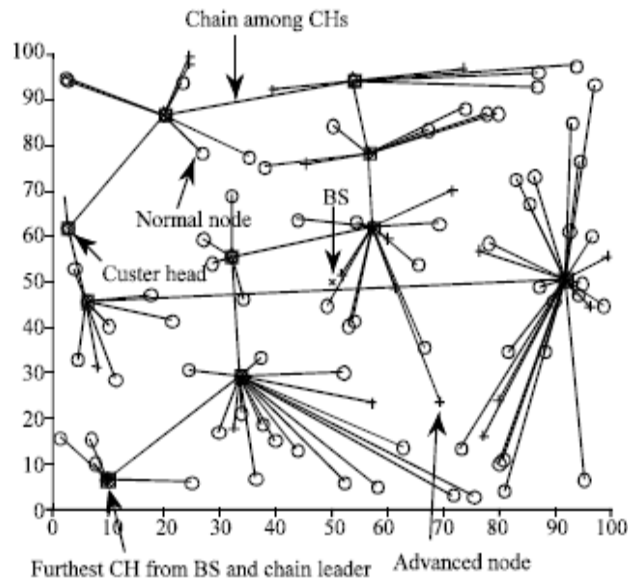
a) CHs are shown from Base Station and chain leader.

Figure 4: Base Station CHs

Normal nodes are combined together to make a cluster head.
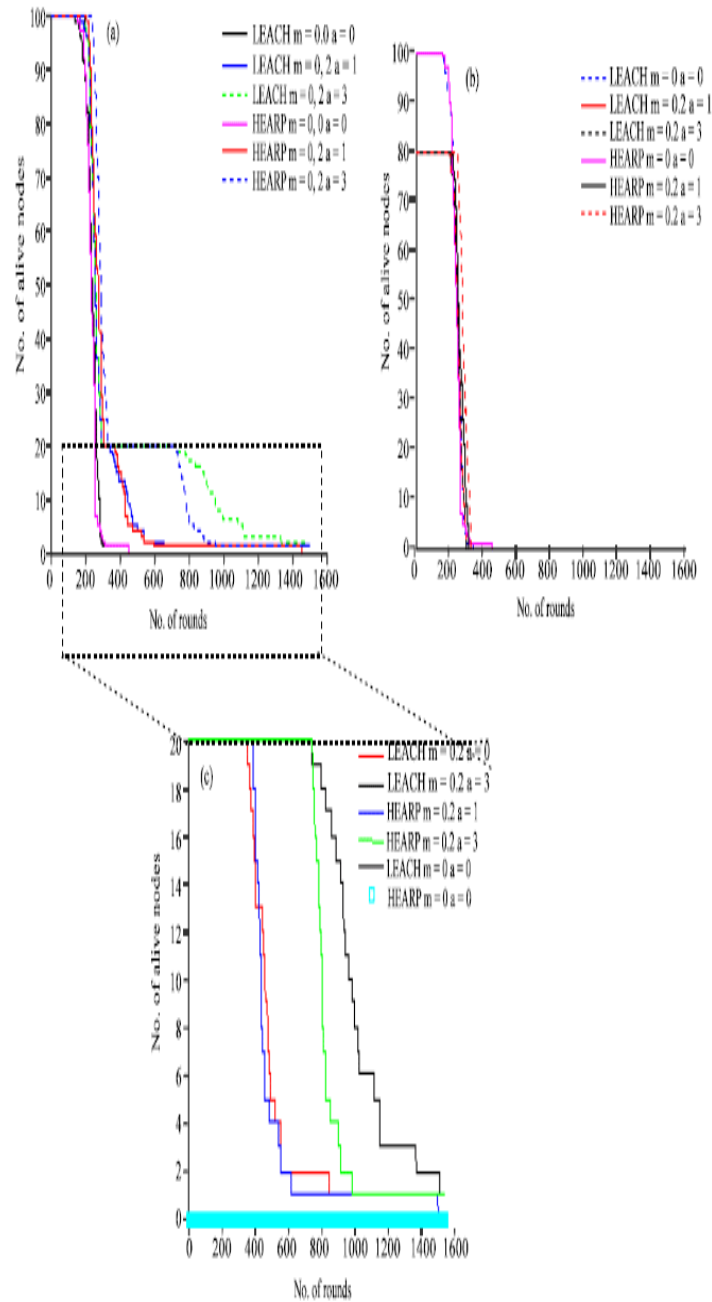   b)   Comparison is done using various different parameters as shown in graph.

Figure 5: comparison with different data

c) Various parameters are used to show the difference between existing and enhanced IB-LEACH. This graph is between numbers of alive nodes versus number of rounds.
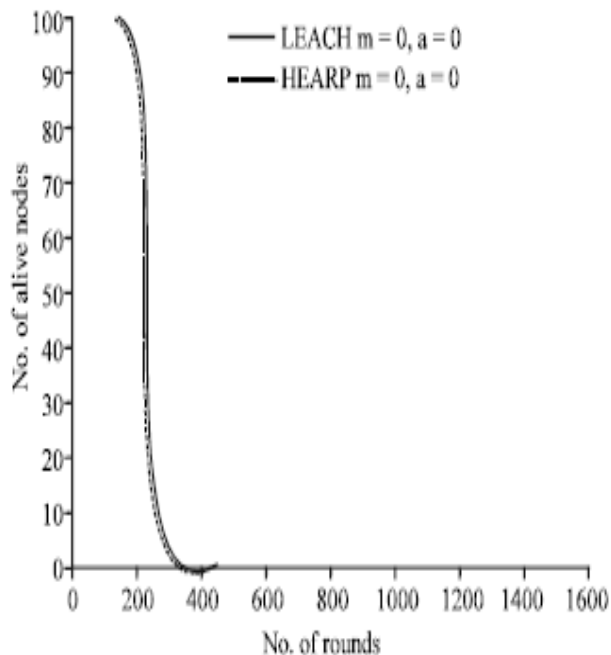
Figure 5: Alive nodes Vs. Round

d) Proposed IB-LEACH: Enhanced IB-LEACH is shown in two graphs 6(a) and 6(b) for both homogenous and heterogeneous networks.
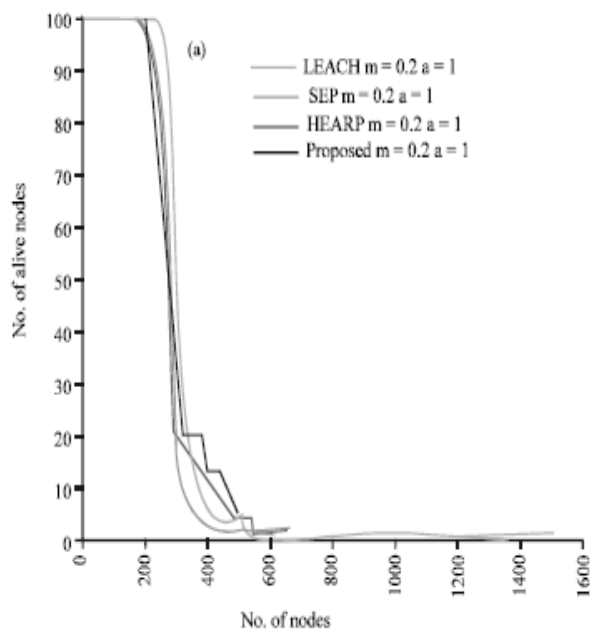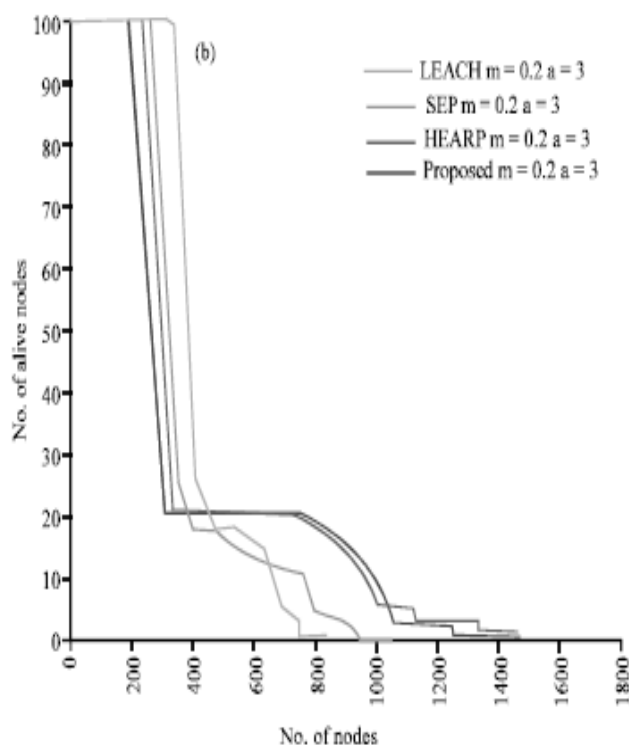

Figure 6a): Enhanced IB-LEACH

Figure 6b): Enhanced IB-LEACH

5. CONCLUSION AND FUTURE WOK

Wireless sensor networks consists of thousands of tiny, low cost, low power and multifunctional sensor nodes where each sensor node has very low battery life. Various energy efficient algorithms have been designed for this. LEACH uses distributed cluster formation & randomized rotation of the cluster head to minimize the network energy consumption. This paper is proposing an algorithm which is the enhancement of existing IB-LEACH. MATLAB is used to implement the simulation. Fair comparison is done by introducing advanced energy levels to LEACH and SEP nodes with same settings as in IBLEACH protocol, so as to assess the performance of these protocols in the presence of heterogeneity. Enhanced IB-LEACH is designed for both homogenous and heterogeneous networks. The field of wireless sensor network is very challenging and recent. Various static methods and parameters can improve the performance of the network. Research can be done on choice of cluster head. Cluster head can be chosen based on the density of nodes.

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