Efficient Cluster Head Selection Scheme for Data Aggregation in Wireless Sensor Network

Kiran Maraiya
Department of Computer Science and Engineering
National Institute of Technology Hamirpur, (H.P)

Kamal Kant
Department of Computer Science and Engineering
ASET, Amity University
Uttar Pradesh, Noida

Nitin Gupta
Department of Computer Science and Engineering
National Institute of Technology Hamirpur, (H.P)

ABSTRACT
A wireless sensor network is a resource constraint network, in which all sensor nodes have limited resources. In order to save resources and energy, data must be aggregated, and avoid amounts of traffic in the network. The aim of data aggregation is that eliminates redundant data transmission and enhances the life time of energy in wireless sensor network. Data aggregation process has to be done with the help of effective clustering scheme .in this paper we gives new scheme related to clustering for data aggregation called "Efficient cluster head selection scheme for data aggregation in wireless sensor network" (ECHSSDA), also we compare our propose scheme to the LEACH clustering algorithm. Comparison is based on the energy consumption, cluster head selection and cluster formation. In which we predict that, our propose algorithm is better than LEACH in the case of consume less energy by the cluster node and cluster head sending data to the base station consume less energy as better then LEACH.

Keywords
Sensor network, clustering, Data aggregation, sensor node, associate cluster head

1. INTRODUCTION
This wireless sensor networks is depends on a simple equation: Sensing + CPU + Radio = Thousands of possible applications. A wireless sensor network is type of wireless network. It is small and infrastructure less .basically wireless sensor network consist a number of sensor node, called tiny device and these are working together to detect a region to take data about the environment. Wireless sensor network has two types: structured and unstructured. if we talk about unstructured so is a collection of sensor nodes. And these deployed in adhoc manner into a region. Once deployed, the network is absent unattended perform monitoring and reporting functions. In other structured wireless sensor network, the all sensor nodes are deployed in pre designed manner. The benefit of structure wireless sensor network is that some nodes can be deployed with lower network maintenance and management cost. Fewer nodes can be deployed now since nodes are placed at specific locations to provide coverage while ad hoc deployment can have uncovered regions. Wireless sensor network aim is to provide efficient connection among the physical environmental condition and internet worlds. The sensor nodes of the wireless sensor network is allows random deployment in inaccessible terrains, this means protocol of the wireless sensor is self organized, another important feature of the wireless sensor network is cooperative effort of the sensor nodes. Sensor nodes are collecting data about environment, after collecting it they process it and then transmit to the base station. Base station provides a interface between user and internet. Basic characteristic of the wireless sensor network are limited energy, dynamic network topology, lower power, node failure and mobility of the nodes, short-range broadcast communication and multi-hop routing and large scale of deployment. Figure 1 show the basic architecture of the wireless sensor network in which sensor node deployed in the sensor fields and they communicate with each other for collect the information from the environment, or directly send to the base station basically base station act as a gateway. With the help of gateway data is transmitting to the internet. Because users are directly connect to the internet. A sensor nodes that generates data , based on its sensing mechanisms observation and transmit sensed data packet to the base station (sink). This process basically direct transmission since base station is may located very far away from sensor nodes needs more energy to transmit data over long distances so that better techniques is to have fewer nodes sends data to the base station. These nodes called aggregator nodes and processes called data aggregation in wireless sensor network.

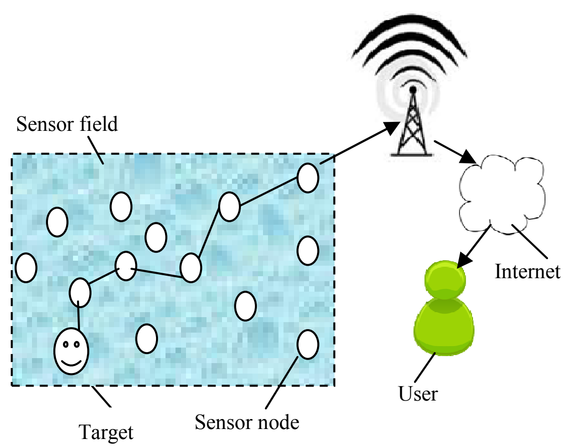


Fig.1 Architecture of wireless sensor network

2. RELATED WORK
2.1 Clustering
Sensor node are densely deployed in wireless sensor network that means physical environment would produce very similar data in close by sensor node and transmitting such type of data is

more or less redundant. So all these facts encourage using some kind of grouping of sensor nodes such that group of sensor node can be combine or compress data together and transmit only compact data. this can reduce localized traffic in individual group and also reduce global data .this grouping process of sensor nodes in a densely deployed large scale sensor node is known as clustering. The way of combing data and compress data belonging to a single cluster called data aggregation. Issues of clustering in wireless sensor network: (a) How many sensor nodes should be taken in a single cluster. Selection procedure of cluster head in a individual cluster.(b) Heterogeneity in a network, it means user can put some power full nodes, in term of energy in the network which can behave like cluster head and simple node in a cluster work as a cluster member only.Many protocol and algorithm have been proposed which deal with each individual issue.

2.2 Clustering Based Protocol for Data Aggregation

LEACH (LOW-ENERGY ADAPTIVE CLUSTERING HIERARCHY) is a cluster-based energy efficient routing protocol, which reduce the number of transmissions towards to the BS. In other words, it reduces network traffic and the contention for the channel. LEACH has motivated the design of several other protocols which try to improve upon the CH selection process. The Protocols basically differ depending on the application and network architecture used in their design. There are number of clustering –based routing protocols proposed in literature for WSNs [2]. These protocols show better energy consumption and performance when compared to flat large-scale WSNs, but it also increase the overhead to configure and maintain. LEACH [3, 16] is one of the first hierarchical routing approaches for WSNs.

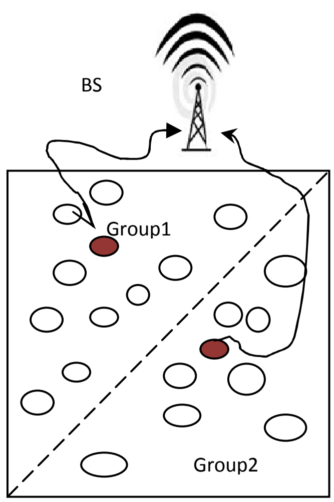


Fig. 2 Cluster-based mechanism inWSNs

It is a cluster-based protocol that utilizes randomized rotation of local base stations (CHs) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic networks, and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the BS. In LEACH nodes organize themselves into clusters. The sensor node in cluster sends data to CH, CH aggregates the data and sends it to BS. The working of LEACH is broken up into *rounds*. Each round consists of two phases: set-up phase and steady-state phase. Set-up Phase divided into Advertisement Phase and Cluster Set-up Phase. Or Steady Phase included Schedule Creation and Data Transmission. Initially, when clusters are being created, each node decides whether or not to become a CH for the current round. This decision is based on the suggested percentage of CHs for the network (determined a priori) and the number of times the node has been a CH so far. This decision is made by the node n choosing a random number between 0 and 1. If the number is less than a threshold $T\ n$ the node becomes a CH for the current round. The threshold is set as:

$$T(n) = \begin{cases} \dfrac{P}{1 - P * (r \bmod \frac{1}{P})} & if\ n \in G \\ 0 & otherwise \end{cases}$$

where P is the desired percentage of CHs (e.g. P =0.05), r is the current round, and G is the set of nodes that have not been CHs in the last $1/P$ rounds. Using this threshold, each node will be a CH at some point within $1/P$ rounds. Each node that has elected itself a CH for the current round broadcasts an advertisement message to the rest of the nodes. For this "CH-advertisement" phase, the CHs use a CSMA MAC protocol, and all CHs transmit their advertisement using the same transmit energy. The non-CH nodes must keep their receivers on during this phase of set-up to hear the advertisements of all the CH nodes. After this phase is complete, each non-CH node decides the cluster to which it will belong for this round. This decision is based on the received signal strength of the advertisement. After each node has decided to which cluster it belongs, it must inform the CH node that it will be a member of the cluster. Each node transmits this information back to the CH again using a CSMA MAC protocol. During this phase, all CH nodes must keep their receivers on. The CH node receives all the messages for nodes that would like to be included in the cluster. Based on the number of nodes in the cluster, the CH node creates a TDMA schedule telling each node when it can transmit. This schedule is broadcast back to the nodes in the cluster. Once the clusters are created and the TDMA schedule is fixed, data transmission can begin. Nodes send it during their allocated transmission time to the CH. This transmission uses a minimal amount of energy. The radio of each non-CH nodes can be turned off until the node's allocated transmission time, to minimizing energy dissipation in these nodes. The CH must keep its receiver on to receive all the data from the nodes in the cluster. When all the data has been received, the CH performs data aggregation. This aggregated data is sent to the BS. This transmission takes high-energy because BS is far away from CH.After a certain time, the next round begins with each node determining if it should be a CH for this round and advertising this information. LEACH protocol suffers from many drawbacks such like: CH selection is randomly, that does not take into account energy consumption, it can't cover a large area, CHs are not uniformly distributed; where CHs can be located at the edges of the cluster and CHs direct communicate with BS. PEGASIS [5] is an improvement of LEACH protocol. It is a near optimal chain-based protocol.

The sensor nodes form chain so that each node can transmit and receive from a neighbour and only one node is selected from that chain to transmit to the BS. Data gathered by sensor nodes moves from node to node, aggregated and finally sent to the BS [2]. The chain construction is performed in a greedy fashion by sensor nodes or centralized manner by the BS and broadcast to all nodes. In order to extend the lifetime of network the basic idea of the protocol is that, in order to extend the network lifetime, all nodes communicate only with their closest neighbours, which in turn communicate to the BS. A round ends, when all the nodes communicate with the BS. This reduces the power required to transmit data per round. It also guarantees that the depletion in power in each node is uniformly distributed. PEGASIS increases the lifetime of each node by using collaborative techniques. It allows only local coordination between nodes that are close together so that the bandwidth consumed in communication is reduced. PEGASIS outperforms LEACH by eliminating the overhead of dynamic cluster formation, minimizing the distance non-CH nodes must transmit, limiting the number of transmissions and receptions among all nodes, and using only one transmission to the BS per round. However, PEGASIS introduces excessive delay for distant node on the chain. In addition the single leader can become a bottleneck. Hierarchical-PEGASIS [7] is an extension to PEGASIS, which aims at decreasing the delay incurred for packets during transmission to the BS. This is achieved by performing simultaneous transmission of data between neighbouring nodes and then to the BS (as shown in [2]. However this leads to collision in the medium. To avoid collisions and possible signal interference among the sensors, two approaches have been used: a) incorporates signal coding, e.g. CDMA and b) only spatially separated nodes are allowed to transmit at the same time. The chain-based protocol with CDMA capable nodes, constructs a chain of nodes, that forms a tree like hierarchy, and each selected node in a particular level transmits data to the node in the upper level of the hierarchy. This method ensures data transmitting in parallel and reduces the delay significantly. TEEN (Threshold-Sensitive Energy Efficient Protocols) Threshold sensitive Energy Efficient sensor Network protocol (TEEN) [8] is a hierarchical protocol designed for time-critical applications and in which the network operated in a reactive mode. TEEN uses a hierarchical approach along with the use of a data-centric mechanism. The closer sensor nodes form clusters and process goes on the second level until BS is reached [8]. After the clusters are formed, the CH broadcasts two thresholds to all nodes in the cluster. These are hard and soft thresholds for sensed attributes. (1) A hard threshold is a particular value of an attribute beyond which a node can be triggered to transmit data. Thus, the hard threshold allows the nodes to transmit only when the sensed attribute is in the range of interest. (2)A soft threshold is a small change in the value of an attribute which can trigger a node to transmit data again. Once a node senses a value at or beyond the hard threshold, it transmits data only when the value of that attributes changes by an amount equal to or greater than the soft threshold. Thus hard threshold and soft threshold reduce the number of transmissions and save the energy. User can adjust both hard and soft threshold values in order to control the number of packet transmissions. When CHs change, new values for the above parameters are broadcasted. The drawback of this scheme is that if the thresholds are not received, the nodes will never communicate and the user will not get any data from the network at all. To avoid collision TDMA scheduling is used, but this will however introduce a delay in the reporting of the time-critical data. TEEN is not good for applications where periodic reports are needed. TEEN outperforms LEACH. The main disadvantage of the TEEN is the overhead with forming and maintaining clusters at two levels, as well as the complexity associated with implementing threshold-based functions, and how to deal with attribute-based naming of queries. APTEEN (Adaptive Periodic TEEN) The architecture of APTEEN [9] is same as in TEEN and an extension to TEEN. APTEEN is capturing periodic data collections and reacting to time-critical events. When the BS forms the clusters, the CHs broadcast the attributes, the threshold values, and the transmission schedule to all nodes. APTEEN outperform LEACH. APTEEN send data periodically to BS. The main disadvantage of the APTEEN is the overhead with forming and maintaining clusters at two levels, as well as the complexity associated with implementing threshold-based functions, and how to deal with attribute-based naming of queries. HEED (Hybrid Energy-Efficient Distributed clustering) [10] is a distributed clustering protocol that considers a hybrid of energy and communication cost to elect the CH. The HEED clustering operation is invoked at each node in order to decide if the node will elect to become a CH or join a cluster. A node with high residual energy has a higher chance to become a CH. The intra-cluster communication cost which is used to "break ties", that is nodes that are common to more than one CH. Cluster size and transmission power level of both intra – communication and inter-communication are considered as functions to determine the communication cost. HEED outperforms LEACH in terms of prolonging network lifetime for a large network by distributing energy consumption. HEED can be applied to design sensor network that require energy efficiency, scalability, prolonged network lifetime, fault tolerance and load balancing. Hierarchical cluster-based routing (HCR) [11] technique is an extension of the LEACH protocol that is a self-organized cluster-based approach for continuous monitoring. The HCR protocol is to generate energy-efficient clusters for randomly deployed sensor nodes and the energy-efficient clusters are retained for a longer period of time; the energy-efficient clusters are identified using heuristics-based approach. The BS determines the cluster formation. A Genetic Algorithm (GA) is used to generate energy-efficient hierarchical clusters. The BS broadcasts the GA-based clusters configuration, which is received by the sensor nodes and the network is configured accordingly. In HCR, each cluster is managed by a set of associates called the head-set; using round-robin technique, each associate member acts as a CH. The role of a CH is energy consuming, after a specified number of transmissions, a new set of clusters are formed. In other words, the clusters are maintained for a short duration called a *round*. A round consists of an election phase and a data transfer phase. In an election phase, the sensor nodes self-organize into a new set of clusters, where each cluster contains a head-set [12]. In data transfer phase, CH receives messages from the cluster members and transmits the aggregated messages to a distant BS. All the transmissions are single-hop, cluster members transmit short-range broadcast messages and CHs transmit long-range broadcast messages. At the end of each round, all the clusters are not destroyed, however, cluster is retained for the number of rounds equal to the head-set size. In other words, the nodes of clusters with the head-set size of 1 become candidates in the next round but the nodes of the clusters with the head-set size greater than 1 do not participate in the next election. This approach reduces the number of CH elections. For the next election, the percentage of headers is decreased according to the number of retained clusters. The retaining of clusters in HCR protocol results in a significant amount of improvement compared to the LEACH protocol. Distributive Energy Efficient Adaptive Clustering (DEEAC) [13] is an enhancement over the LEACH protocol. It is an optimal cluster- based protocol with the basic idea to extend network lifetime. The design of protocol considers the data reporting rates and residual energy of each node within the network. Moreover the protocol is adaptive and cluster formation is done based on the spatio-temporal variations in data reporting rates across different regions. The regions in the network having high data generation rate are considered to be "hot regions". "Hotness" value of a node is a parameter indicating the data generation rate at that node relative to the whole network. The DEEAC considers two additional parameters for CH selection. These parameters are the residual energy of a node and the hotness of the region sensed by the node. The main principle of DEEAC algorithm is to choose nodes with high residual energy and greater hotness values as CHs. This can be achieved by making some beneficial adjustments to the threshold T(n) proposed in LEACH. Modified T(n) is denoted in Eq.

$$T(n) = \left\{ k \times \frac{E_{res}}{E_{est_{net}}} \times Hotness\_factor \right\}$$

Using this equation each node decides whether or not to be a CH for the current round, where k is the optimal number of CH nodes per round, E_{res} is the residual energy of the node and $E_{est_{net}}$ is the estimate of the residual energy of the network. *Hotness_factor* is the relative hotness of the node with respect to the network. DEEAC selects a node to be a CH depending upon its hotness value and residual energy. This is an improvement over stochastic approach used in LEACH in terms of energy efficiency. DEEAC's distributive approach is more energy efficient than the centralized approach. DEEAC evenly distributes energy-usage among the nodes in the network by efficiently adapting to the variations in the network, optimal CH selection saves a large amount of communication energy of sensor nodes. This increases the lifetime of the system. Distributed Energy-efficient Clustering Hierarchy Protocol (DECHP)[14], which distributes the energy dissipation evenly among all sensor nodes to improve network lifetime and average energy savings. DECHP uses a geographical and energy aware neighbour CHs selection heuristic to transfer fused data to the BS. DECHP uses a class-based addressing of the form <Location-ID, Node-Type-ID>. The Location-ID identifies the location (by GPS or some localization system) of a node that conducts sensing activities in a specified region of the network. It is assumed that each node knows its own location and remaining energy level. Each node within the cluster is further provided with a Node-Type-ID that describes the functionality of the sensor such as seismic sensing, thermal sensing, and so on [15].DECHP operates in two major phases: setup and data communication. In setup phase, cluster setup and CH selection, routing paths between CHs formation, and schedule creation for each cluster are main activities. The data communication phase consists of three major activities: Data gathering, Data fusion and Data routing. Sensor nodes are geographically grouped into clusters, these transmissions consume minimal energy due to small spatial separations between the CH and the sensing nodes. Once data from all sensor nodes have been received, the CH performs data fusion on the collected data send to the BS via the routing path created between CHs.

LEACH-C (LEACH-Centralized) [18] protocol is an enhancement of LEACH. It uses a centralized clustering algorithm to elect CH and same steady –state phase as LEACH. During the set-up phase of LEACH-C, each node sends information about it to BS –current location (possibly determined using GPS) and residual energy level. To determining good clusters, the BS needs to ensure that the energy load is evenly distributed among all the nodes. For this, BS computes the average node energy, and determines which nodes have energy below this average. And nodes have energy below this average cannot be CHs for the current round. Once the CHs and associated clusters are found, the BS broadcasts a message that obtains the CH ID for each node. If a CH ID matches its own ID, the node is a CH; otherwise the node determines its TDMA slot for data transmission and goes sleep until its time to transmit data. LEACH uses distributed clustering algorithm and offers no guarantee about the placement and/or number of CHs. LEACH-C protocol can produce better performance by dispersing the CHs throughout the network. CM (Clustering-based data-gathering protocol with mobility) CM [22, 23] is a clustering-based and time-driven protocol which minimizes energy dissipation for data gathering with mobile sensor nodes. In this protocol, the cluster formation is done based on node's mobility. Each node has a GPS device attached to them that calculate its speed and direction. The sensor node uses the information obtained from GPS device to estimate its distances from all other CHs. This estimate helps the nodes to decide the cluster to which it needs to associate. Clustering-based data-gathering protocol works in rounds. Each round has two major phases: organizing clusters and message transmission. In organizing clusters phase consist of two steps- one step is to elect the CHs and then the following step is to form the clusters. CM protocol provides two distributed algorithms (CM-IR and CM-C) which avoid the case that there is no CH in a round. The first algorithm is based on LEACH but it skips the round which has no CHs elected. The second distributed algorithm uses the unique IDs of the sensor nodes and decides the CHs by counting. This protocol prolongs the lifetime of network as compare to LEACH. It considers node mobility.

3. PROBLEM DEFINITION

Clustering is efficient scheme for data aggregation in the wireless sensor network. In which each sensor node sends data to the aggregator node means cluster head (CH) and then cluster head perform aggregation process on the received data and then send it to the base station (BS). Performing aggregation function over cluster-head still causes significant energy wastage. In case of homogeneous sensor network cluster-head will soon die out and again re-clustering has to be done which again cause energy consumption. In this paper we would like to propose an algorithm that performs data aggregation process within a cluster. In this propose algorithm we will focus on avoiding reclustering, reduce the overhead of clustering process, reduce the load over cluster head, and reduce the energy consumption within cluster in large-scale and dense sensor networks with the help of cluster head selection and cluster formation. To achieve these objectives we would like to present an algorithm in which

CHs are selected from same cluster in each round and data are sent to CH in multi-hop manner to prolong the lifetime of network.

4. NETWORK AND ENERGY MODEL

Consider a homogeneous network of n sensor nodes and a base station node distributed over a area. The location of the sensors and the base station are set and known priori. Sensor nodes location aware,i.e, equipped with GPS capable antenna. Nodes are left unattended after deployment. Therefore, battery recharge is not possible. Efficient, energy-aware sensor network protocols are thus required for energy conservation. All node have similar capabilities and equal significance. This motivates the need for extending the lifetime of every sensor. Each sensor produces some information as it monitors its surrounding area. We suppose that the whole network is separated in to a number of clusters; each cluster has a cluster-head (CH). The clustering and the selection of cluster-head (CH) can be done by using any existing protocol like LEACH, such that cluster-head (CH) is maximum k-hop away from any node in cluster. We also suppose that after the formation of cluster the transmission power of all nodes is adjusted in such a way that they can perform single hop broadcast.

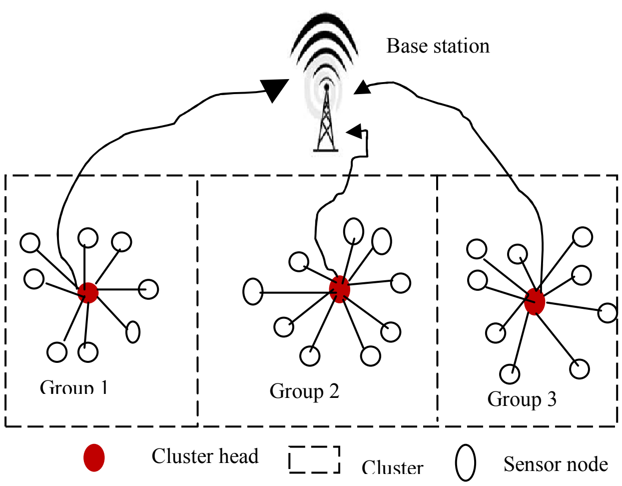


Fig 3: Sensor Network Model

Our energy model for the sensors is based on the first order radio model described in [17]. A sensor consumes Eelec = 50nJ/bit to run the transmitter or receiver circuitry and Eamp = $100pJ/bit/m^2$ for the transmitter amplifier. Thus, the energy consumed by a sensor *i* in receiving a N-bit data packet is given by,

$$E_{Rxi} = E_{elec} . N \qquad (1)$$

While the energy consumed in transmitting a data packet to sensor *j* is given by,

$$E_{Txi,j} = E_{elec} . N + E_{amp} . d^2_{i,j} . N \qquad (2)$$

5. PROPOSED ALGORITHM

In Efficient cluster head selection scheme for data aggregation in wireless sensor network" (ECHSSDA) approach, In which cluster contains; Cluster head (CH) is responsible only for received data from the cluster members, perform aggregation process over the received data and then to the BS), Associate CH the node that will become a CH of the cluster in case of CH energy below from average energy, cluster nodes gathering data from environment and send it to the CH. In case of LEACH the CH will die earlier than the other nodes in the cluster because of its operation of receiving, sending and overhearing. When the CH die, the cluster will become useless because the data gathered by cluster nodes will never reach the base station because of sensor node have resource constraint in the network. There for selection of cluster head become important, cluster-head is selected based on the energy and that sensor node is selected as a CH (cluster-head). While processing of Cluster-head node the energy become reduce, so if the energy of CH is becomes below to the non cluster head nodes energies means next round should be processed. In the next round, the Associate cluster-head should be made as a lead while selection of cluster-head for the first round, so no need to select the cluster-head for next round. ECHSSD reclustering, reduce the overhead of clustering process, reduce the load over cluster head, and reduce the energy consumption within cluster in large-scale and dense sensor networks with the help of A approach consumes limited energy to send the data. also avoiding cluster set up phase and cluster steady phase. In Efficient cluster head selection scheme for data aggregation in wireless sensor network" (ECHSSDA) approach works in two phases namely: Cluster set-up phase and cluster steady phase same as a LEACH protocol. This proposes ECHSSDA approach work into rounds. Each round begins with a set-up (clustering) phase when clusters are structured, followed by a cluster steady phase, the CH is always on receiving data from cluster members, aggregate these data and then send it to the BS that might be located far away from it.

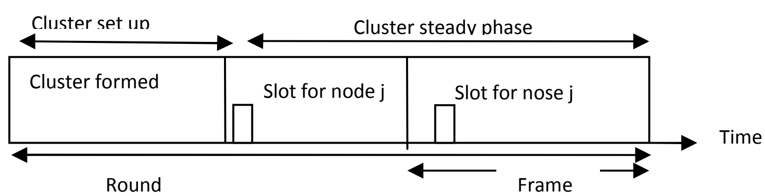


Fig. 4 ECHSSDA operations

5.1 Cluster set-up phase

In set-up phase, the cluster head is selected and then it forms a group.So after some time the corresponding Cluster head energy to be reduced and to rotate the cluster head selection process. In the selection of cluster head each node decides wether to turn into cluster head or not average residual energy. Some nodes with more residual energy turn into cluster heads and send cluster head information to inform other nodes. The other nodes with less residual energy turn into common nodes, and send information about joining cluster to a cluster head.

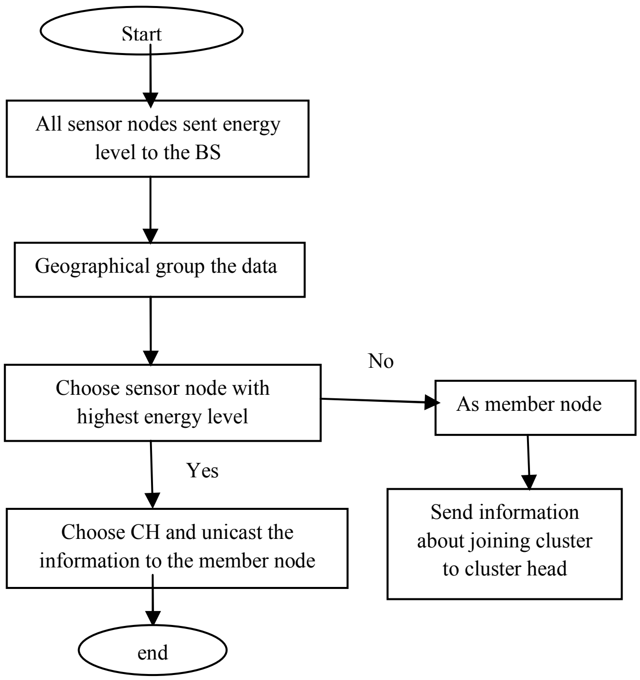


Fig. 5 CH selection process

5.2. Cluster steady phase

In which clusters are created and the corresponding cluster head is selected. After the cluster head receives the data it can be aggregated and the data can be transmitted to the base station. During the set-up phase each sensor node sends information about its current location to the base station. In order to determining good clusters, the base station needs to ensure that the energy load is evenly distributed among all the sensor nodes. Sensor nodes sends their energy level to the base station, The base station computes average node energy, and determines which nodes have energy high or below this average, some nodes having higher energy compare to average energy choose as cluster head for current round. Then broadcasts an advertisement message to the rest of the nodes. For this "CH-advertisement" phase, the CHs use a CSMA MAC protocol, and all CHs transmit their advertisement using the same transmit energy. The non CH nodes must keep their receiver on during the phase of set up to hear the advertisements of all the CH nodes. After this phase is complete, each non-CH node decides the cluster to which it will belong for this round. This decision is based on the received signal strength of the advertisement. After each node has decided to which cluster it belongs, it must inform the CH node that it will be a member of the cluster. Each node transmits this information back to the CH again using a CSMA MAC protocol. During this phase, all CH nodes must keep their receivers on. The CH node receives all the messages for nodes that would like to be included in the cluster. Based on the number of nodes in the cluster, the CH node creates a TDMA schedule telling each node when it can transmit. This schedule is broadcast back to the nodes in the cluster. Once the clusters are created and the TDMA schedule is fixed, data transmission can begin. Nodes send it during their allocated transmission time to the CH. This transmission uses a minimal amount of energy. The radio of each non-CH nodes can be turned off until the node's allocated transmission time, to minimizing energy dissipation in these nodes. The CH must keep its receiver on to receive all the data from the nodes in the cluster. When all the data has been received, the CH performs data aggregation. This aggregated data is sent to the BS. This transmission takes high-energy because BS is far away from CH. After certain period Cluster-head node energy become reduced, because of its operation of receiving, sending and overhearing processing so if the energy of CH is becomes below the non-cluster-head nodes energies means next round should to be processed. In the next round, the Associate cluster-head should be made as a lead while selection of cluster-head for the first round, so no need to select the cluster-head for next round. then Associate CH node that will become a CH of the cluster.

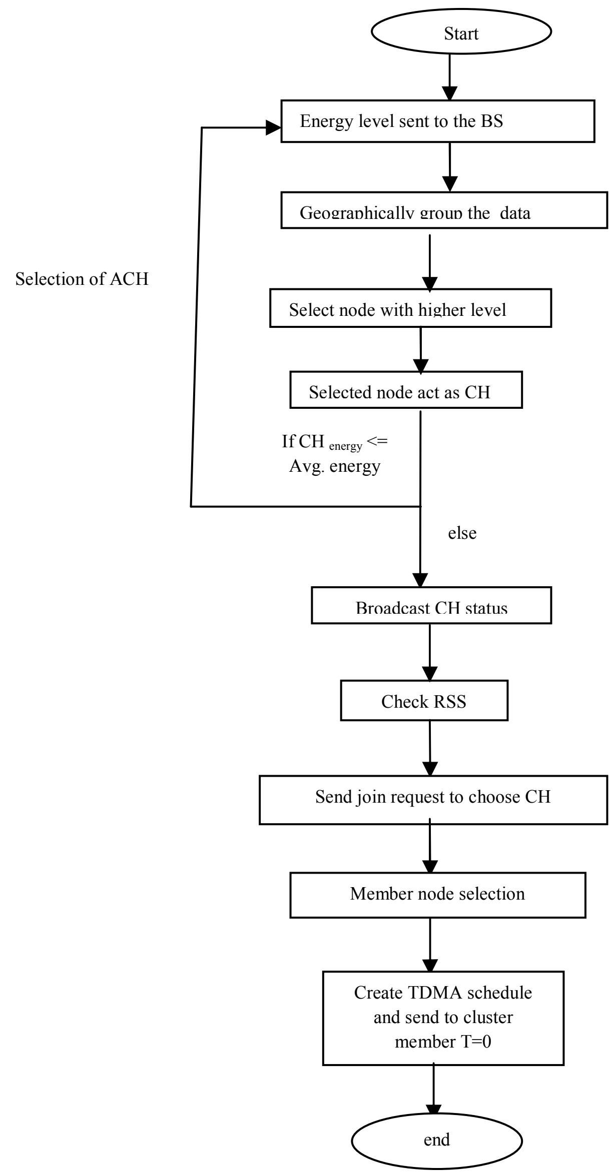
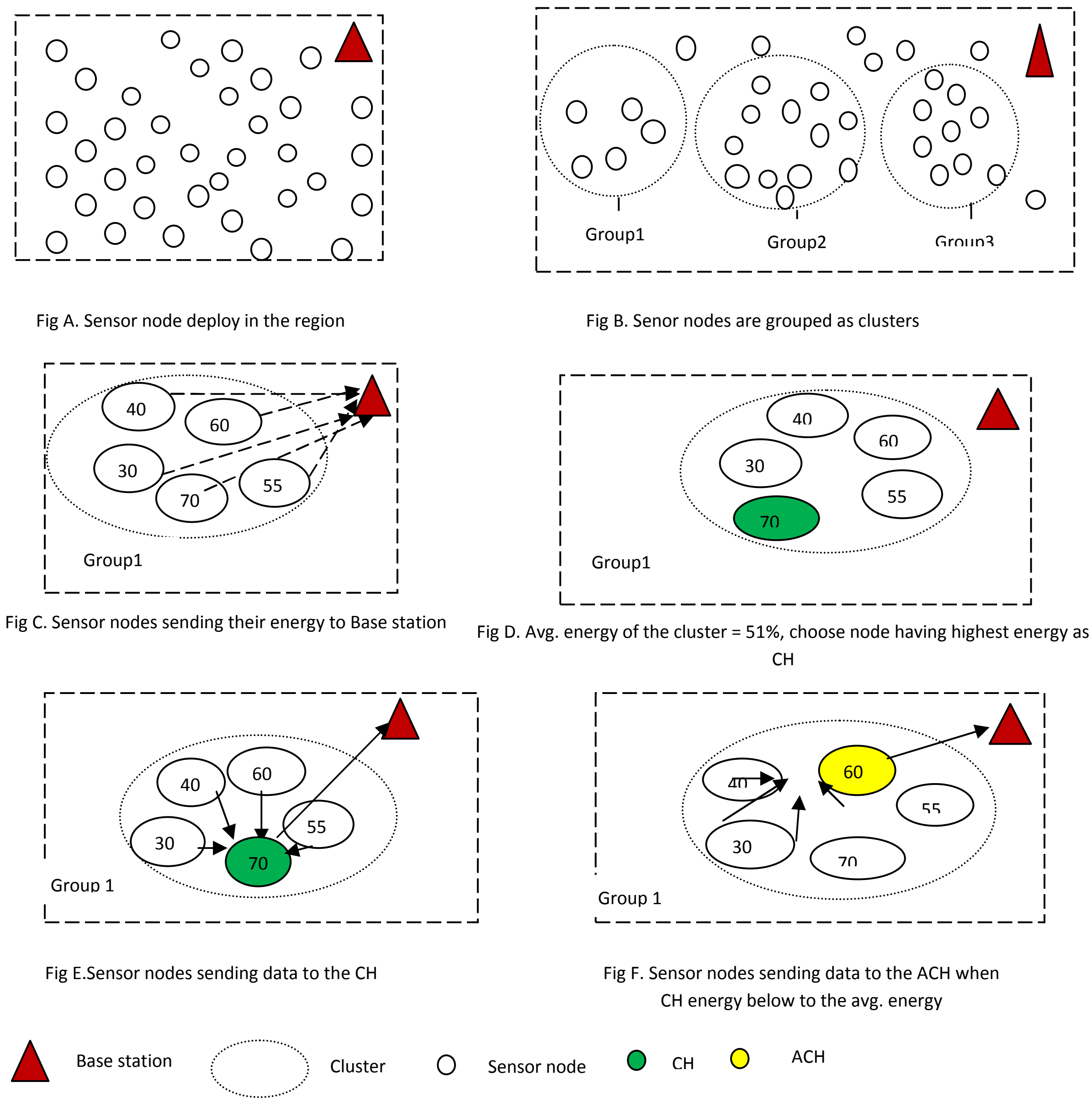


Fig.6 Flow chart of cluster steady phase

Fig. 7 Associate CH operation based on random deployment of the sensor nodes in network



Pseudo code

For Associate cluster formation

Associate cluster head (ACH) to be selected with the decrease in energy level of cluster head
if
For selection of ACH, the node which has higher energy level, after the energy of CH<= Avg. energy act as a ACH.
then
After the reduction in energy level for 1st round as compare to average energy, without selection the CH for the next round the ACH act as CH for next round.
else
Resection of CH leads to be an selection overhead.
else if
More energy consumption

Pseudo Code

For Cluster Head Selection

```
During the selection of cluster head
if
Sensor nodes energy level>= average energy level
    then
     Sensor node suitable for cluster head
     if
    Sensor node with highest energy level work as a    CH
else
Not eligible for cluster head selection process.
```

Fig. 6 show the flow chart of cluster steady phase in which cluster head choose based on higher energy level . after certain time cluster head enegy become reduce as compare of average energy ,then Associate cluster-head should be made as a lead while selection of cluster-head for the first round . then all data would be transfer to associate CH. And associate cluster head take place as a CH for that round. Fig.7 Show the associate CH operation based on random deployment of the sensor nodes in the network. In which diagram fig. (a) sensor nodes are randomly deployed in the region .fig. (b) sensor nodes are geographically grouped as clusters. Fig. (c) all sensor nodes sending their energy to Base station. Because base station is responsible for ensure that the energy load is evenly distributed among all the sensor nodes, then base station compute the avg. Energy of the nodes. Fig. (d) Avg. energy of the cluster = 51%, choose node having highest energy as CH.because highest energy nodes act ascluster head, after that Fig. (e) Sensor nodes sending data to the CH.when CH energy below the avg. Energy then ACH take place as CH for that round Fig. (f) Sensor nodes sending data to the ACH when CH energy below to the avg. Energy. There for no need to choose CH for the first round.

6. SIMULATION AND RESULTS

In this section we present the performance of the proposed algorithm ECHSSDA obtained by simulation using Omnet++ 4.0 [23]. In this simulation, our experiment model performed on 100 nodes which were randomly deployed and distributed in a 100×100 square meter area. Sensor nodes contain two kinds of nodes: sink nodes (no energy restriction) and common nodes (with energy restriction). We assume that all nodes have no mobility since the nodes are fixed in applications of most wireless sensor networks. For the simulation we set the energy dissipated per bit in the transceiver electronics to be E_{elec} = 50 *nJ* / *bit* for 1*Mbps* transceiver.

Table 1 Simulation Parameters

Parameter	**Value**
Simulation time	950 sec
Initial node power	2 Joule
Nodes distribution	Nodes are randomly distributed
BS position	Located at 110x 45

Finally, computation energy for beam-forming is set to 5 *nJ* / *bit* / *signal* . Once a node runs out of energy, it is considered dead and cannot longer transmit or receive data. For these simulations, energy is removed whenever a node transmits or receives data and whenever it performs data aggregation. We do not assume any static energy dissipation, nor do we remove energy during carrier-sense operations.

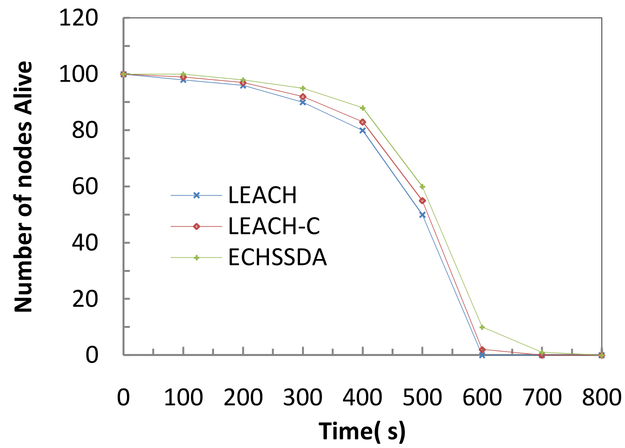


Figure 8. The number of nodes alive vs. the elapsed time

As shown in Figure 8, ECHSSDA has less energy consumption of nodes in process of cluster head selection than LEACH and LEACH-C protocols.. Based upon the simulation results, ECHSSDA can control the residual node energy and effectively extend the network lifetime without performance degradation.

7. CONCLUSION

In this paper, we studied various cluster head selection algorithm for data aggregation in wireless sensor networks. But all have survived due to periodically select cluster head for this lots of energy is consumed. That's why we have proposed the most favorable Algorithm for the efficient cluster head selection in which no need to select cluster head periodically, so lots of energy is saved in the wireless sensor network. Through simulation result we can conclude that ECHSSDA is better than LEACH and LEACH-C protocol in term of energy consumption in cluster selection process.

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