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A NOVEL DISTRIBUTED PROTOCOL FOR RANDOMLY DEPLOYED CLUSTERED BASED WIRELESS SENSOR NETWORK:

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ABSTRACT

Grouping sensor nodes into cluster has been popularly used in order to achieve the network scalability. Every cluster needs a leader, and referred as the cluster-head. Many clustering Schemes for Wireless sensor Networks focus on the stable clustering techniques for mobile environments. In this paper, we have proposed a novel Distributed protocol in randomly deployed Wireless Sensor networks. Our work minimizes the selection of cluster heads in which both energy of the nodes and total energy consumption of the cluster are considered. We have shown the correctness & effectiveness of our protocol by mathematical simulation studies.

Keywords: *Cluster, Maximum Number Of Nodes , Sensor Network*

1. INTRODUCTION

Sensor networks are self-organizing multi hop systems of sensor nodes [5,6,7]which can communicate with each other. These systems do not have pre-existing infrastructure but each node can act as a router to relay packets to its neighbors. Now we describe our novel approach to the clustering the sensor network. The nodes are randomly distributed at the beginning in an area of interest and then clustering starts

2. DIRECT BASED AND MINIMUM ENERGY BASED ROUTING PROTOCOLS FOR SENSOR NETWORK

There are many routing protocols that are proposed for the problem of routing the data in wireless sensor networks. These routing mechanisms have considered the characteristics of sensor nodes along with the application and architecture requirements.

A. Hierarchical Protocols

Similar to other communication networks, scalability is one of the major design attributes of sensor networks. A single-tier network can cause the gateway to overload with the increase in sensors density. Such overload might cause latency in communication and inadequate tracking of events. In addition, the single gateway architecture is not Scalable for a larger set of sensors covering a wider area of interest since the sensors are typically not capable of long-haul communication. To allow the system to cope with additional load and to be able to cover a large area of interest without degrading the service, networking clustering has been pursued in some routing approaches. The main aim of hierarchical routing is to efficiently maintain the energy consumption of sensor nodes by involving them in multi-hop communication within a particular cluster and by performing data aggregation and fusion in order to decrease the number of transmitted messages to the sink. Cluster formation is typically based on the energy reserve of sensors and sensor's proximity to the cluster head. LEACH [9] is one of the first hierarchical routing approaches for sensors networks. The idea proposed in LEACH has been an inspiration for many hierarchical routing protocols, although some protocols have been independently developed.

Examples

Low - Energy Adaptive Clustering Hierarchy (LEACH)[9], Power-Efficient Gathering in Sensor Information Systems (PEGASIS)[8], Hierarchical-PEGASIS[11], Threshold sensitive Energy Efficient Sensor Network protocol (TEEN)[10],Adaptive Threshold sensitive Energy Efficient sensor Network protocol (APTEEN)[12], Energy-aware routing for cluster-based sensor networks (Younis et al)[13].

B.Location - based Protocols

Most of the routing protocols for sensor networks require location information for sensor nodes. In most cases location information is needed in order to calculate the distance between two particular nodes so that energy consumption can be estimated. Since, there is no addressing scheme for sensor networks like IP addresses and they are spatially deployed on a region, location information can be utilized in routing data in an energy efficient way. For instance, if the region to be sensed is known, using the location of sensors, the query can be diffused only to that particular region which will eliminate the number of transmission significantly.

Examples

Minimum Energy Communication Network (MECN)[14], Small Minimum Energy Communication Network (SMECN)[15], Geographic Adaptive Fidelity (GAF)[16], Geographic and Energy Aware Routing (GEAR)[17].

3. SIMULATION AND RESULTS

Assumptions

Every node in the network belongs to some cluster; if a cluster has a single node we call it as orphan node. Our assumptions regarding the cost of communication are as follows:

One unit cost for communication between any two nodes.

One unit of cost for sending request to joining into a cluster.

One unit of cost for accepting and assigning a node to its cluster.

If any node sends a joining request to some other node or fulfills a joining request then its energy gets decreased by two units.

With the help of these assumptions we simulated our algorithm.

A. Simulation Parameters

The various parameters considered for simulation were:

- Network size: It is important to study the performance of a clustering algorithm with respect to the number of nodes in the network (network size). We simulated our algorithm for different network sizes.
- Area: The radius of the network is a measure of its area. Nodes are randomly deployed in a given area, and we have simulated our algorithm for different sized areas.
- Hop count: The maximum hop count between cluster head and any node belonging to the cluster.
- Maximum number of nodes in a cluster and minimum number of nodes in a cluster.

B. Performance Metrics

Our aim is to minimize the energy consumption in clustering a network, and also to minimize the number of communications while forming a cluster.

- Energy: Energy is most considerable parameter in cluster formation. We calculated the initial energy of whole network and the energy of the network after the cluster formation, which reflects the energy consumed during the formation of clusters.
- Orphan nodes: A cluster with single node.
- Message communications: It is the number of communications occurred between any pair of nodes while clustering the network.

4. DESCRIPTION OF PROTOCOL

STEP 1: Each node finds and stores the neighbor nodes that are the nodes which are in its communication range.

STEP 2: Each node broadcasts the list of nodes that it can hear, that is, the set of nodes that are within the communication range of the original, node. If a node A hears from a node B with a higher number of neighbors than itself, node A sends a message to B requesting to join B's cluster. If B already has resigned as a cluster head itself, B returns a rejection, otherwise B returns a confirmation. When A receives the confirmation, A resigns as a cluster head. Another possibility is that the cluster with node B as cluster head has already reached maximum size or its energy level is very low. In this case, all requests are automatically met with rejection. If the cluster would be allowed to grow too large, the cluster head's power supply would soon be depleted since the routing would take too many resources.

STEP 3: When the previous step is completed, the entire network is divided into a number of clusters. Each node belongs to exactly one cluster, and a node is either a cluster head or directly connected to one. The next step is that every cluster broadcasts its size to all neighboring nodes. If a node receives a message from a cluster that has a larger size than the cluster it currently belongs to, it joins new cluster instead. It sends notifications to both the new and the old cluster to update them about its new status. This assumes that the larger cluster has not reached the maximum size yet. The notifications first go to the cluster heads, and are then propagated to the entire cluster. This process can be repeated several times, depending on what the maximum cluster diameter is considered to be in this case. Each node keeps track of the id of its cluster head, the time the node has been a member of its current cluster, as well as the number of nodes in the cluster. A cluster head also keeps track of the time each node in its cluster has been a member of that cluster.

STEP 4: It is possible for a cluster to grow too large. Consider a situation when a cluster is just below the maximum allowed size, and several nodes joins simultaneously. Eventually, the cluster head will be notified of all the new nodes. Since the size of the cluster exceeds the maximum allowed size ,one or several nodes need to be disconnected from cluster. Based on the assumption that some nodes move in groups, the nodes that have been members of the cluster for a long time are the nodes that are most likely to stay in the vicinity of the cluster head. This means that the nodes that have been with the cluster for the shortest amount of time should be the first to leave the cluster when it grows too large.

STEP 5: A node can leave a cluster, either because the situation described above, or because it is moving away from the cluster. Even if it loses contact with the node that is the first step to the cluster head, it might still be able to connect to another node in the cluster. However, if the node is more than d hops away from the cluster head, it must leave that cluster. When a node leaves a cluster, it tries to find another cluster to connect to. That cluster must be smaller than the maximum allowed size, and the node cannot be more than d hops away from the cluster head. If several such clusters are found, the node joins the largest one. If no such cluster is found, the node forms a cluster with itself as cluster head and only member.

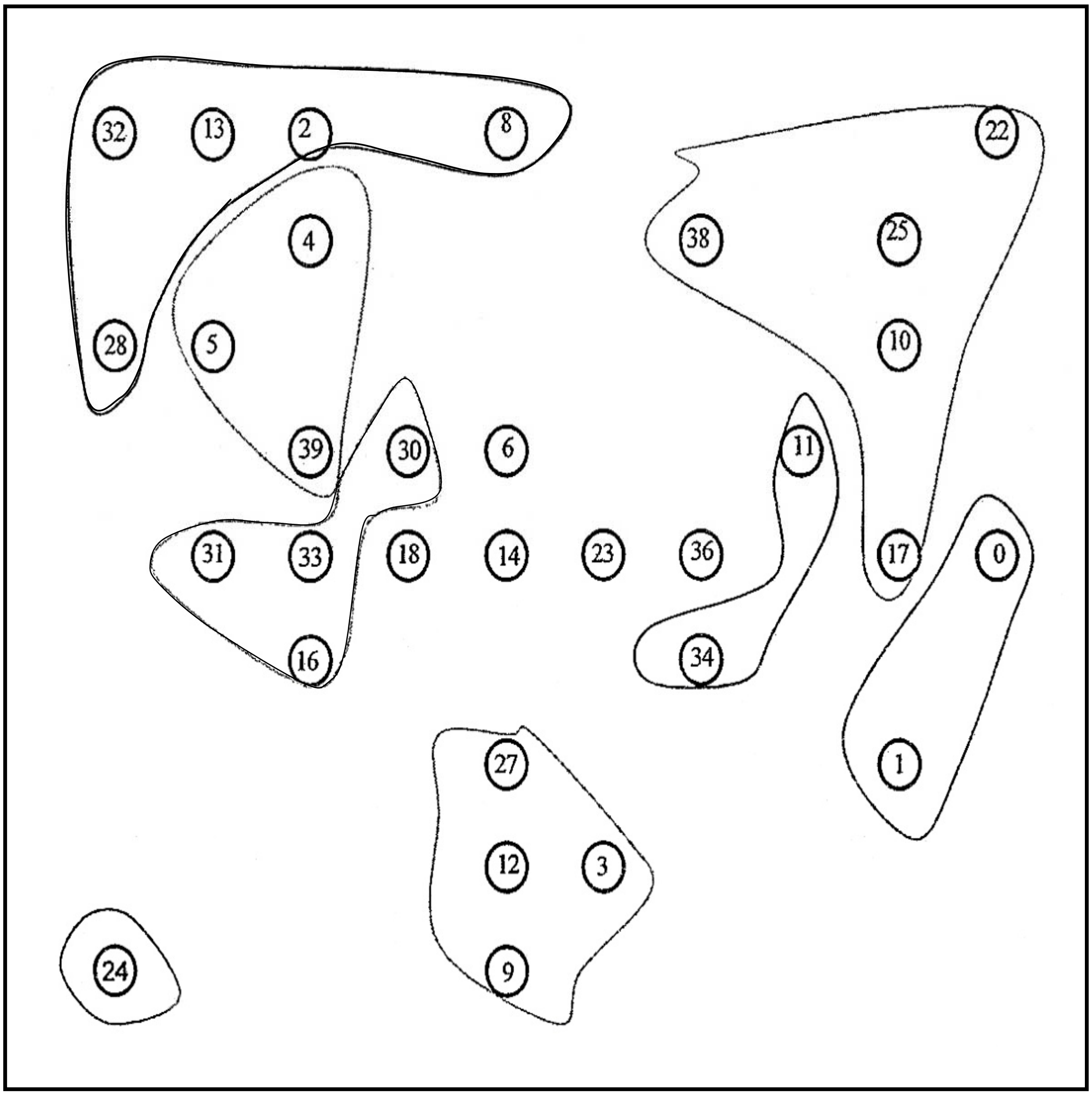
A. Pseudo Code for Proposed Clustering Algorithm

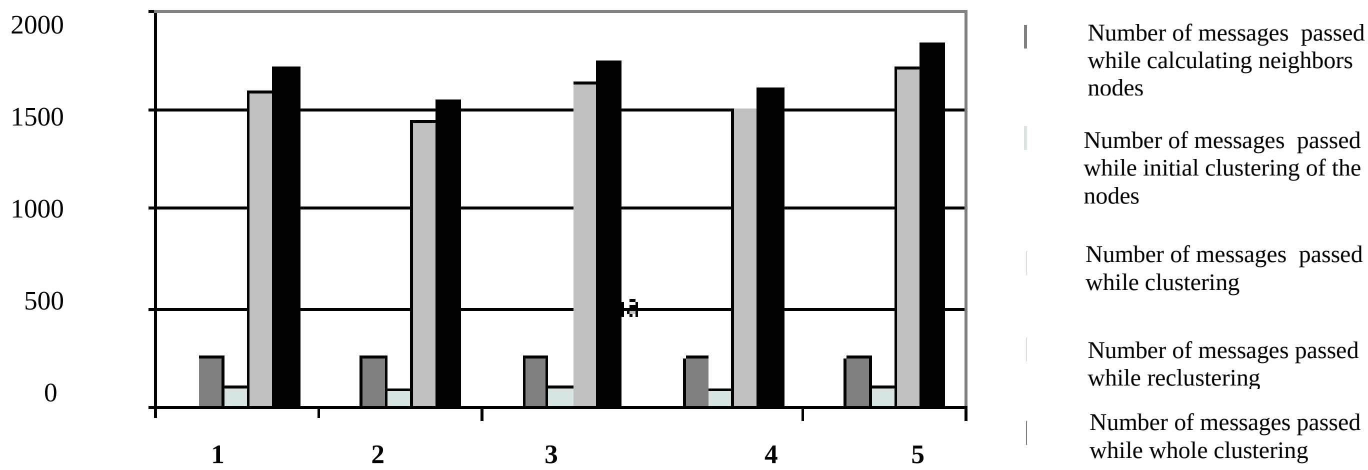
```
Cluster The Node(node n)
{
        findNeighborNode( n);
        initialCluster(n);
        for maximum hop number of times do
        cluster Node(n);
        endfor
        recluster(n);
}
findNeighborNode(node n)
{
        for (all nodes ni in network) do
        find distance between node n and all other
nodes
                if (distance is less than maximum
                transmission range)
                accept node ni as neighbor for
                node n
                endif
        endfor
}
initialCluster( node n)
{
find neighbor node ni which can hear more number
of nodes than the node n
sendRequest;
if ( request is accepted)
assign node n to neighbor node ni 's cluster
endif
}
c1usterNode(node n)
{
find cluster head nh for node n;
find neighbor cluster Cn which has more number of
nodes then in the cluster nh
send Request;
if( request is accepted)
assign node n to neighbor cluster Cn
endif
}
recluster(node n)
{
if the node n is belong to the cluster Cn and Cn
have less number of nodes then minimum cluster
size then re cluster the node n
if it is not reclustered declare it as a orphan node}
```

B. Simulation Studies

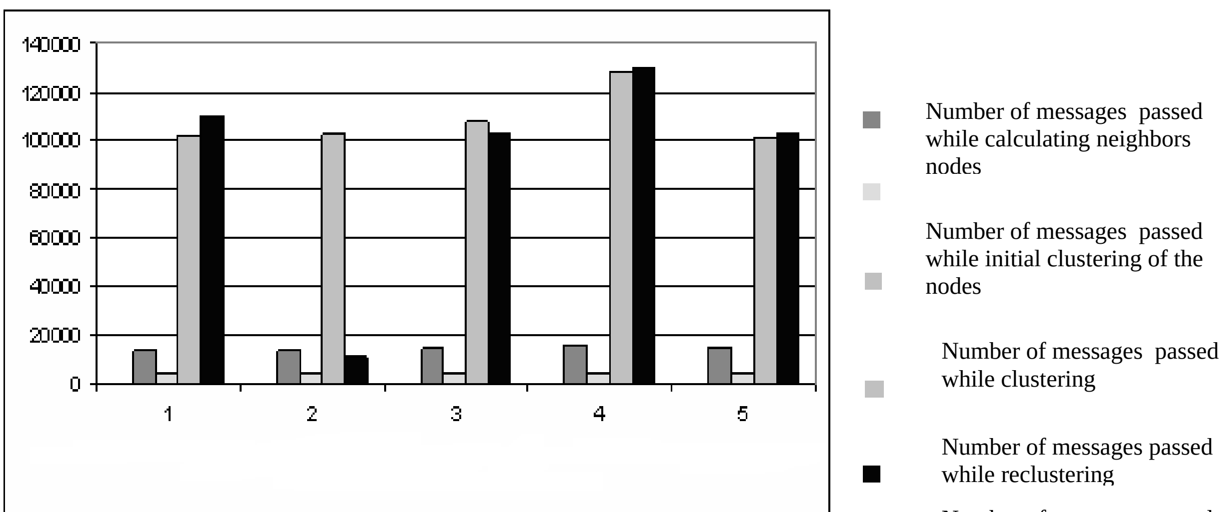
For various parameters we have computed the results for the above algorithm. The parameters are size of network, maximum transmission range, maximum number of nodes in a cluster, number of hops.

The following figure shows the cluster formation produced by our algorithm for an input of 40 nodes and 10X10 area network.

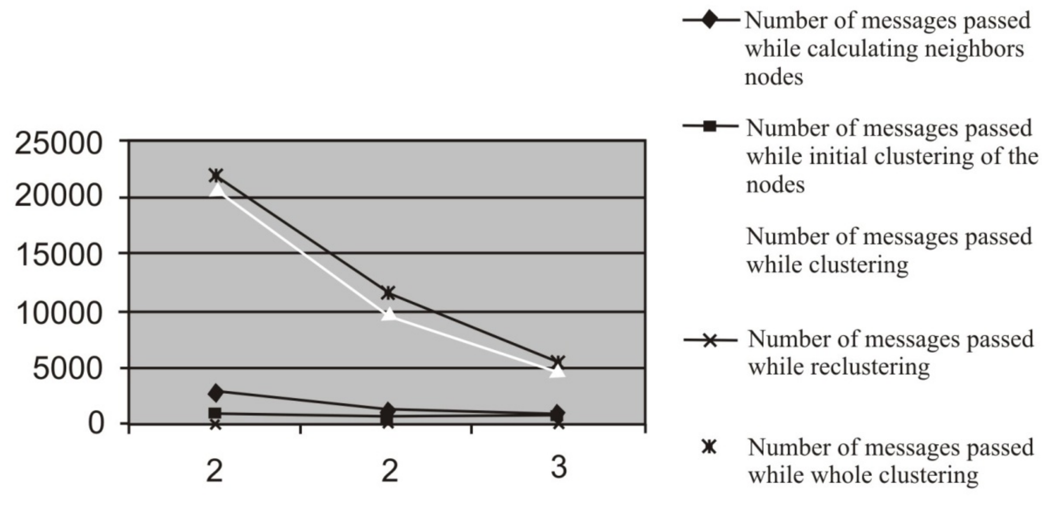




Number of messages passed in size of the network which contains the 100 nos. nodes and deployed in 10 sq.units of the area

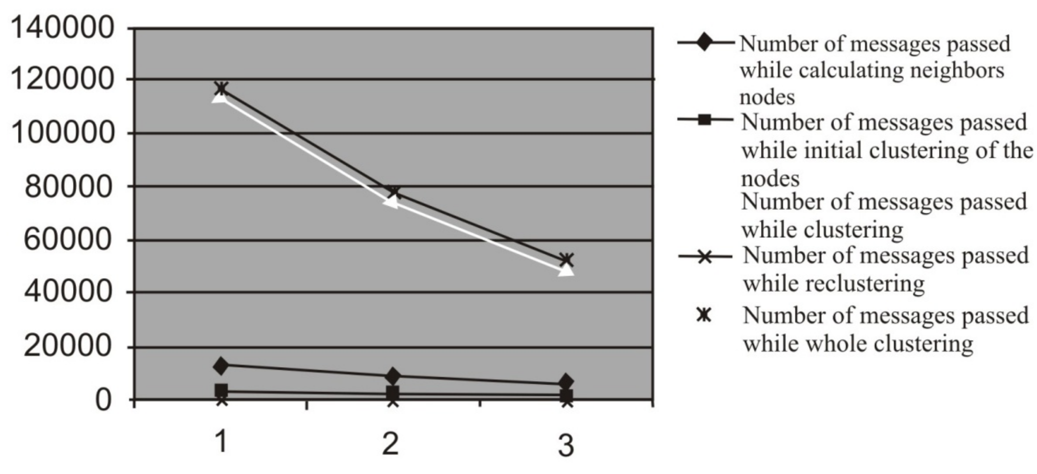


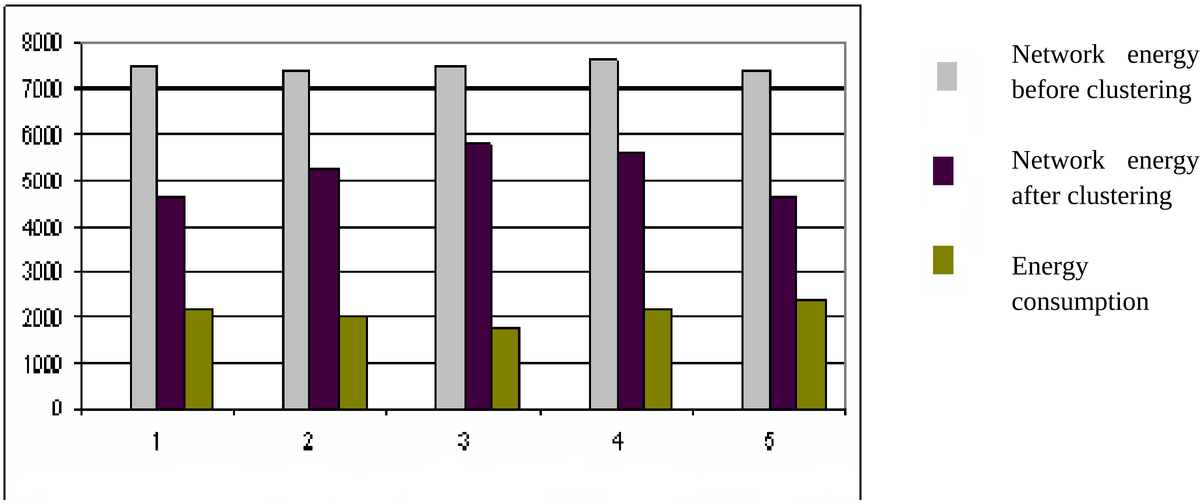
Number of messages passed in size of the network which contains the 100 nos. nodes and deployed in 10 sq.units of the area



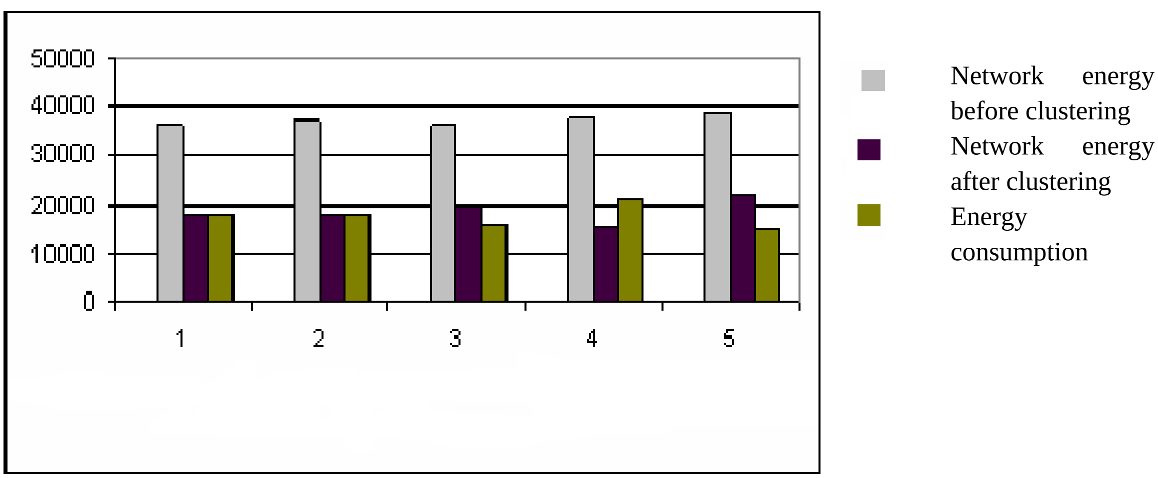
Number of messages passed in the network which contains 100 nos. Of nodes and deployed in different units of area

Number of messages passed in the network which contains 500 no. Of nodes and deployed in different units of area 25,30 and 35

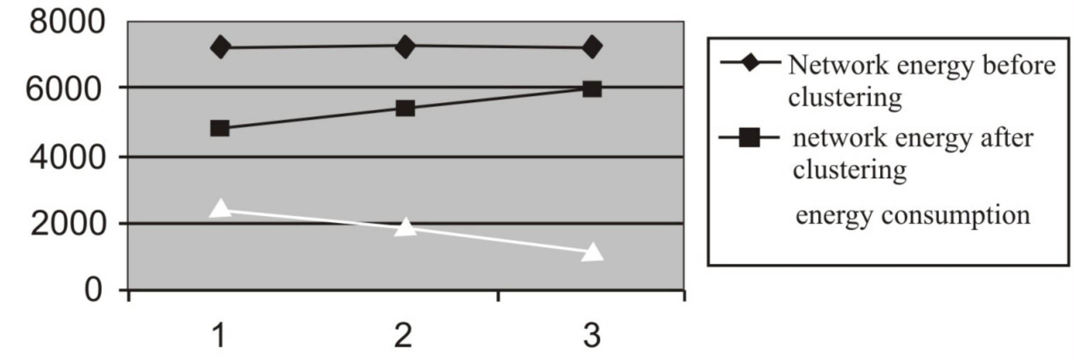




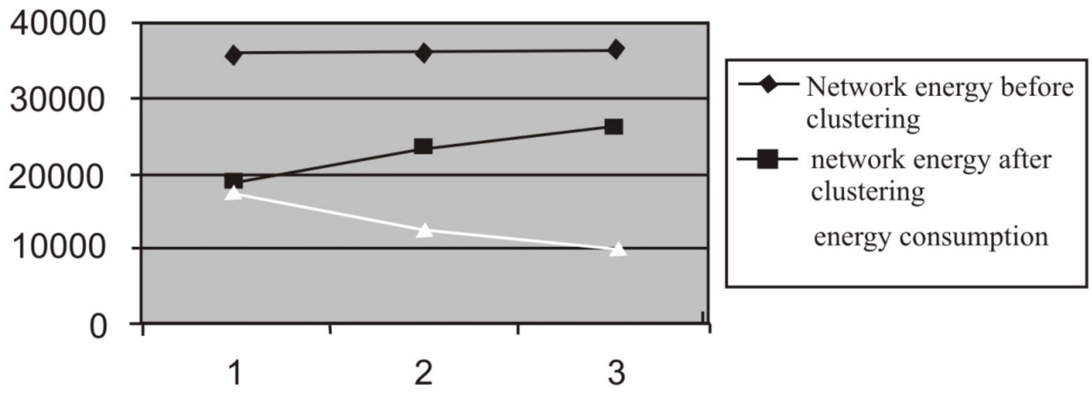
Energy consumed in the size of network which contains 100 no. of nodes and deployed in 10 sq. units of area



Energy consumed in the size of network which contains 500 no. of nodes and deployed in 25 sq. units of area



Energy consumed in the network which contains 100 no. Of nodes and deployed in different units of area



Energy consumed in the network which contains 500no. Of nodes and deployed in different units of area

It can be observed from the above graphs that if the nodes deployed in large area then the communication cost will be decreasing and at the same time the consumption of energy increases. In this chapter we give simulation results of our algorithm for various parameters

5. CONCLUSION

This paper has proposed an algorithm for clustering scattered distribution of the sensor nodes. It is based on distributed approach, and it is of complexity $O(d^2)$,where d is the maximum number of hopes. As a result of algorithm we will have initial routing table for sensor nodes. Since it is based on distributed approach it will have improved performance over centralized approach.

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