CLUSTERING and LOCALIZATION ALGORITHM IN WIRELESS SENSOR NETWORK

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***Abstract-* Clustering is a standard approach for achieving efficient and scalable performance in wireless sensor networks. Often the nature of these clustering networks is huristic and aim at generating the minimum number of diffrent clusters. Dispersal of control over the network is facilitate by the clustering and, hence enables the locality of communication. Clustering nodes into groups saves energy[1] and reduces network contention because nodes communicate their data over shorter distances to their respective cluster heads. The assembled information to the base station is forwarded by cluster head. Long distances communication to the base station is only needed by the cluster head; this burden can be alleviated further by hierarchical clustering, i.e., by applying clustering recursively over the cluster heads of a lower level.**
***Keywords-* Clustering, network contention, cluster heads.**

I. INTRODUCTION

Recent advances in wireless communications and microelectro-mechanical systems have motivated the development of cheap and very small sensors that are capable of acquire sensing, signaling and wireless communication. These sensors can be extend at a cost much lower than traditional wired sensor systems. A wireless network have a lot of small sensors with low-power transceivers can be an effective tool for gathering data in a variety of environments. The data gathered by every sensor is exchanging through the network to a single processing center that uses all reported data to determine characteristics of the environment or detect an event. The communication or message sending process must be designed to conserve the limited energy resources of the sensors. Clustering sensors into batches, so that sensors communicate information with cluster heads and then the cluster heads communicate the accumulated information to the processing center. In this paper, algorithm is used in such a way to consider principle of designing a clustering algorithm, in addition to provide an environment for designing a localization algorithm based on clustering. The algorithm uses a combined weight function and tries to classify the sensor nodes so that minimum number of clusters with maximum number of nodes in each cluster could be achieved. . It also has the flexibility of assigning different weights and takes into account a combined effect of the ideal degree, transmission power[3], and battery power of the nodes.

The number of sensor nodes in a sensor network can be several orders of magnitude higher than the nodes in an ad hoc network.

• Sensor nodes are densely deployed.

• Sensor nodes are prone to failures.

• The topology of a sensor network changes very frequently.

• Sensor nodes mainly use broadcast communication paradigm whereas most ad hoc network are based on point-to-point communications.

• Sensor nodes are limited in power, memory and computational capacities.

• Sensor nodes may not have global identification (ID) because of the large amount of overhead and large number of sensors.

CFL: A Clustering Algorithm For Localization in Wireless Sensor Networks:

CFL is designed in such a way to consider principle of designing a clustering algorithm, in addition to provide an environment for designing a localization algorithm based on clustering. The algorithm uses a combined weight function and tries to classify the sensor nodes so that minimum number of clusters with maximum number of nodes in each cluster could be attained. The simulation results confirm that the

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CFL algorithm has better performance than that of the existing algorithms.

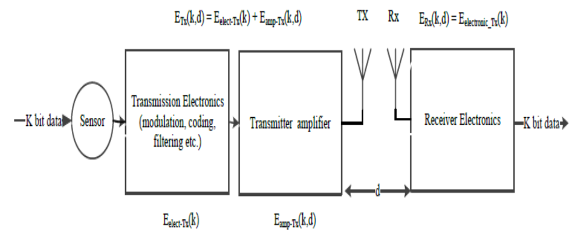
A sensor node's radio can be in one of the following four states: transmit, receiving, idle, or sleep. The idle state is when the transceiver is neither transmitting nor receiving, and the sleep mode is when the radio is turned off. As presented in [4], an analysis of the power usage for WINS Rockwell seismic sensor indicates power consumption for the transmit state between 0:38W and 0:7W, for the receive state 0:36W, for the idle state 0:34W and for the sleep state 0:03W. The power consumed for the sensing task is 0:02W. Therefore local data processing and data communication are highly desirable. Clustering is a standard approach for achieving efficient and scalable performance in wireless sensor networks. Clustering nodes into groups saves energy and reduces network contention because nodes communicate their data over shorter distances to their respective cluster heads. The cluster heads forward the collective information to the base station.

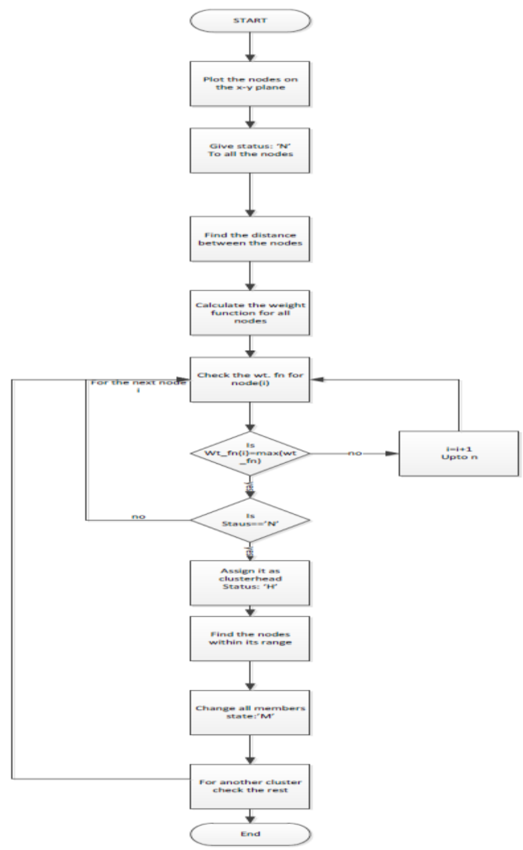
Clustering is a fundamental mechanism to design scalable sensor network protocols. A clustering algorithm seprates the network into disjoint sets of nodes each centering around a chosen cluster-head. A good clustering impose a regular high-level structure on the network. Many clustering protocols have been investigated as either stand alone protocols or as a side effect of other protocol operations, e.g. in the context of routing protocols or in topology management protocols. The majority of protocols construct clusters where every node in the network is no more than 1 hop away from a cluster head.

Cluster protocols themselves can be distributed or centralized. In centralized algorithm, a base node (usually Sink node) collects information from network nodes and then partitions them into cluster. Hence one node arrange clusters by global information that are gathered from the whole network. But in distributed algorithm every node runs algorithm independently by information about local neighbors CFL (Cluster for Localization), that can be used for localization algorithms in future. The algorithm uses a weight function at each sensor node, which is a composition of various parameters including: transmission power, reminding energy, and number of neighbors. Using the weight function the algorithm tries to classify the sensor nodes so that minimum number of clusters with maximum number of nodes in each cluster could be achieved.

Energy model

The energy model considered in this work is shown in Fig. 1. It is also assumed that both Fris's free space and multipath losses rely on the transmitter amplifier model and the respective node distances (d).





II. ALGORITHM

CFL is a distributed, side-effect algorithm for clustering nodes in Wireless sensor network. In CFL algorithm, each node can be placed in one of the following states: UNCLUSTER, CLUSTER HEAD, CLUSTER MEMBER. At beginning of the algorithm all nodes are in the UNCLUSTER state, but at end of the algorithm, any node is exactly in one of the following states: CLUSTER HEAD or CLUSTER

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MEMBER. To choose the cluster head efficiently the CFL algorithm performs the following steps:

1. The first step includes getting familiar with the neighbors. In this step all nodes telecast the "Hello" message. By getting any “Hello” message the node not only adds it as a neighbor to its neighbors' table, but also estimate sits own distance to the sender using an estimation method such as RSSI algorithm, and retain it for later reference.
2. In the second step, each network node *i* computes its weight function (*Wi*) which is related to three different parameters including: the reminding energy (*Ei*) the number of node’s neighbors (*N i*) and the transmission power (*Pi*),as follows:

$$Wi = aNi + bEi + C\frac{1}{P_i}$$

Where *a*, *b* ,*c*(*a* +*b* +*c* ≤1) are positive constant factors. After that, the node broadcasts its weight (*Wi*) using My State message.

Since there is no assumption about the node's similarity, we calculate the energy parameter (*Ei*) as below:

$$Ei = \frac{Er}{Emax}$$

Where *Er*is the available energy and *E*max is the initial energy of node. When number of neighbours of a node is high then it is more eligible to be the cluster head. More transmission power means more energy consumption, therefore the reverse of the transmission power is used to compute the weight(*Wi*). When any node receives the My State message it records the weight(*Wi)* for the sender of message and estimates its own distance with this node and saves the average of the two distances as the distance of this node.

3. In the third step, the node which has more weight than its neighbours node, selects itself as the cluster head and as it change sits state to the CLUSTERHEAD it deals with sending cluster messages throughout its neighbors. Any node with the state other than CLUSTERHEAD, when receiving a cluster message, records the address of the sender node as that of the cluster head in its own table, it also changes its state to the CLUSTERMEMBER. If a node at UNCLUSTER state does not receive any CLUSTER message from its neighbors with higher weight than its weight then changes its state to CLUSTERHEAD and broadcasts CLUSTER message. If a node receives more than one CLUSTER message from various nodes, considering the distance to any node, the nearest node which has rewarded the message, chooses as the cluster head.

III. RESULTS

Here in figure 1 we have shown the distribution of 100 sensor nodes on 1000m x 1000m area. The red pointed nodes give us idea about the clusterheads and the remaining about nodes those will be connected to their respective clusterheads to collect the data from their neighbor.

Fig 1: Deployment of sensor Nodes

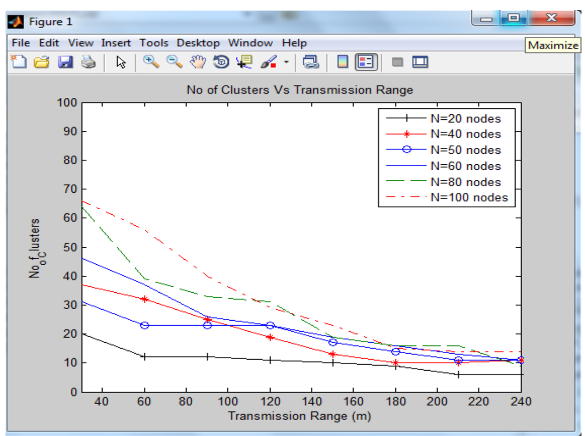

Fig 2: No of Clusters Vs Transmission Range for Improved Method

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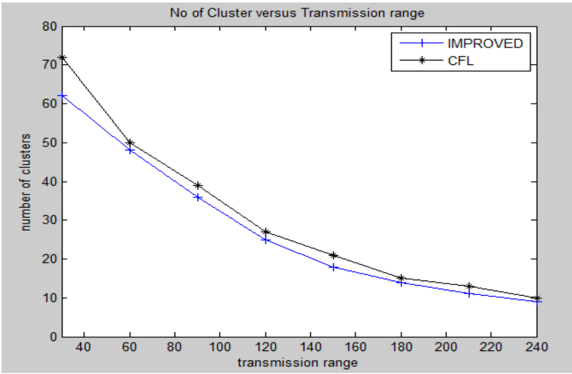

Fig 3: Comparison of Results between Improved and CFL Algorithm For Number of clusters

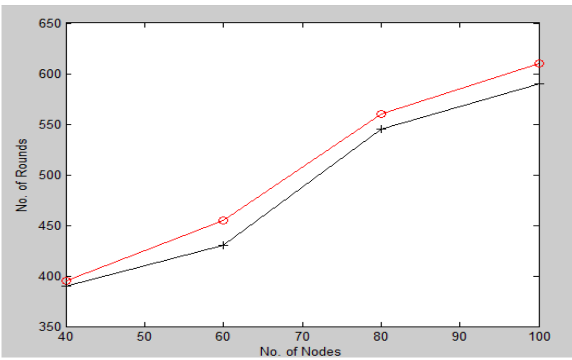

Figure 4: Comparison of Results for Energy consumption

IV. CONCLUSIONS

We have proposed an algorithm to reduce the no of clusters required with an increased number of clusters and to increase the network lifetime. This algorithm is fast and robust enough for communication purpose between the sensor nodes. The algorithm does not require geographic location information. It also has the flexibility of allocate different weights and takes into account a combined effect of the ideal degree, transmission power, and battery power of the nodes. The algorithm is executed only when there is a demand. This algorithm gives the lesser number of cluster-heads than the other algorithm existed.

References

[1] G. J. Pottie and W. J. Kaiser, “Wireless Integrated Network Sensors”, Communications of the ACM, Vol. 43, No. 5, pp 51-58, May 2000.
[2] D. J. Baker and A. Ephremides, “The Architectural Organization of a Mobile Radio Network via a Distributed Algorithm”, IEEE Transactions on Communications, Vol. 29, No. 11, pp. 1694-1701, November 1981.
[3] B. Das and V. Bharghavan, “Routing in Ad-Hoc Networks Using Minimum Connected Dominating Sets”, in Proceedings of ICC, 1997.
[4] C. R. Lin and M. Gerla, “Adaptive Clustering for Mobile Wireless Networks”, Journal on Selected Areas in Communication, Vol. 15 pp. 1265-1275, September 1997.
[5] A. D. Amis, R. Prakash, T. H. P. Vuong and D. T. Huynh, “ Max-Min D-Cluster Formation in Wireless Ad Hoc Networks”, in Proceedings of IEEE INFOCOM, March 2000.

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