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Two Levels Clustering for Lifetime Efficiency in WSN

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ABSTRACT
In Wireless Sensor Networks, cluster head is the key technology where nodes or motes the information transmit it to the base station. The energy consumption in a wireless sensor network can be reduced by allowing only some nodes to communicate with the base station. One way to support efficient communication between sensors is to organize the network into multiple groups, called clusters, with each cluster electing one node as the head of cluster. To support scalability, nodes are often grouped mostly non-overlapping clusters. This paper proposes a new design of an efficient clustering in wireless sensor head which is based on two level clustering. In two levels clustering approach instead of sensor nodes sends the data to cluster heads directly, each node sends data to their cluster head and then sends data to the base station.

Introduction

A wireless sensor networks as a rule has vitality limitation because of every sensor hub needs battery with a restricted vitality supply to work. Likewise, reviving or supplanting sensor battery may be less than ideal and unfeasible in a few situations. On the other side, the Wireless sensor system ought to work sufficiently long to consideration fulfill the application prerequisites. Along these lines, vitality protection is a fundamental matter in the arrangement of Wireless sensor systems. There are disparate ways to deal with protect vitality tradition and drag out the system lifetime or prolong in WSN. The key way to deal with improve vitality use in WSN is the development of vitality mindful system conventions. In this dissertation display an audit of directing and bunching calculations for force protection in Wireless sensor systems. This additionally show a force mindful bunching strategy for improving the system lifetime and also growing the quantity of effectively conveyed bundles and diminishing the system delay time.

There are several key attributes that designers must carefully consider, which are of particular importance in wireless sensor networks.

- Cost of nested clustering
- Selection of Cluster heads and sub cluster heads
- Synchronization
- Data Aggregation
- Repair Mechanisms
- Quality of Service (QoS)

A WSN commonly comprises of an expansive number of low cost, low power and multiple functional sensor hubs that are conveyed in an area of consideration. These sensor hubs are little in size, yet are furnished with sensors, implanted chip, and radio handsets, and correspondingly have to finding ability, as well as information controlling and conveying capacities. They impart over a short separation by means of a remote medium and communicate with other to finish a typical undertaking, for instance, environment checking, combat zone watch, and modern procedure control.

Contrasted and customary remote correspondence systems, for instance, cell frameworks and mobile adhoc [12] network; sensor systems have the accompanying restrictive attributes and limitations:

Unique characteristics of a WSN include:

- Limited power they can harvest or store
- Ability to withstand harsh environmental conditions
- Ability to cope with node failures
- Mobility of nodes
- Dynamic network topology
- Communication failures
- Heterogeneity of nodes
- Large scale of deployment
- Unattended operation
- Node capacity is scalable, only limited by bandwidth of gateway node.

Network Design Objectives

The qualities of sensor systems and necessities of various applications decisively affect the system outline targets regarding system capacities and system execution. The primary plan targets for sensor systems incorporate the accompanying a few angles:

Little Node Size

Lessening hub measure is one of the essential outline targets of sensor systems. Sensor hubs are typically conveyed in a brutal or unfriendly condition in substantial numbers. Lessening hub size can encourage hub arrangement, and furthermore diminish the cost and power utilization of sensor hubs.

Low Node Cost

Diminishing hub cost is another essential plan target of sensor systems. Since sensor hubs are typically conveyed in a brutal or threatening condition in huge numbers and can't be reused, it is vital to decrease the cost of sensor hubs with the goal that the cost of the entire system is diminished.

Low Power Consumption

Diminishing force utilization is the most vital goal in the outline of a sensor arrange. Since sensor hubs are fueled by battery and usually exceptionally troublesome or even difficult to change or revive their batteries, it is urgent to lessen the power utilization of sensor hubs with the goal that the lifetime of the sensor hubs, and also the entire system is delayed.

Self - Configurability

In sensor systems, sensor hubs are typically sent in an area of enthusiasm without watchful arranging and building. Once conveyed, sensor hubs ought to have the capacity to independently arrange themselves into a correspondence organize and reconfigure their availability in case of topology changes and hub disappointments.

Adaptability

In sensor organizes, the quantity of sensor hubs might be on the request of tens, hundreds, or thousands. Along these lines, arrange conventions intended for sensor systems ought to be versatile to various system sizes.

Sensor networks are needed in the applications like environment monitoring, industrial control units, military applications and in the context aware computing environments. Based on this critical expectation, in many crucial WSN applications the sensor nodes are often deployed randomly in the area of interest by relatively uncontrolled means (i.e., dropped by a helicopter) and they form a network in an ad hoc manner [1, 2].

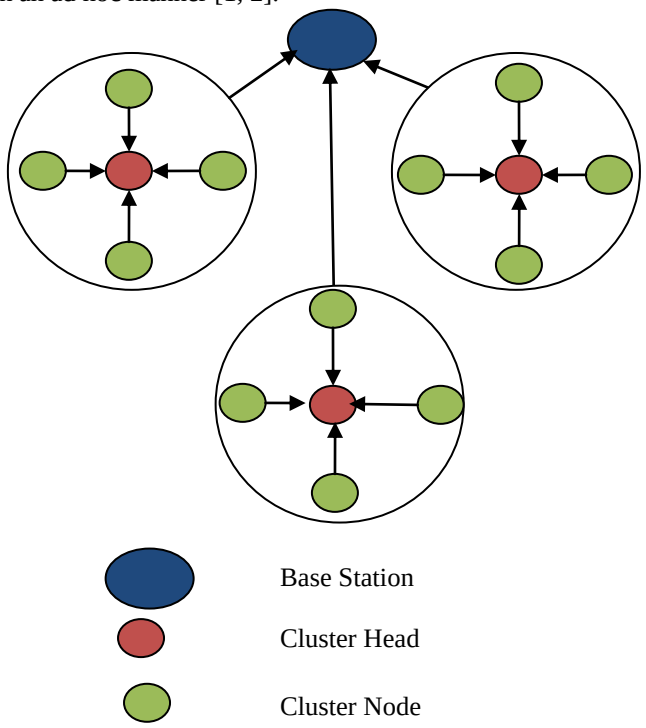

Fig 1. Cluster architecture in WSN.

Figure.1 shows a typical cluster-based WSN architecture. The nodes sense the information and transmit it to the base station through an intermediate node called the cluster-head (CH). The cluster-head aggregates the data, compresses it and then sends it to the base station. The base station serves as a gateway node to sends the data to another network. The database connected to the base station provides the means to update and retrieve the data on-demand.

WSNs have one or more centralized control units called the base station or gateway. The base station serves as a gateway for each sensor node to send data to another network (Figure 1). Thus it can be an interface to interact with the network, to extract and transfer information to the sensor nodes. Unlike nodes, base stations are many times more powerful and have an AC power supply, high communication bandwidth, and larger processing power and storage facilities. The energy consumption in a WSN can be reduced by allowing only some nodes to communicate with the base station. These nodes called cluster-heads [3] [4] [5] collect the data sent by each node in that cluster, compressing it and then transmitting the aggregated data to the base station [7]. The model is suitable considering the amount of redundancy found in WSNs; direct transmissions the base station will consume large amount of transmit power from each node.

Background

Many greedy algorithms have been proposed to choose cluster heads in ad hoc networks, and wireless sensor networks. They are based on the criteria of highest degree, lowest- ID, highest-ID, and node-weight, residual energy, probability, and any combination of these. The clustering techniques can also be classified based on cluster size, namely Single hop, and Multi-hop. LEACH [8] (Low-Energy Adaptive Clustering Hierarchy) elects cluster heads based on randomly generated value between 0 and 1. If this randomly generated value is less than threshold value then the node becomes cluster head for the current round. LEACH [11] is the first tree based cluster-based routing protocol for wireless sensor network which divides the nodes into clusters, in each cluster a node with extra privileges called Cluster Head (CH) is responsible for creating and manipulating a TDMA (Time division multiple access) schedule and sending aggregated data from nodes to the BS where these data is needed using CDMA (Code division multiple access). Remaining nodes are cluster nodes. PEGASIS (power-efficient gathering in sensor information systems) [6] [7] is an improvement over LEACH by making only one node transmit data to the base station in this protocol every node transmits it's data only to its nearest/neighbor node in the data fusion phase. PEGASIS starts with the farthest node from the base station. HEED (Distributed Clustering in Ad-hoc Sensor Networks: A Hybrid, Energy-Efficient Approach) [9] periodically selects cluster heads according to a combination of their residual energy (RE), and communication cost of nodes. Distributed Weight-Based Energy-Efficient Hierarchical Clustering (DWEHC) [10] is an extension or modified version of the HEED. It claims to provide more balanced cluster size. HEED uses two clustering parameter to select CH: one is residual energy, and the other is communication cost.

In HEED, each node must be mapped to exactly one cluster, and each node belongs to its only CH within one hop. After a clustering process, each node can either elect to become a CH due to a probability or join a cluster according to CH messages.

Proposed Work

The amount of redundancy found in WSNs; direct transmissions the base station will consume large amount of transmit power from each node. In two level clustering approach, instead of sensor nodes sending the data to the cluster-heads directly, each node sends it to its sub cluster. We want to save power consumption of cluster heads by this architecture because cluster head will communicate with all the sub cluster head nodes directly. The proposed algorithm is successfully implemented in MATLAB R2009b.

A. Cluster head selection using kmean

Initially we have collection of nodes, so with help of KMEAN [12] algorithm we create clusters of nodes in Fig 2, by which nodes come under in different clusters. Each node

belongs to one cluster. Next level of working we find the center of cluster & also find the nearest node of center that node work as cluster head. Selected CH work for each node of respective cluster to collect data from nodes and send to the base station.

B. Two level clustering or Sub cluster

Fig 2 shows, firstly draw a outer circle , each node of Cluster come under this circle and CH coordinates work center point of circle, now find out average distance between nodes & CH, and draw an inner circle , with radius as average distance with center point is CH coordinates. To mark CH node coordinates draw dimension of x-axis & y-axis. We have four partitions & quadrants, each partition having some nodes which are lies in between outer & inner circle.

So by which we found four sub clusters. This process is knows as two level clustering.

Next phase of our proposed work to select SCH of each SC. After formation of SC, we need to find out that node of SC, which is having minimum distance from CH, so that node of SC will work as SCH of that SC. So finally each SC having own SCH. Now the flow of data is moving from SC node to own SCH and then finally sends to CH with aggregation operation.

C. Energy Calculation

To calculate the energy we focused on two approaches:

1) Clustering

In clustering each node sends the data to own CH. So we need to calculate the sending energy of each node.

$$E_c = \sum_{i=1}^{i=n_c} Node_i$$

$Node_i$=Nodes of cluster

E_C=Sending energy of cluster

2) Two level clustering

But in Two levels clustering energy consumption is different in comparison to clustering. Firstly four SC nodes send data to own SCH, we calculate the energy on the basis of SC and then SCH consume energy to send the data to CH.

$$E_{SC} = E_{SCH} + \sum_{i=1}^{i=n_{sc}} SCNode_i$$

$$Total\ E_{SC} = E_{SC} + \sum_{i=1}^{i=n_c} Node_i$$

$Node_i$=Nodes of cluster

E_{SC}=Sending energy of sub cluster

$SCNode_i$=Nodes of sub cluster

E_{SCH}=Sending energy of sub cluster head

$Node_i$=Nodes of cluster

Total E_{SC}=Sending energy of cluster

To calculate the sending energy with using following formula:

$$E(t) = (E(elec) * k) + (E(amp) * k * d * d)$$

TABLE 1. RADIO PARAMETERS.

Parameter	Definition	Unit
E (elec)	Energy dissipation rate to run the radio	50nJ / bit
E(amp)	Energy dissipation rate to run transmit amplifier	100 pJ / bit /m2
K	Data length	bit (8)
d	Node transmission Range	m

3) Comparison between clustering & two levels clustering

Fig 3 depicts graph of energy between clustering & two level clustering. This graph drawn based on number of nodes in cluster & energy consumption in both clustering & two levels clustering. Fig 3 depicts that energy consumption in clustering is more in comparison of two level clustering.

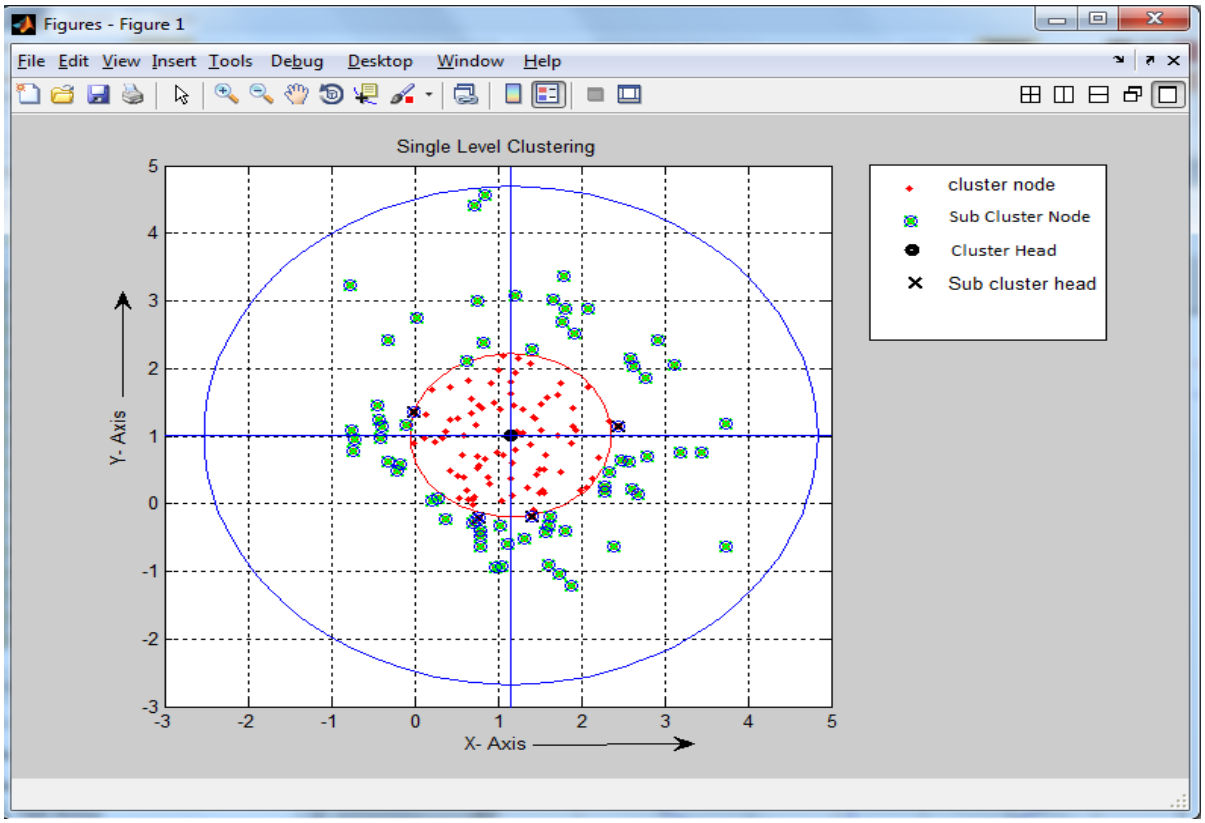

Fig 2. Two level Clustering.

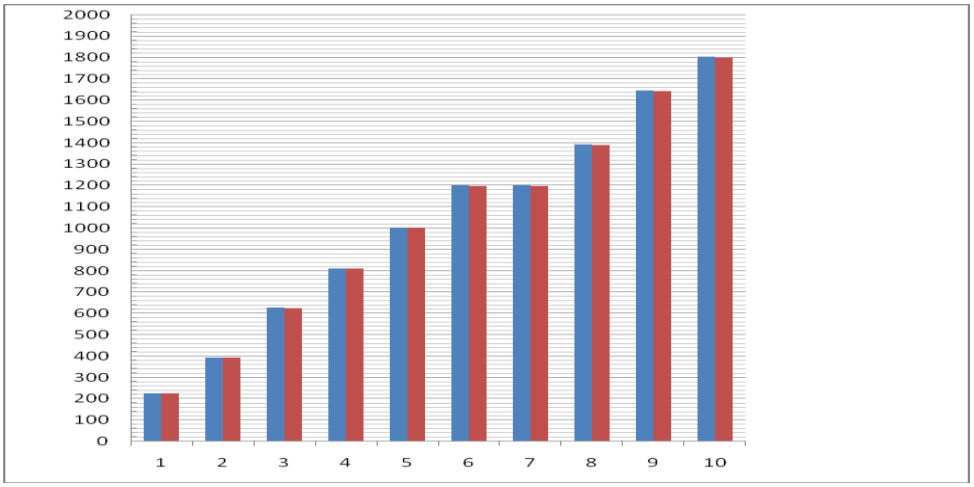

Fig 3.Graph between clustering & two levels clustering.

TABLE II. SENDING ENERGY WASTAGE OF NODES IN CLUSTERING & TWO LEVELS CLUSTERING.

Number of Nodes	Energy Usage in Clustering (In nj)	Energy Usage in Two Level Clustering (In nj)	Saving Energy by using Two levels Clustering (nj)
50	22515.97101	22464.03758	51.93343
100	39339.13822	39293.75822	45.38
150	62661.18551	62534.80382	126.38169
200	81067.55358	80935.08111	132.47247
250	100335.6963	100159.2454	176.4509
300	120000.8884	119801.9817	198.9067
350	139260.2053	139049.3044	210.9009
400	164595.5473	164344.8574	250.6899
450	180308.3102	179988.6439	319.6663
500	201552.1931	201234.5559	317.6372

Conclusion

In clustering, the cluster head decision is a major challenge. If network is taken as a whole, then the energy consumption can be optimized by the rotation of this cluster head & SCH (sub cluster head) inside the individual clusters & sub cluster. This paper mainly focused on clustering & two levels clustering for energy consumption of Wireless Sensor Network. The approach involves the concept which represents the different steps that are performed to conserve the energy of CH & SCH in wireless sensor networks. In this paper, a new technique is proposed to select sub cluster head among some of the wireless sensor nodes based on distance from CH. The proposed two level clustering used to increase & improve the lifetime of the network.

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