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Centroid Cluster Head Selection in Wireless Sensor Network

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Abstract: ***In Wireless Sensor Networks, having two types of approaches non-clustering & clustering based. In both cases the prime role in network is energy consumption to transmit the data that will decide the life time of network. So this paper focused on the energy consumption. This research paper works for generation or formation of cluster & how to select the cluster head by which consideration of energy consumption should be less than non-clustering approach. In this research paper to create the cluster, implement the K-Mean algorithm to select the cluster head based on the nearest node to the centroid of cluster. This paper considers the sending energy consumption of each node in the whole network in both cases i.e. non-clustering & clustering.***

Keywords: Wireless Sensor network, clustering, energy, cluster head. K-Mean

I. 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:

- **Dense Node Deployment:** Sensor nodes are generally nearly sent in a field of hobby. The quantity of sensor hubs in a sensor system can have different requests of degree is higher than that in a mobile adhoc network.
- **Battery Powered Sensor Node:** Sensor hubs are typically fueled by battery. Much of the time, they are sent in a brutal or unfriendly environment, where it is extremely troublesome or even difficult to change or revive the batteries.
- **Severe Energy, Computation, and Storage Constraints:** Sensor hubs are to a great degree restricted in vitality, calculation, and capacity limits.
- **Self Configure:** Sensor hubs are typically inconsistently sent without watchful arrangement and building. Once conveyed, sensor hubs need to independently sort out themselves into a correspondence system.
- **Application Specific:** Sensor systems are application particular. A system is normally arranged and sent for a particular application. The outline necessities of a system change with its application.
- **Unreliable Sensor Nodes:** Sensor hubs are normally sent in unfeeling or threatening situations and work without participation. They are inclined to physical harms or disappointments.

- **Frequent Topology Change:** System topology changes regularly because of hub quit working, hurt, gathering, and vitality diminish, or channel vanishing.
- **No Global Identification**: Because of the substantial number of sensor hubs, it is normally unrealistic to fabricate an all inclusive tending to get ready for a sensor system in light of the fact that it would start a high slide for the recognize.

Sensor networks are required 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 positioned randomly in the area of interest by relatively uncontrolled means (i.e., dropped by a helicopter) and they establish a network in an ad-hoc manner [1, 2].

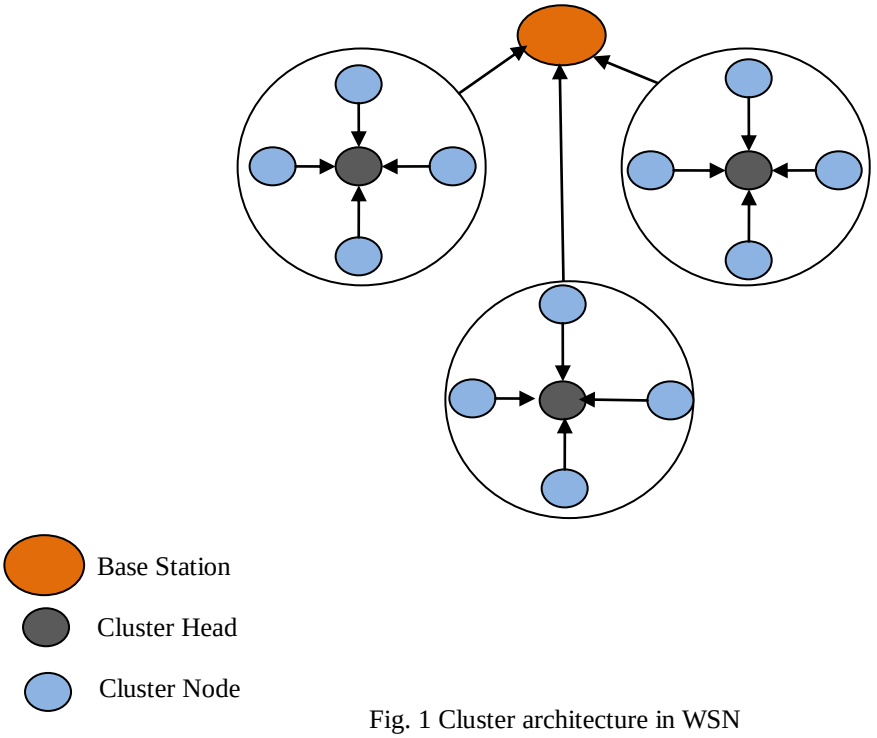

Fig. 1 Cluster architecture in WSN

Figure.1 shows a typical cluster-based WSN architecture. The nodes sense the information and transmit it to the base station through an intermediary 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 pluck out and transfer information to the sensor nodes. Unlike nodes, base stations are many times more powerful and have an Alternating Current power supply, high communication bandwidth, and larger processing power and storage facilities.

The energy consumption in a WSN can be minimised 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; in the direct transmission of data the base station will consume large amount of transmit power from each node.

II. RELATED WORK

Many gluttonous algorithms have been proposed to choose cluster heads in ad hoc networks, and wireless sensor networks. They are based on the standard norms of highest degree, lowest- ID, highest-ID, and node-weight, residual energy, probability, and any other 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 arbitrary generated value between 0 and 1. If this arbitrary generated value is less than threshold value then the node turn as cluster head for the current round. LEACH [11] is the first tree based cluster-based routing protocol for wireless sensor network which splits the nodes into clusters, in each cluster a node with extra privileges called Cluster Head (CH) is responsible for creating and operating a TDMA (Time division multiple access) scheme and forward aggregated data from nodes to the Base Station where these data is required 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 forming only one node to transmit data to the base station in this protocol every node transmits it's data only to its nearest 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] occasionally selects cluster heads according to a combination of their remaining energy (RE), and communication cost of nodes. Distributed Weight-Based Energy-Efficient Hierarchical Clustering (DWEHC) [10] is a modified version of the HEED. It claims to provide more balanced cluster size. HEED uses two clustering parameter to select CH: one is remaining energy, and the other is communication cost.

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

III. PROPOSED WORK

The amount of redundancies found in WSNs; direct transmissions the base station will consume large amount of transmit power from each node. In clustering approach, instead of sensor nodes sending the data to the base station here data send to the cluster-heads. This paper wants to save power consumption of whole network by this architecture because node communicates with cluster head & CH further communicates with BS consumes less energy than non - clustering approach. The proposed algorithm is successfully implemented in MATLAB R2009b.

A. Cluster head selection using k-mean

Originally in WSN, there is collection of nodes, so with help of KMEAN algorithm [13] [14] creates clusters of nodes in Fig 2, by which nodes come under in different clusters. Each node belongs to one cluster. Next level of working 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. Centroid CH Selection

Fig 2 shows preparing a cluster & find out the center of circle of cluster using K-Mean algorithm. Then next phase is to select the nearest node to the centroid. That node will be work as cluster head (CH). All the nodes of cluster will communicate to the CH head and sends own sense data to CH. Cluster head aggregates the collected data and sends to the base station of the network.

C. Energy Calculation

To calculate the energy focused on two approaches:

1) Non-Clustering

In non-clustering each node directly communicates to the base station (BS).So, calculates the energy consumption of each node.

$$E_{BS} = \sum_{i=1}^{i=n_c} Node_i$$

2) Clustering: Centroid CH selection approach

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

$$E_{CH} = \sum_{i=1}^{i=n_c} Node_i$$

$$\mathrm{E(total)} = (E_{CH}) + (E_{CHtoBS})$$

$\mathrm{Node_i}$ = Nodes of cluster

$\mathrm{E_C}$ = Sending energy of cluster

E(total) = Total energy

$\mathrm{E_{CHtoBS}}$ = CH to BS energy

To calculate the sending energy with using following formula:

$$\mathrm{E(t)} = (\mathrm{E(elec)} * \mathrm{k}) + (\mathrm{E(amp)} * \mathrm{k} * \mathrm{d} * \mathrm{d})$$

Table1. 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 non - clustering & centroid clustering

Fig 3 depicts graph of energy between non - clustering & centroid CH selection approach. This graph drawn based on number of nodes in cluster & energy consumption in non - clustering & centroid CH selection approach. Fig 3 depicts that energy consumption in non - clustering is more in comparison of centroid CH selection approach.

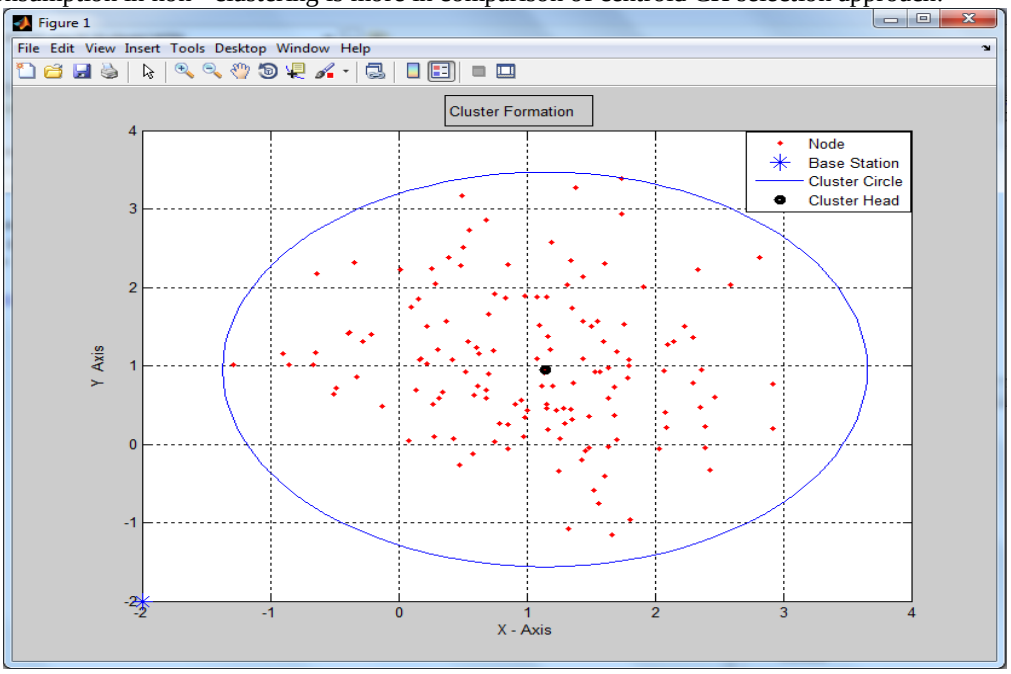

Fig 2: Cluster Formation

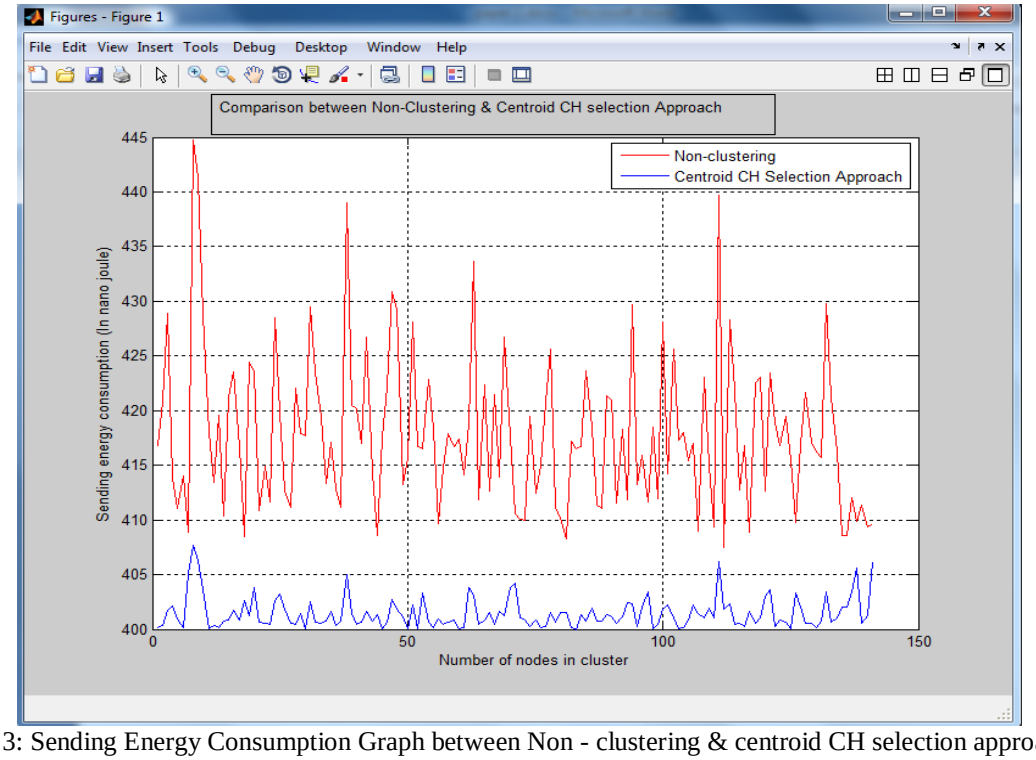

Fig 3: Sending Energy Consumption Graph between Non - clustering & centroid CH selection approach

Table II Sending energy Consumption of nodes in NON-clustering & centroid CH selection approach

Number of Nodes	Energy Usage in Non - Clustering (in nj)	Energy Usage in centroid CH selection approach (in nj)	Saving Energy by using centroid CH selection approach (in nj)
50	22053.23846	21280.33405	**772.904**
100	39910.58883	39755.47002	**155.119**
150	64131.50985	61820.94383	**2310.57**
200	80594.50285	80275.80423	**318.699**

250	98652.36554	98349.47081	**302.895**
300	118847.0926	118396.1213	**450.971**
350	142437.2904	137262.8585	**5174.43**
400	165906.5131	160131.4298	**5775.08**
450	189724.3167	183053.1342	**6671.18**
500	203760.4789	196319.5726	**7440.91**
550	216277.6422	215568.4339	**709.208**
600	224360.8863	223611.8643	**749.022**
650	259807.6745	250494.567	**9313.11**
700	294590.4425	284205.4866	**10385**
750	303006.3558	301822.0653	**1184.29**
800	329436.6337	317524.2306	**11912.4**
850	348630.6315	347172.0708	**1458.56**
900	358165.7069	345274.6509	**12891.1**
950	388948.1401	374974.4469	**13973.7**
1000	400067.6499	398649.4147	**1418.24**
1050	419407.8681	417904.65	**1503.22**
1100	464957.1748	448447.5037	**16509.7**
1150	469919.1889	468168.2668	**1750.92**
1200	498551.6113	480990.4636	**17561.1**
1250	527268.8928	508613.4801	**18655.4**
1300	544031.3677	524606.1944	**19425.2**
1350	572458.573	552274.6504	**20183.9**
1400	575376.0268	573223.9011	**2152.13**
1450	587891.5421	585739.6239	**2151.92**
1500	636432.7804	613845.2733	**22587.5**

IV. 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 inside the individual clusters. This paper mainly focused on non-clustering & centroid CH selection approach 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 on non-clustering & centroid CH selection approach in wireless sensor networks. In this paper, a new technique is proposed to select cluster head among some of the wireless sensor nodes based on distance from CH. The proposed centroid CH selection approach used to increase & improve the lifetime of the network.

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