Network Lifetime Enhancement by a New Clustering Method in Wireless Sensor Networks

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***Abstract*— One serious request in scheming and conduct a wireless sensor network is how to save the energy ingesting of the sensors in order to exploit network lifetime below the restraint of full reporting of the checked targets. However, utmost of the current schemes are either geared in the direction of extending network period or improving amount. Even excellence of service trials can be reduced to lifetime thoughts. A great amount of systems and methods were proposed to increase the lifetime of a sensor network while their assessments were always based on a particular meaning of network lifetime. Since targets are unnecessarily covered by more sensors, in order to conserve energy capitals, sensors can be organized in sets, activated successively. In this paper, a new way has been presented to development of network superiority, which in that network, in count that improve life time of wireless sensor network. Extensive inexperienced tests show that the use of the area of maximizing the total block energy of the covers creates covers with substantially longer network lifetime than the lifetime of the covers created with the goal of exploiting solely the number of covers.**

***Keywords*—Wireless Sensor Networks; Clustering; Data storage; Lifetime: Quality of Service.**

Wireless sensor networks (WSNs) contain of a possibly large amount of wireless networked sensors required to operate in a probably hostile situation for an extreme duration without human intervention. First, sensor nodes have a limited calculating power and a low memory limits the type of the processed algorithms which could be used. Second, the wireless sensors have a little battery and the lifetime of the sensors is a main issue in designing this system [1].

Wireless Sensor Network collected of sensor nodes deployed in the region of interest. Sensor nodes sense and detect events in the region and connect data back to the Base Station. The region of attention can be remote area or hostile setting where human intrusion is not probable, hence the reliability of wireless sensor network is greatest important. To style sensor networks more reliable postures a great challenge to research public [2]. A characteristic wireless sensor network is composed of electric devices, the sensors, which screen targets and collect data about them and transmit it to the sink which acts as the network border to serve external user applications. One substantial nose of wireless sensor networks is that sensors are usually freestyle powered, and then have limited and usually irreplaceable power source [3]. WSN node is comprised of low-power sensing devices, embedded processor, and communication channel and power module. The embedded computer is generally used for collecting and dispensation the signal data taken from the sensors. Sensor element produces a quantifiable response to a change in the physical complaint [4].

A significant subject in sensor networks is power scarcity, ambitious in part by battery size and heaviness limitations. Mechanisms that optimize sensor energy consumption have a great impact on extending the network lifetime. Power saving techniques can generally be classified in two groups: scheduling the sensor nodes to alternate amid active and sleep mode, and regulating the broadcast or sensing range of the wireless nodes [5].

In this paper in Section 2, we will present the related mechanism. In Section 3, we will offer a proposed approach for clustering. The experimental results have been mentioned in Section 4, and finally, we will come up with the conclusion in Section 5.

I. RELATED WORK

A. Data storage method

Data storage in WSNs mainly falls into two categories, namely central data storage and distributed data storage Gonizzi[6] Data obtainability, security, enquiry processing and data retrieval, network lifetime, energy efficiency are the main challenges faced by data storage in wireless sensor networks. In the earlier case, data are sensed, processed, combined and managed at a central location, usually a sink. In the latter case, afterward a sensor node has produced some data, the node stores the data locally or at some designated nodes within the network, instead of directly forwarding the data to a centralized location out of the network. Data obtainability, security, query processing and data retrieval, network lifetime, energy competence are the

 - ISSN: 2467-293X
Website: www.i-cses.com --- E-mail: info@i-cses.com

major challenges faced by data storage in wireless sensor networks. Since sensor nodes are more prone to failure, data loss will occur in WSNs. As a result of these data obtainability in WSN becomes very little. Use of data replication mechanisms will help to avoid such states.

When data is stored in the sensor networks, it could bring several problems:

- Sensors have an imperfect memory, so we couldn't store a large quantity of data regular or annually.
- Since the feeding source of sensors is battery when it dies, the stored data in it will be failed.
- Exploring in the expanded and scattered network will be more difficult.

The problem with the limited capacity of memory, transmission and battery capacity will be improved partially [7, 8].

Storage and forward nodes have been mentioned in [7] as follows:

Storage Nodes: These nodes store all the received data from the other nodes and also their self-generated data and send nothing before receiving Query. According to the definition of Query, they come up with the desired results from Raw Data and transmit the relevant results to the base. The base itself is interpreted as the storage node.

II. CLUSTERING METHOD

Newly, clustering protocols have been established in order to recover scalability and reduce the network circulation towards the sink. Cluster based procedures have shown lower energy ingesting than flat systems despite the above introduced by cluster edifice and maintenance.

The group of sensor nodes into bands has been widely pursued by the research communal in order to achieve the network scalability impartial. Every cluster would have a leader, often referred to as the cluster-head (CH). Although many clustering algorithms have been proposed in the literature for ad-hoc networks, the objective was mainly to generate stable clusters in settings with mobile nodes. Many of such methods care mostly about node reachability and route stability, without much fear about critical design goals of WSNs such as network longevity and coverage. Recently, a number of collecting algorithms have been specifically intended for WSNs.

Cluster heads manage the internal network of the cluster as shown in Figure 1. Three clustering methods have been explained below:

A. GC (Greedy clustering method)

In this method, there is just one criterion for clustering the storage nodes:

The storage node must be in the range of the cluster head. The problem with this method is that the storage node might be next to another cluster head.

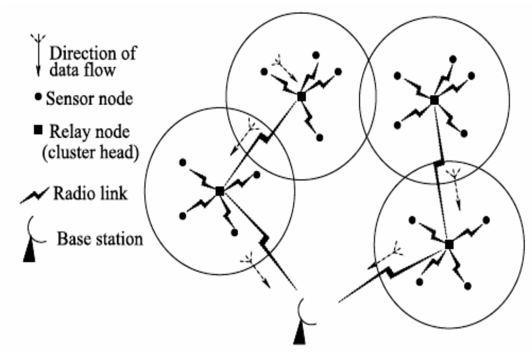

Figure 1. A clustered sensor network

B. LDC (Least distance clustering method)

Distance is the important criteria in this method and the storage node belongs to a cluster which is next to it.

The problem with this method is that several storage nodes might have been near a cluster and different workload will be exerted on the cluster heads and this lack of counterbalance could decrease the lifetime of the network.

C. MCVC (Minimal cardinality variance clustering method)

Counterbalance is the important criteria in this method. First the storage nodes which are only in the range of one cluster head will be located in that cluster. Then for the remaining storage nodes it will be investigated that slightly node is in range of which cluster heads. It chooses among the cluster heads the one which is the most uncrowned one.

D. Single-Level Clustering Algorithm

Each sensor in the network develops a cluster head (CH) with likelihood p and promotes itself as a cluster head to the sensors within its radio range. We call these cluster heads the volunteer cluster heads. This advertisement is forwarded to all the sensors that are no more than k hops away from the cluster head. Any sensor that receives such advertisements and is not itself a cluster head joins the cluster of the closest cluster head. Any sensor that is neither a cluster head nor has joined any cluster itself becomes a cluster head; we call these cluster heads the forced cluster heads. Because we have incomplete the announcement forwarding to k hops, if a sensor does not receive a CH billboard within time duration t (where t units is the time required for data to reach the cluster head from any sensor k hops away) it can infer that it is not within k hops of any volunteer cluster head and hence become a obligatory cluster head. Besides, then all the sensors within a cluster are at most k hops away from the cluster-head, the cluster head can transmit the accumulated material to the giving out center after every t units of time.

III. THE PROPOSED ALGORITHM

The main purpose of the future procedure is to make use of the positive points of both clustering and data storage methods. It means that we could increase the lifetime of the network and put the work load on the relay nodes by this method. In this method, the sensed data will be transmitted periodically to the base station and this will lead to the placement of the data in a safe place. So, they won't be failed. In this method, the life time of the network is more than the others. [9,10]

Also data gathering is carried out beforehand clustering and clustering processes will be done on the storage nodes which are copious less than the number of the sensors which kind the cluster heads to send material about the time schedule to a few numbers of nodes. Sending information in pipeline form is another characteristic of this method. Sending information in pipeline form is another characteristic of this method. [11-14] .

A. Data storage phase

In this phase, after creating a sensor network and putting the storage nodes and the cluster heads on the network, each forwarding node must select a storage node. The purpose of this phase is to provide a sensor network to send the sensed information to the storage nodes by sensors. In this phase, each sensor must select a storage node for itself to send its information to it, so that the cost of sending data to that storage node will be less than that of the other storage nodes [15].

The algorithm of this method is so that for each storage node a counter is defined. First, those sensors which are only in the range of one storage node belong to it. Then, for the remaining sensors, each sensor belongs to a storage node which:

Firstly, is at its range and secondly the counter of that storage node is less than the other storage nodes in its range. If there are two or more storage nodes which their counter is equal, sensor will belong to a storage node which has little distance from it. If a sensor is in the range of no storing node, the multi-hop technique will be used to send its detected data to a storage node.

Begin

For each $i \in S$ do {

If sensor node i can communicate only with storage node j then {

$$S^j = S^j \bigcup \{i\}$$

$$S = S - \{i\}$$

$$C^j = C^j + 1$$

}

}

Else if sensor node i can communicate with more than one storage node then

{ if $C^j < C^k, \forall K \in R$ such that $J \neq K$ and i can communicate with k {

$$S = S - \{i\}$$

$$C^j = C^j + 1$$

$$S^j = S^j \bigcup \{i\}$$

}

}

Else if $C^j < C^k, \forall K \in R$ and $C^j = C^l$ such that $J \neq K$ and i can communicate with k

If distance j < distance l then {

$$S^j = S^j \bigcup \{i\}$$

$$S = S - \{i\}$$

$$C^j = C^j + 1$$

}

Else if sensor node i can not communicate with any storage node then

Use multi-hop routing strategy

S is set of sensors. i is a sensor that want to communicate with a storage node. j and k is name of storage nodes. S^j is set of sensors that communicate whit j and C^j is number of theirs.

B. Clustering phase

The main purpose of this phase is clustering of the network on the storage nodes.

MCVC [16-19] algorithm is used in this case. Since the storage nodes participate in clustering and each storage node has a lot of information, so observing the counterbalance in clustering could distribute the transmission workload in the equipoise counterbalance.

When the sensed data in the data storage phase is transmitted to the storage nodes, in the clustering phase, the data which has been gathered in the storage nodes will be transmitted to the cluster heads, and finally, it will be sent to the base station as shown in Figure 2.

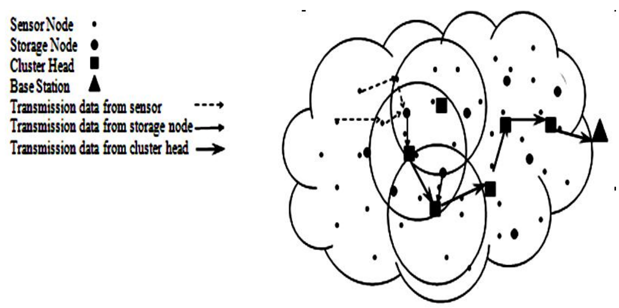

Figure 2. The proposed sensor network with storage node and cluster head

Generally, Data transmission is done in the various stages which have been stated below:

1. From sensor to sensor and also from sensor to storage node.
2. From storage node to cluster head.
3. From cluster head to cluster head and also from cluster head to base station.

One of the advantages of this algorithm is that, the levels 1 and 3 could be carried out by it simultaneously.

Begin

$$C^j = 0 \qquad S^j = 0 \qquad \forall J \in R$$

For each $i \in S$ do {

If storage node i can communicate only with storage node j then

Lifetime in rounds

{

$$S^j = S^j \bigcup \{i\}$$

$$S = S - \{i\}$$

$$C^j = C^j + 1$$

}

}

For each $i \in S$ do {

Find the storage node $J \in R$ such that {

a) i can communicate with j , and

b) $C^j \leq C^k, \forall K \in R$ Communicate with k

$$S = S - \{i\}$$

$$C^j = C^j + 1$$

$$S^j = S^j \bigcup \{i\}$$

}

}

So, in a moment, sensors send data to storage node and also cluster heads send data to base station in pipeline form.

Another advantage of this method is that firstly, the transmission workload is more on the relay nodes, which that increases the lifetime of the network. Secondly, it doesn't have the problem of the storage node method because data will not be failed when the storage node wipes out, since in this method, data is sent to cluster heads periodically. Thirdly, because of the simultaneous sending of data from sensor to storage node and also from cluster head to base station, the speed of data transmission will increase.

IV. Experimental Results

We imitation our method using both, the Avrora sensor network simulator/emulator and the tinyOS simulator TOSSIM. The simulation results achieved with the Avrora simulator were in some suitcases mistaken, because the radio units of the nodes incline to block for very great or thick networks. Thus, here we current the results for TOSSIM simulation for three situations with the following limits. In any case the network was mesh, with constant distance between each column and row. To expand the thickness of the network we used either the single or dual radio range, connotation that the nodes were able to reach the bulges one or two rows/columns away, respectively. First, we carried out the test on the network of 12 clusters by 75 to 150 sensors as shown in Figure 3. Then, we simulate for the network of 24 clusters by 200 to 750 sensors as shown in Figure 4.

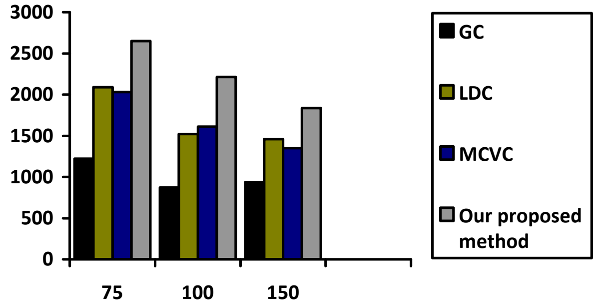

Figure. 3. Comparison of network lifetimes with different clustering methods for a 12 relay node network

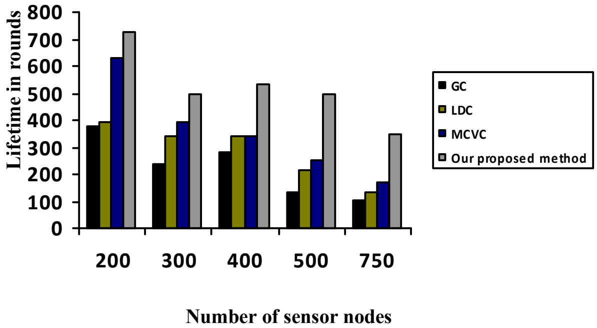

Figure. 4. Comparison of network lifetimes with different clustering methods for a 24 relay node network

Our proposed method has been compared with GC, LDC, and MCVC methods. The table for the comparison is as follows:

Table I displays that our proposed technique by 75, 100 or 150 sensors and 12 relay nodes has longer life time than other methods. Also our proposed method in a network by 200, 300, 400, 500 or 750 sensors and by 24 relay nodes is better than other methods as shown in table II.

TABLE I.

LIFE TIME AMOUNTS WITH 12 RELAY NODES

Clustering method	Number of sensor nodes		
	N=75	*N=100*	*N=150*
GC	***1220***	***871***	***938***
LDC	***2090***	***1520***	***1460***
MCVC	***2030***	***1610***	***1350***
Our proposed method	***2650***	***2215***	***1835***

TABLE II.

LIFE TIME AMOUNTS WITH 24 RELAY NODES

Clustering method	Number of sensor nodes				
	N=200	*N=300*	*N=400*	*N=500*	*N=750*
GC	***375***	***235***	***282***	***137***	***106***
LDC	***395***	***341***	***338***	***215***	***133***
MCVC	***626***	***390***	***340***	***254***	***169***
Our proposed method	***725***	***493***	***536***	***498***	***350***

V. CONCLUSION AND FUTURE WORK

In this paper, we have proposed an effective clustering method for the sensor network. In this method we have divided the method of data transmission from sensor to the base station to two general stages. Using this method leads to more involvement of the relay nodes with data sending. This increases the life time of the network. Also this method solves the risk of the failure of the sensed data. The results of the simulation show that in networks with different clusters and sensor nodes, the proposed method has a longer life time than the other methods.

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