Energy efficiency sink based data collection protocol in WSN

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Abstract: A sensor node is that the significant part of a wireless sensor network. Sensor nodes have various roles in a network includes identifying data storage, data processing and routing method. Cluster is an organizational element for wireless sensor networks. The powerful environment of this network is very essential for them to be broken down into clusters to make easier responsibilities such as communication. Cluster heads are the group head of a cluster have greater data rate match the alternative cluster member. They frequently needed to associate activities within the cluster. These methods comprise but are not controlled to data aggregation and forming account of a cluster. Base station is at the upper level of organized wireless sensor network. It generates communication link among the sensor network and the end user. The data in a sensor network can be used for an enormous variety of applications. A detailed application is form use of network data over the internet retaining a personal digital assistant or desktop computer. This paper contributions mobility based reactive protocol named “Mobility of Sink based Data Collection Protocol (MSDCP)”. This protocol sensor with great energy and maximum quantity information are picked as cluster heads that gather data from the common nodes between the clusters. This data is placed unless mobile sink comes within the transmission area of cluster heads and request for the gathered data. One time the request is received from cluster head and it forward data to the mobile sink.

1. INTRODUCTION

Clustering is an associate of an effective routing system in which the whole network of sensors is split into multiple clusters. Every cluster has one Cluster Head who is primarily responsible for aggregating data[2]. Therefore, traffic congestion is prevented by cluster nodes which send data to the cluster head instead of direct communication with the base station. Wireless sensor network clustering algorithms pay considerable attention to energy savings as it is impossible to replace or recharge sensor node batteries. The topology of clustering will connect the route within the cluster and therefore reduces the size of the routing table stored on the sensor nodes of the entities.

Traffic costs in a wireless sensor network minimized by the cluster head by data aggregation. The hierarchical model includes two vitally important methods:

a) Selection of Cluster Heads, and
b) Assignment of every node to one or several clusters.

An energy-efficient algorithm elects cluster heads for energy-saving, however if such cluster heads do not have a smart relationship between the nodes or links, retransmission tends to be stable and dropped packets will greatly reduce network efficiency and thereby waste total resources.

For any clustering algorithm which aims to minimize the energy consumption in a network, efficient and safe communication is necessary. The network time cycle will be determined not only by the
moment the original energy first node or last node stops, but also by the moment the network is configured to deliver infrastructure and run properly. As the network is usually small and few nodes are redundant, the lack of restricted nodes does not threaten the network. Thus the network time span is entirely combined with the efficiency of the network.

2. OBJECTIVES

The following objectives are active to most sensor applications.

a) Load Balancing: Load balancing is distributing the work between two other nodes. Having an obvious allocation of nodes across the cluster groups is energetic for improving the life of entire wireless sensor network. A load balancing is that the progression of server gathering. If the size of cluster sets becomes irregular at that moment the lifetime of a cluster is conveyed. Depending on conformation of a sensor node is irregular a cluster might have harm method of complete sensor network. Different study of cluster head collects the complete amount of data to accomplish this assignment. The subject on the application and details of data being collected besides a report will analyse what quantity of direction this must functionality of sensor network.

b) Fault-Tolerance: Fault tolerance is engaged to attain reliability and accuracy, energy saving, and moreover enrich the network life time. The physical harm malfunction should be restrained in the design of sensor network. The negative consequences if a CH ineffective in the deployment and there was not any design to remove the CH tasks. Since the genuineness of unintended failures there should be an arrangement for opinion performance of every CH and a plan to shift a crashed cluster head.

c) Energy Efficiency: Maximizing the lifetime of sensor is an important purpose for sensor application. Energy acquired by manipulative receiving, transmission, observing messages on a radio channel. Mission of a sensor node will reply away battery life gained by rejecting energy inefficiencies from the sensor node. Collection of responsibilities set before this node does not seem to be enhanced for energy then the lifetime of sensor is extremely concentrated. Value of sensor network is slightly tied with a life expectancy of a sensor node.

d) Clustering Process: Clustering process method[3] with successfully organize the complete sensor network into groups of clusters that are organized to communicate between their own cluster member and different cluster. Additionally, capable of aggregated information is send data to the base station. A procedure for selecting a cluster head is needed along with a structure to rotate this responsibility among the sensor nodes. There are different approaches between predetermined CH selections. Clustering method separated a network primary and secondary tiers based on the recognized signal strength of sensor node from the base station.

2.1 Advantages and Objectives of Clustering

The different measurements are used to examining the performance of the clustering mechanisms such as

a) Throughput- It’s a quantity of successful data welcome within the specified time.

\[
\text{Throughput} = \frac{\text{Number of packets received successfully at the receiver side}}{\text{Time duration of data transmission}} \tag{1}
\]

b) End to end delay – A measurement of time taken by a data packet to reach the endpoint.

\[
\text{End delay} = \frac{\text{Time to received packets}}{\text{Time to connected packets}} \tag{2}
\]

c) Transmission Cost – Dimension of required number of data transmissions from the source to end.
A total kind of transmission

\[
\text{Transmission Cost} = \sum \frac{\text{Cost}}{\text{Total number of data packets}} \tag{3}
\]

d) Packet Delivery – Ratio between the number of packets received by endpoint and number of data packets communicated by source point.

\[
\text{Packet Delivery} = \frac{\text{Number of data packets received}}{\text{Number of packets transmitted}} \tag{4}
\]

e) Overhead – A measurement of the overhead for effective clustering and data forwarding.

Flat routing protocols in wireless sensor network and clustering protocols have numerous types of advantages it includes added scalability minimum weight, and minimum energy expenditure an extra robustness. The advantages and goal of sensor summarized follows:

2.2 Scalability

![Figure 1. Structural Design of WSN](image)

Scalability is critical to split into a number of clusters with different assignment thresholds for successful network presentation in clustering sensor nodes of the routing system. The cluster manager is responsible for data consolidation and for information exchange and network management. The square dimensions of MNs used for detecting occurrences and collecting information about them. Clustering topology (Figure 1) would restrict the route set up within the cluster and reduce the routing counter balance held at different sensor nodes.

This form of network topology is easy to manage, and is introduced with versatility to respond to environmental events.
2.3 Data Aggregation
Data aggregation is also referred to as cell data union and can travel at a higher pace. It is the approach of aggregating the data from several nodes to eliminate redundant communication and send aggregated data to the base station; this strategy is successful in saving high energy for wireless sensor networks. The most popular strategy for data union is data mix clustering, in which each cluster head aggregates the collected data and transmits combined data to base station.

3. MAXIMIZATION OF NETWORK LIFETIME
Network lifetime nodes are humiliated when it comes to power supply network capacity and transmitting bandwidth for hard environment operation. In general, it is important to that energy absorption by cluster head for intracluster communication that is at ease in resource than alternative MNs. Sensor nodes that connect to most of the sensor nodes within the clusters should be subject to cluster heads. The aim of the energy warning concept is to select which paths obtained from nodes with greater energy resources would be chosen to spring up the lifespan of the network in internal cluster communications.

Power feeding inside the transmitter or receiver working system and cellular contact in the antenna amp $E_{\text{circuit}}=50$ NJ/bit, $E_{\text{amplifier}}=100$ PJ/bit/m2. The worth of $E_{\text{amplifier}}$ is traditional relative to the four sided of transmission distance.

Transmission kit energy anywhere k is the size of the packets transmitted and d is the interval between the transmitter and the receiver

$$E_{\text{transmit}}(k, d) = E_{\text{circuit}} x k + E_{\text{amplifier}} x k x d^2 \quad (6)$$

The energy for receiving a packet is

$$E_{\text{receive}}(d) = E_{\text{circuit}} x k \quad (7)$$

Accessible sensor with N nodes are formally positioned in field wherever, the location and energy information of these knots are as given in calculation

$$X = [x_1, x_2, x_3, \ldots \ldots , x_n]$$
$$Y = [y_1, y_2, y_3, \ldots \ldots , y_m]$$
$$E = [e_1, e_2, e_3, \ldots \ldots , e_n] \quad (8)$$

N nodes are within the disclosure of base station the nodes are also aware of their remaining energy levels E. It's probable that the argument of node to get the network is controlled by medium access control protocol. Clusters are planned based on the knowledge of nodes so that neighbouring nodes that are within a positive distance D form a cluster. The cluster size is minor the energy engagement of cluster head is reduced then the cluster head approaches are fewer amounts of data acknowledged from cluster supporters [3]. The earliest cluster head is absolute by base station and this CH selects its cluster members.

Around the cluster heads are based on the energy nodes because being a CH, fixtures the battery of node. Nodes stimulate CH selection request message comprising its location (x, y) and outstanding energy E to its adjacent nodes within its choice. The selection is fixed as r dependent on the network, and number of nodes in a cluster is a extreme of 25.
Table 1. Layout of Cluster Head

| Node-Id | Location of Node (x, y) | Remaining Energy (E) |
|---------|------------------------|---------------------|
|         |                        |                     |

All nodes within the network promote cluster head selection request as in Table 1. The nodes send their position information and residual energy to its adjacent nodes inside its coverage range vary and wait for answer from their adjacent nodes. Reply messages have comprises of location and residual energy. Each sensor node that has communicated cluster head request message associates its outstanding energy level with the nodes that have includes location and residual energy. Every sensor node that has connected cluster head request message associates its unsettled energy level with the nodes that have focused the answer as in Table 2.

Table 2. Cluster Information Table for Every Cluster

| Cluster Node ID | Location of Cluster Member | Residual Energy |
|-----------------|----------------------------|-----------------|
| SN₁             | X₁,y₁                      | E₇rem₁          |
| SN₂             | X₂,y₂                      | E₇rem₂          |
| SN₃             | X₃,y₃                      | E₇rem₃          |

The node that personal most extreme remaining energy itself CH for that rounds. This CH interconnects its position to the base station the routing table for CH routing data to the BS is resolute by the BS and directed to CHs. CH controls its track to the base station beached on this table that is efficient regularly by the base station dependent on the exceptional energy of the nodes within the network. In data transmission is finished for one round technique of cluster head election; cluster construction cluster statements and residual energy informs for every sensor node are done by the network routing algorithm.

The routing algorithm accomplishes data aggregation at the cluster head and directions data to base station grounded on reserve between cluster head, and base station. Single hop display is done by base station is in the broadcast range of CH multi-hop transmission rates residence distance for transmissions vary of cluster head to base station.

4. MSDCP PROCEEDING

Sensors are loosely viewed within the target sensing field; cluster is obtained anywhere cluster heads are similar by choosing sensors on the basis of both storage data and extensive sensor energy remaining.
Cluster heads (Figure 2) area units are chosen as standard nodes connected with CH, and their suspicious readings are redirected to cluster heads within a cluster. Together, the data is cluster heads forward their supposedly reported readings to a mobile sink based as it happens within the local region or around the touch spectrum. The basic aim behind infrastructure- and data-based CH selection is to reduce the general intra-cluster communication to achieve prolonged network existence.

5. MSDCP CLUSTER ARRANGEMENT

The design of sensor node clusters is primarily focused on their cluster head size. Essential cluster heads shall be chosen in the best possible way. MSDCP elects the heads of the cluster by measuring residual energy E and scale of sensor node expected data D. Growing node determines a weight W being E and D, and labels the outcome of the option to become a head of the cluster.

\[ W = (\alpha \times E) + (\beta \times D) + (\mu \times I) \]  \hspace{1cm} (9)

\[ 0 < \mu < \beta < 1 \]

For the sensor nodes, cluster forming is focused primarily on a collection of their cluster eyes. Necessary heads of clusters shall be picked in the best manner possible. MSDCP elects cluster heads by calculating residual energy E and size of data perceived by sensor node D. Growing node calculates a weight W being E and D, which labels the outcome of the cluster's choice to become a hand.

\[ T = \frac{1}{W} \]  \hspace{1cm} (10)

Initialization stage both nodes decide that they are heads of clusters and it's right that they locked their head flag of the cluster. The corresponding node timers are extended, with nodes conveying their cluster message by node weight. The other nodes accept the clustering message that they just measure to its local weight. If the received weight is greater they marked the node as their cluster leader. Then mark the self-cluster head flag to fake scheduled order for a cluster.

5.1 MSDCP Intra-Cluster Communication

When the clustering is completed and the remaining nodes are combined with the heads of the cluster and allow their sensed data to be sent to the respective heads of the cluster based on a saved head ID. The cluster head on obtaining the data accomplishes aggregation and usually directs the data through reachable mobile sink before the cluster head is beyond the ranges of communication to reach the cluster head(Figure 3).
5.1.1 Mobile Sink Data Collection
MSDCP, the sink follows traditional rectangular mobility and covers the entire network which crosses the planned clusters. It sends the data specifications between the broadcast ranges to cluster heads, and gathers aggregated data. The sink collects the aggregated data from the cluster heads during this process, the information collection portion relies on the speed of the mobile sink and is long enough to communicate across the network with a mobile sink.

5.1.2 MSDCP Algorithm
The following segment describes the MSDCP algorithmic scheme which was divided into three sections of the initialization process, in particular Aspect1, Aspect2, and Aspect3. It is the original aspect that gathers the information needed for original configuration and focuses on the preceding part. Clustering happens at aspect1, requiring a selection of the cluster core. Aspect 2 transmits data from traditional nodes via the head of clusters. Aspect 3 is responsible for the collection of data through mobile sink movement from the cluster end.

5.1.3 Initialization Aspects
- Schedule _CHmessage (T)
- E ← Assign default energy ()
- T= 1/W
- D ← Sense data ()
Deploy Nodes()
I \leftarrow \text{Assign NodelD()}
W = (\alpha \times E) + (\beta \times D) + (\mu \times I)
\text{Is}_\text{Clusterhead} = \text{True}

Aspect 1
- IF[Timer Expires()]
- Broadcast [CHMessage()]
- END-IF
- IF[CH Message Received()]
- IF[Rec W>W]
- Set[CH (Rec NodelD)]
- Is[ClusterHead = False]
- END-IF
- END-IF

Aspect 2
- IF[NormalNode()]
- Send [Data (D, CH_ID)]
- END-IF

Aspect 3
- IF[Node is _Sink()]
- Broadcast [Data _Request()]
- END IF
- IF[Data Request _Received()]
- IF[Node is _CH()]
- Send[Data ( D, Sink ID)]
- END-IF
- END-IF

6. RESULTS AND DISCUSSION

Using OMNET++ a simulator that uses INET structure, the widespread simulations are structured to test MSDCP presentation. INET Architecture consists of simulation modules which are developed exclusively for WSN. The energy used to relay a k bit of a message over a distance d is measured as:

\[ \text{ETx} (k,d) = \text{ETx} \text{- elec} (k) + \text{ETx} \text{- amp}(k, d) \]  
\[ \text{ETx} (k,d) = E \text{elec } * k + E\text{amp}*k*d \]  

The energy expended when the message is sent is measured as

\[ \text{ERx} (K) = \text{ERx} \text{- elec} (k) \]  
\[ \text{ERx} (k) = E\text{elec}*k \]  

Where, Equation 13 represents a quantity of energy required to deliver k bit message over distance d metres. ERx (k) reflects the amount of energy needed to accept the k bit post, E elec and E amp both characterize the amount of energy required to use the transceivers and amplifier.
6.1 Simulation Parameters
The simulation parameters used is given in table 3

| Name                                | Value                  |
|-------------------------------------|------------------------|
| Number of Nodes                     | 100                    |
| Area Size                           | 500 * 500              |
| Mac                                 | 802.11                 |
| Routing Protocol                    | MSDCP                  |
| Simulation Time                     | 50s                    |
| Traffic Source                      | CBR                    |
| Packet size                         | 512 byte               |
| Rate                                | 250 kb                 |
| Transmission range                  | 250 m                  |
| Number of clusters Sending data     | 1,2,3 and 4            |
| Number of nodes per cluster send    | 3                      |
| Transmit power                      | 0.395 w                |
| Receiving power                     | 0.660 w                |
| Idle power                          | 0.035 w                |
| Initial energy                      | 17.1 J                 |

6.2 Sum of Residual Energy
Figure 4, displays the effects of all detector nodes with respect to the sum of residual energy presence in an adjustable circular scale. MSDCP and MSDCPE are calculated for static detector network with mobile sink that the overall energy usage is tested to be low, as is the case for static sink or DEMC dependent base station. However, during the clustering phase both MSDCP and MSDCPE use a single message collection approach that plays a crucial role in saving energy needed for clustering as equated with DEMC, which not only uses multi-messaging through clustering, but also uses multi-hopes to transfer messages to a base station that is prevented by both MSDCP and MSDCPE-E. The outcome indicates that with all three systems the energy intake during the middle rounds is stopped, and then slows down due to the poor node absorption at the top.
Figure 4 indicates the amount of dead nodes about the fixed number of MSDCP, MSDCPE, and DEMC protocol rolls. As possibly as a consequence and since both MSDCP and MSDCPE are managed using a common sink versatility system, there is just a small gap in their number of dead nodes that are exceptional in the separation of cluster testing, while the separate methodology of DEMC shows heterogeneity.

7. CONCLUSION

The Mobile sink data collection protocol (MSDCP) is effective in meeting the defined goals for energy consumption and increases the network’s lifetime by increasing the number of classifications. Second Contributions a stability management method for the keying framework of the sensor network can be obtained. The computer selects nodes as cluster heads with varied energy resource communication choice and high processing capacity. The cluster keys for cluster heads and pair-wise node keys are rendered into the sink that is done over the exclusion foundation network.

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