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Redundancy Resilient Mobile Sink Scheduling Protocol for Cluster based Wireless Sensor Network

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Abstract

Wireless sensor network is employed to wide variety of applications. Due to size of the sensor element, battery unit of the device is fabricated with limited energy which leads to data losses during heavy traffic on data transmission. Many conventional techniques employs the scheduling technique and incorporation of the mobile sink to balance the energy to avoid the data losses on node failure. However those mechanisms fails to handle the redundancy issues. In order to mitigate those challenges, redundancy resilient mobile sink scheduling protocol for cluster based wireless sensor network is proposed in this paper. The proposed architecture is capable of withstanding network on dynamic conditions. Initially, sensor node has been clustered on selection of cluster head, cluster head manage the other sensor node information and transmit the sensed information of the nodes to base station through mobile sink. During data transmission to base station, mobile sink computes the redundancy computation on basis of packet differentiation technique. It computes the difference in the packet with numerous iteration on each bandwidth. Thus, condition satisfied packet is transmitted to the base station where other packet are eliminated. Simulation analysis of proposed model is evaluated on NS2 and its performance has been compared with conventional scheme to demonstrate the effectiveness of the proposed model especially in eliminating the redundant packet and prolonging life time of node on providing high throughput data communication. Further network performances such as packet delivery ratio , Energy consumption and network overhead is evaluated. Finally it is verified that proposed model reaches high energy efficiency due to redundancy elimination on the clustered network

Keywords: Wireless Sensor Network, Mobile Sink, Clustering, Redundancy elimination, Scheduling, Routing

1. Introduction

Wireless Sensor Network composed of the multiple small sensor node which contains reduced energy and memory capacity but those sensor node contains bandwidth and processing power for good communication capabilities[1]. Further it is deployed in large scale network as where it needs to be operational for long period and it is highly challenging to frequently recharge or to replace battery on its operation for long period. In order to manage the mentioned complication, energy efficient routing technique has been employed as conventional technique in the literature to increase the energy utilization and reduces the data losses due to node failure[2] . However it still fails to handle the redundancy issues.

To mitigate those challenges, redundancy resilient mobile sink scheduling protocol for cluster based wireless sensor network is proposed in this paper. The proposed architecture is capable of withstanding network on dynamic conditions on incorporating the clustering and security concept. Initially, sensor node has been clustered on selection of cluster head[3], cluster head manage the other sensor node information and transmit the sensed information of the nodes to base station through mobile sink. During data transmission to base station, mobile sink computes the redundancy computation on basis of packet differentiation technique. It computes the difference in the packet with numerous iteration on each bandwidth. Thus, condition satisfied packet is transmitted to the base station on aggregating the packet where other packet are eliminated.

The rest of the paper is organized into following section, section 2 details the review of literature related to the energy efficiency technique employed to wireless sensor network on basis of various routing and security techniques. Section 3 provided proposed architecture design of the work with its protocol description. Simulation analysis of the proposed model against the conventional technique on enhancing the energy consumption and eliminating the packet redundancy is illustrated. Finally research article is summarized in the section 5.

2. Related works

In this section, various existing methodology enumerating energy efficient routing techniques on wireless sensor network has been analyzed on basis of mobile sink scheduling aspects towards efficient data communication between nodes in detail as follows

2.1. Dynamic Mobile Sink Scheduling

In this method, mobile scheduling scheme has been analyzed in depth as sensor nodes and mobile sink in this network can dynamically adapts to changes of the network[4]. It dynamically determines a cluster heads of the clustered node at different times on basis of the energy density, such that the mobile sink required to be select the cluster head with optimal trajectory generation for data collection using optimal energy efficient routing technique.

3. Proposed model

In this section , a new energy efficient approach named as redundancy elimination technique based on the packet differentiation analysis has been developed to enhance the life time of network of interacting nodes on specific topology has been designed using various energy related constraints as follows

3.1. Network Model

In this model, sensor nodes is deployed to form a network to monitor the environment [5]. Wireless Sensor Network is established with multiple sensor node incorporating the base station and mobile sink in random order. Each sensor node transmit the sensing information on its sphere sensing range to base station (BS) using mobile sink. Mobile sink acts data collector and transmitted. Further it is considered as transceiver to manage the sensor information**.** The mobile sink collect the sensed information from the cluster head and transmit the collected sense data to base station..

3.2. Clustering of Wireless Sensor Network

In this section, Leach [6] based Clustering model is applied to cluster the sensor nodes into cluster. Further it cluster head is estimated using the residual energy of the sensor node and number of neighbor nodes in the particular cluster. Cluster head selection is carried out to ensure uniform distribution of energy among

the sensors, and consequently increasing the lifespan of a sensor network. After selection of the cluster head, the cluster head periodically collect, aggregate, and forward data to the BS using the minimum energy (cost) routing. Below representation indicate the cluster head representation

CH = {N1,N2,N3...} or CH= {s1,s2,s3...}

Where N1,N2,N3 represents the Sensor node and s1,s2,s3 represent the sensor information of the cluster

In the clustering algorithm, each sensor node firstly counts the number of neighboring nodes within d transmitting hops, which is called the potential number of nCH nodes based on d-hop for each sensor node. Then the node with maximum potential number of nCH nodes based on d-hop is selected as the CH node in each locality. It means that if an sensor node can connect with more neighboring nodes within its effective communication range, it is more likely to become the CH node.

3.3. Mobile sink Scheduling

Mobile sink scheduling in the WSN is to employ the mobile sink to collect the sensed information of each CH node and to transmit the aggregated sensor information to base station. Sensor node trajectory is established trajectory information. The mobile sink close to CH node consumes less energy and mobile sink distance more than one hop consumers more energy[7]The optimal design of mobile sink data collection path among the CH nodes carried out using metaheuristic technique such as genetic algorithm or particle swarm optimization.

Optimal trajectory of the mobile sink M_t = {T1,T2,T3.....}

Employment of meta- heuristic technique to the data of the cluster head and sink, it highly reduces the energy consumption and increase the communication speed of packet distribution to the base station[10]. It identifies optimal cluster head to mobile sink towards the data collection. It computes the optimal cluster head on basis of fitness function. Those technique identifies the fitness path and yield trajectory to mobile sink for data collection.

3.4. Packet differentiation technique

Packet differentiation technique is employed to eliminate the redundant packets propagating from the cluster head into mobile sink to reach base station[8]. During data transmission to base station, mobile sink computes the redundancy computation on basis of packet differentiation technique. It computes the difference in the packet with numerous iteration on each bandwidth. Particular technique builds the packet reference table.

Packet reference table is generated on basis of unique packet and it is provided to mobile sink. Mobile sink utilizes the reference table to identify the redundant packet, on identification, it eliminates the data collection from the particular cluster head. Thus, condition satisfied packet is transmitted to the base station on aggregating the packet where other packet are eliminated.

Algorithm 1: Packet Redundancy Elimination

Input: Sensed Information from cluster head CH = {S1,S2,S3...} & Mobile Sink Trajectory M_t = {T1, T2,T3...}

iteration =0

while (mobile sink Traverse in T1)

For (I=0;I< Node Length, I++)

compute the packet difference between the CH1 in the current iteration and previous iteration

Compute the packer difference between the CH1 and other CH

if (packet difference persist in condition 1 & condition 2)

Allocate the packet to the node

Else Iterate

Allocate the packet to the New node

Transmit the packet to base station

Else

Drop the packet from collection

iteration ++

return

End

Proposed algorithm searches for the node with the packet difference for the data transmission to the base station through mobile sink.

4. Simulation Results

Simulation of the proposed energy efficient redundancy elimination approach for cluster based wireless sensor network is experimented and it is simulated using ns2 simulator [9]. In this deployment of the network containing the sensor node and mobile sink along its configuration with parameter setting has been provided in the table1

Table1: Simulation Configuration Setting

Parameter	Configuration Value
Network Coverage Area	1000*1000m^2
Number of Sensor Nodes	50
Initial Energy of Node	1000 Joules
No of Mobile Sink	1

Based on the above configuration setting, network results for proposed and conventional schemes has presented illustrated in terms of and energy utilization. On analysis, the energy consumption of the sensor nodes on employing proposed architecture, it increase the energy efficiency on compared with conventional model for data transmission. Figure 3 represents the performance analysis of the energy efficiency schemes of WSN[10].

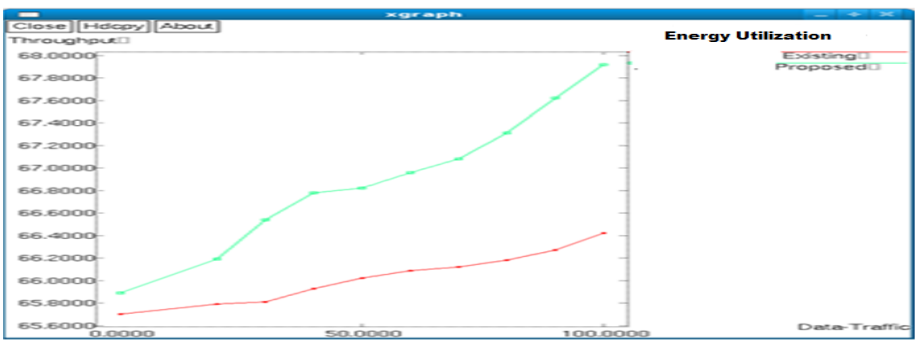

Figure 2: Performance of Energy Utilization

The Proposed scheme can effectively avoid the packet redundancy and increase the energy utilization of sensor node and mobile sink. Mobile sink traverse in the trajectory to collect the data from cluster head and transmit the same to the base station. Cluster head aggregate the data before communicating with mobile sink. Table 2 details the performance of the energy efficient schemes for cluster based wireless sensor networks.

Table 2: Performance Evaluation of Routing Technique of WSN

Technique	Packet Delivery Ratio	Energy Utilization
Energy Efficient Clustering Algorithm- Existing	**96.87**	**6.89 Joules**
Redundancy Resilient technique- Proposed	**97.87**	**5.56 Joules**

Moreover, with the increase of the number of the sensor nodes, the network life time of the scheme would be in high level. Finally proposed scheme has proved that it can achieve the goal of effectively optimizing the system energy as well as providing a good communication performance.

5. Conclusion

Redundancy elimination Algorithm for Sensor Network has been designed and simulated in this article. Proposed approach incorporate the node clustering techniques, cluster head selection technique, mobile sink scheduling techniques and packet differentiation technique to increase the energy efficiency of the wireless sensor network. Proposed model completely eliminate the redundant packet propagation and enhance the life time of the network. Finally the simulation outcomes demonstrate that the proposed approach can effectively achieving high throughput and good packer delivery ratio on various network dynamic conditions.

6. References

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