Evaluating the Performance Using Hybrid Data Aggregation Method for Wireless Sensor Network

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***Abstract*--** In WSN environment, energy and lifetime of the sensor nodes are important factors and it is need to utilize these factors efficiently. Data aggregation at the base station by individual sensor node causes flooding of the data which results in maximum energy consumption. To minimize this problem we propose the hybrid data aggregation method, where nodes are grouped based on available data and correlation in the intracluster and cluster heads are grouped at the network level help to reduce the energy consumption.Simulation result shows, proposed algorithm provides an improvement of energy consumption as compared with Forward aware factor.

***Keywords*—** *Data Aggregation, Wireless Sensor network (WSN), Forward aware factor.*

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I. INTRODUCTION

Wireless sensor networks[6] is widely considered as one of the most important field for research.In Wireless sensor network, sensor nodes are used for gathering data and transmitting to sink but due to limited energy and communication ability of sensor node, it is important to design a routing protocol for WSNs so that sensing data can be transmitted efficiently.it balances the energy consumption and increases the network lifetime.Routing protocols are used for finding and keeping the routes in the network.

In WSNs based on network structure routing is divided into three categories which is flat based routing hierarchical routing and location based routing. All nodes in a flat routing protocol are assigned equal roles or functionality and the nodes collaborate to perform the sensing tasks. The BS sends queries to certain regions within the WSN and awaits data from the sensors located in that region. SPIN and directed diffusion are examples of flat routing protocols. Location or position information of sensor nodes is essential to calculate the distance between neighboring nodes. If the location of sensor nodes are known then data transmission only occurs on that region to reduce the number of transmissions. GAF and GEAR are examples of location-based energy-efficient routing protocols. In the hierarchical routing approach In hierarchical routing protocols, clusters are created and a head node is assigned to each cluster. The head nodes are the leaders of their groups having responsibilities like collection and aggregation the data from their respective clusters and transmitting the aggregated data to the Base Station. This data aggregation in the head nodes greatly reduces energy consumption in the network (CH) and the CH transmits the data to the global BS. This reduces the transmission range of normal nodes to conserve energy.

II. RELATED WORK

➢ FORWARD AWARE FACTOR

In forward aware factor[12] ,we measure the forward transmission area, by defining forward energy density,which constitutes forward-aware factor with link weight that balancing the energy consumption and increases the network lifetime.

A. Network Model

As shown in Fig. 2, suppose sensor nodes are randomly distributed in a W*H rectangular sensing field.Data are sent to the regional central node(cluster head),then transferred to the sink node(Sink).The descriptions and definitions are as follows.

1) All sensor nodes are isomorphic, and they have limited capabilities to compute, communicate and store data. The set of sensor nodes is defined as V= $(v_1, v_2, \ldots, v_N)$. and the total number of nodes are i={1,2,3.....N}.Here, i is the identifier for a node.

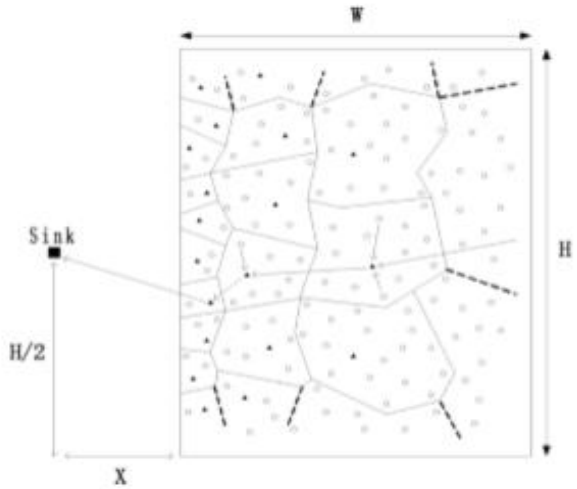

Figure 2 Distribution of sink and sensor nodes[2]

2) The energy of sensor nodes is limited,and the initial

energy is **E.**However, the energy of the sink node can be added. Locations of nodes and Sink do not change after being constant and a node cannot obtain the absolute position depend on its own location device.

3) Nodes transmission power changes according to the distance to its receiver.The sink node can broadcast message to all sensor nodes which is in the sensing area. The distance between the source and receiver can be computed based on the received signal strength. central nodes are not selected at the beginning, on the contrary, they spring up during the topology evolution.Importance nodes have more connections,whose degree and intensity are significantly more than neighbor nodes.

The energy spent for sending a l-bit packet over distance d[12] is

$$E_{Tx}(l,d) = E_{Tx-elec}(l) + E_{Tx-amp}(l,d) = \begin{cases} lE_{elec} + l\varepsilon_{fs}d^2, & d < d_0 \\ lE_{elec} + l\varepsilon_{mp}d^4, & d \geq d_0 \end{cases}$$

Where

$$d_0 = \sqrt{\frac{\varepsilon_{fs}^2}{\varepsilon_{mp}}}$$

When the data transmission distance is larger than threshold , the energy consumption would rise sharply, so the maximum communication radius of common sensor nodes is set to d_0 .

As time goes on,the amount of data becomes larger with the increase of nodes.when *d(i,j)* is long, the data transmission tends to choose a short-distance link. In same way , when is *d(i,j)* large, the communication link is busy,the data transmission choose low-load link firstly.Energy plays a key role in edge weight,

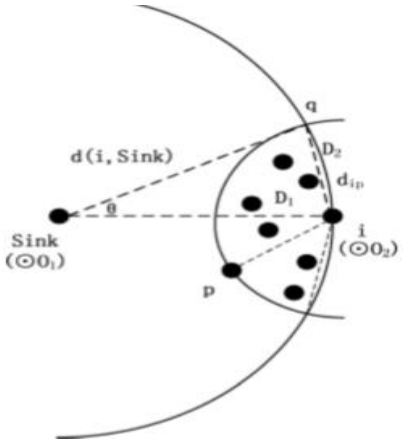

Fig 3 forward transmission area[12]

- **DATA AGGREGATION**

The purpose of data aggregation[1] process is to collect the useful information by eliminating repeated readings of sensor. It helps to reduce the communication cost by improving energy consumption and network lifetime of WSN. It also tries to minimize the problem of congestion. Based on the functionality and selection of aggregator, DA methods are :-

Cluster based data Aggregation :-

To overcome the problem such as transmission delay and loss of data caused due to node failure in the root to sink, and minimizes using cluster based aggregation. In large sized network, efficient communication of data to the sink requires to find the optimal path according to the number of hops. It increases communication cost and reduces the efficiency. In such a scenario instead of communicating data individually to sink, it can be aggregated at cluster head, and transmits compressed data to sink.

III. HYBRID DATA AGGREGATION MODEL

In hybrid data aggregation(proposed model) working at the node and network level are as below:-

1) **At Node Level**:-

- Initially all the nodes have same energy.
- Nodes at the network level groups according to data in the packet.
- CH decides the correlation of data packets from the nodes, which are at one hop distance.

2) **At Network Level**:

- The Sink, Cluster Head and all the sensor nodes are static and homogeneous.
- All sensor nodes in the cluster distribute uniformly.
- grouping of Clusters heads according to aggregated data packets.

IV. PROPOSED ALGORITHM

The proposed algorithm performs in three stages

1)Cluster formation stage,

2) intra-cluster stage

3)inter-cluster aggregation stage

In the initial stage, the uniformly distributed node organizes into the number of clusters (n). It select cluster head according to the highest energy and minimum distance to sink defined using Euclidean distance and the highest number of neighbor nodes.

In the second stage, CH is responsible for aggregation of data packets generated by the source nodes within a cluster.In intra-cluster aggregation, CH sends the broad cast message and collect the data packets from different nodes after regular period of time. It performs the aggregation of data packets based on the additive and divisible aggregation functions by forming a group of nodes. This phase runs recursively for all the clusters within the network.

In the third stage, CH groups according to available data from each CH to perform the further aggregation for communicating to sink. Grouping of nodes in intra-cluster and grouping of CH at inter cluster reduces the data packet count at the sink. It reduces the effective energy required,

V. SIMULATION AND RESULTS

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In the following, we evaluate the energy consumption of hybrid data aggrgation and shows improvement over Forward aware factor protocol The network considers a diameter of 100 x 100 meters with 50-100 nodes, length of message bits 512 (64 bytes), Number of data frames Nf =1000. Table I summarizes simulation parameters used

Initial energy of nodes	100J
Transmitter/receiver electronics	50nJ/bit
Transmit Amplifer short distance	10 -100 pJ/bit/m2
Transmit amplifier-long distance	0.01310 pJ/bit/m4
Energy for data aggregation	=nJ/bit/signal

Table 1 showing simulation parameters

Results of both Forward aware factor and Hybrid data aggregation are compared , in which packets to CH,Packets to base station ,alive nodes and average consumed energy is compared which shows that energy consumed by forward aware factor is more than proposed method i.e. hybrid data aggregation

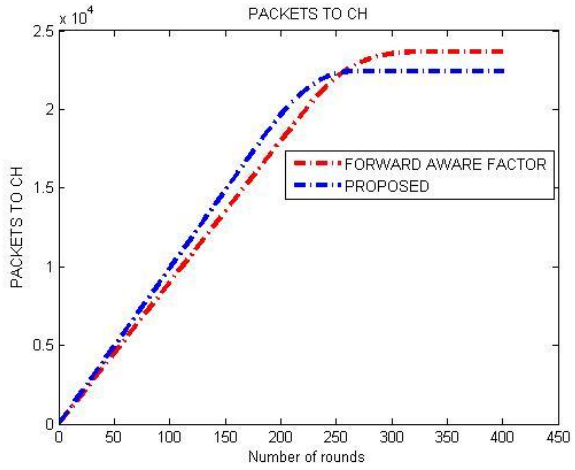

Fig 5 Packets to CH

This figure 5 shows packets to cluster head in both the cases i.e in forward aware factor and in hybrid Data aggregation.results shows that there is less transfer of packet to CH in proposed algorithm.

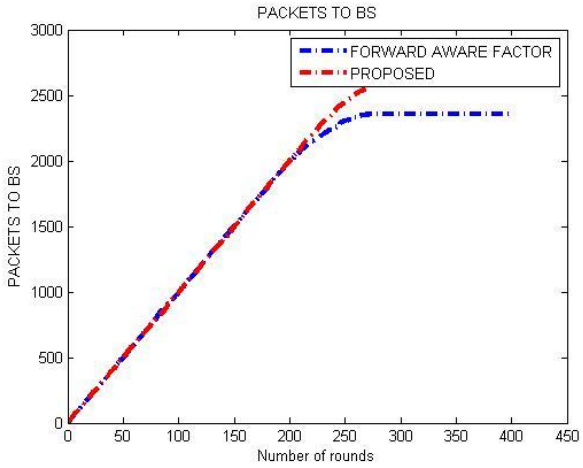

Fig6 showing packets to BS

Figure 6 shows packets to BS in both forward aware factor and hybrid data aggregation, results shows that number of packets with base station increases with rounds in hybrid data aggregation as compared to Forward aware factor

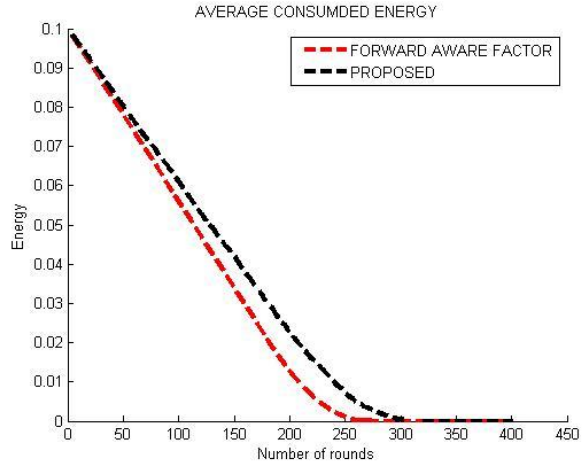

Fig 7 showing energy conservation

Figure 7 showing conservation of energy as figure shows in forward aware factor consumes more energy than proposed system

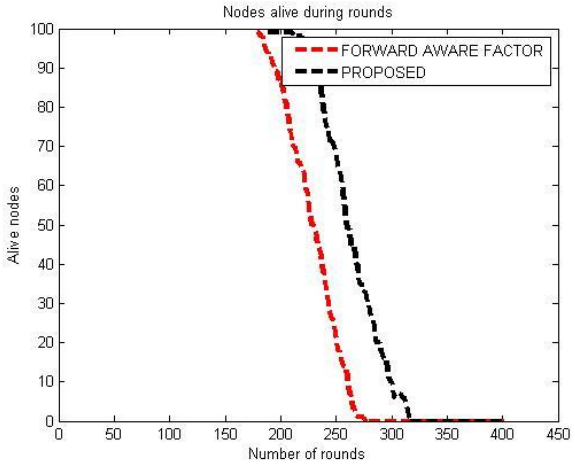

Fig 8 showing alive nodes

Figure 8 showing alive nodes during rounds.in proposed model i.e. In hybrid data aggregation alive nodes are more than forward aware factor within rounds

CONCLUSION

Hybrid data aggregation improves the lifetime of network and reduces the energy consumption in aggregation of data. Result shows that when the number of clusters grouped together in the second level of aggregation reduces energy consumption to Also, if the network diameter increases, then energy consumption increases approximately by 1%. This causes due to the same number of optimal cluster heads with an increase in the distance between them. Optimal number of cluster head has a direct effect on energy consumption. Reduced energy consumption in transmission of aggregated data indicates benefit of the increase in a lifetime of the network.

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