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Tree based Data aggregation algorithm in wireless sensor networks

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Abstract-Wireless sensor network is a cluster of various sensors, which has capability of sensing and communicating the data collected. Effective and efficient data aggregation algorithm in Wireless Sensor Networks (WSNs) can increase the lifecycle of the network by bringing down the communication of unnecessary data and make the security of the networks better. The conventional data aggregation algorithm in WSNs predominantly aims to raise the level of energy utilization, and pay no heed to security and lifecycle. We propose a data aggregation algorithm by constructing a data aggregation tree to deal between energy utilization and lifecycle. The algorithm extends the duration of lifecycle by reducing the maximum energy consumption by the nodes. In scheduled data aggregation, selected communications are accounted to deal between low weighted delay and high network lifecycle. Simulation results shows that the proposed algorithm utilizes less energy for aggregation of the data from the sensor nodes, and hence increases the lifecycle of the network.

Keywords- WirelessSensor Networks, scheduled data aggregation, tree based data aggregation tree.

I. INTRODUCTION

The WSNs contains various kinds of sensors that are very important in the computing platforms. Sensors in WSNs are positioned randomly in a region to observe and gather the data of the actuality environment.

Data aggregation is process of collecting data from various sources and aggregating it to remove duplicate data[1]. The gathered data in the region are usually redundant, and same data can be gathered by various sensors. In a wireless sensor network, the data transmission uses about 70% of the energy, so to minimize the overhead of communication between the sensors and to extend the life cycle of the WSN; the data gathered from individual unalike sensors has to be aggregated.

Researchers have put forward many data aggregation algorithms for data of wireless sensor networks. Data aggregation algorithms can be classified into Flat network and hierarchical networks , which are further divided into push diffusion, two phase pull diffusion and cluster, chain, tree, grid respectively based on network architecture[2]. The primary goal of these algorithms is to minimize the energy consumption in the wireless channels by minimizing the amount of data transmission. Thus, improve the efficiency of network.

WSNs have been applied to many fields, such the environment monitoring, military applications and so on, whereas the secure data aggregation is still a hot research in WSNs[3]. In assurance to the security of data aggregation of sensed data, the main points that can be considered is either the raw data or the aggregation process. In order to enhance the raw data security, data authorization can be used, but it maximizes the total communication overhead of the network.[4] Using secured aggregation algorithms, the data aggregation node can lessen the data fault from nodes that are invalid, but various applications requires various data aggregation algorithms, and they cannot confirm that valid redundant data be obtained.

In this paper to increase the lifecycle of the WSNs, we opt to select the number of communications of each and every node watchfully and get the substitution between high network lifecycle and low weighted delay which makes the whole network longer.

Rest of the paper is organized as follows,Section II contains related works, where the previous research works in wireless sensor networks is described. Section III explains the system model and assumptions along with description of the algorithms, section IV is the results and discussion of the implemented algorithm. Section V concludes the paper.

Our Contributions:
We implement the algorithm in two steps by an increasing implementation area from 200*200m to 500*500m. Firstly, a tree based data aggregation algorithm is built considering the energy of sensor nodes. Secondly a data scheduling algorithm is implemented to schedule the nodes to send the data. We analyse the proposed algorithm using parameters

data aggregation delay, average weighted delay and network lifecycle by comparing it with other algorithms.

II. LITERATURE SURVEY

Network of wireless sensor uses the topology of cluster [7-8] for its management. In this mechanism there is a head node which is selected to manage nodes in the said cluster, gather data in the node and transfer it to other clusters. Transmission of data which is encrypted is impossible between head node and bases as the node head has the semantic of the data which is gathered.

Li et al proposes a secured, energy efficient data aggregation methodology expansion of ESPDA[5]. Master node in network receives the pattern codes, generated using the unanalyzed data by sensor nodes. It then divides the data using *Pattern Comparing Algorithms* and chooses the code required and encrypted data is received from specific sensors.

Ibrahim Atoui Et. Al[6] proposed a similar technique using fitting functions. Jaccard similarity measure between the received data is used for aggregation using and Bayesian Belief Network is used to test the accuracy of system.

Przydatek et al [9] proposed SIA (expansion of SIA) whose framework is used for a larger scale of networks. These have aggregators which decrease the cost of communication in the network by aggregating the data in a queue. The data is the most appropriate to the actual values by sampling it randomly and verifying them.

Mahimkar et al [10] have proposed secure data aggregation and verification protocol. Nodes are assigned in the same cluster by *Secret Sharing Scheme* which is based on the elliptic curve. Average value of the unassigned data is given a partial signature and is gathered by the head node and this process is continued by all the clusters and the final data is sent to the base. The base verifies each signature by their respective public keys.

Another protocol based on the works proposed by Sanli et al[11]finds the difference between unanalyzed data and the referenced one after comparing them and transmit only the differential data to decrease the total communication.

Sugandhi et al[12] also have worked on an energy saving protocol regarding the dangers of leaking aggregated data.
Another aggregation protocol was proposed by Wu et al [13] in WSNs. Each of these algorithms havetheir own advantages but few debase the resource limits and the complexity of their computation is very high. This drains a lot of energy during the process of aggregation. A few other algorithms only focus on securing the data and not securing the transmission from different sensors.

III. SYSTEM MODEL AND ASSUMPTIONS

Weassume that nodes always have data to send & all nodes including start with the same initial energy.

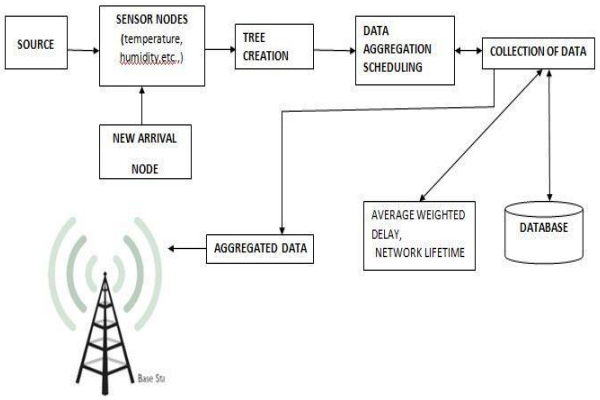


Fig 1. Block diagram of the system

System contains two modules namely data aggregation and data scheduling, explained in the subsections below:

1.DATA AGGREGATION

The main idea of this algorithm is adjusting the sensor nodes in form of tree structure according to the energy of each node as tree structure is more suitable for WSN because of multiple sensors and single base station. Thus reducing communication overhead in the network. Multiple levels of data aggregation is scheduling is carried out. Basic level of data aggregation is done during data transfer between child nodes to parent node. Next levels of data aggregation is carried out during data transfer between parent node and root, before sending to base station. Hence reducing energy consumption of sensor nodes.

2.DATA SCHEDULING

The aim of data aggregation scheduling algorithm is to assign intervals for nodes. We propose an approximating maximal weighted independent set based scheduling algorithm. Firstly, we select the link set, where each link is able to communicate, and construct the link collision matrix according to the collision relationships in the data aggregation tree. Then, based on the collision matrix, we ascertain the communication links in each interval according to constructing an approximate maximal weighted independent set.

In order to reduce the energy consumption of nodes, the state-of-the-art algorithms schedule each link only once, but they can't make sure the data with high priorities are scheduled first. If we don't limit the number of communications for each node, then the energy consumption

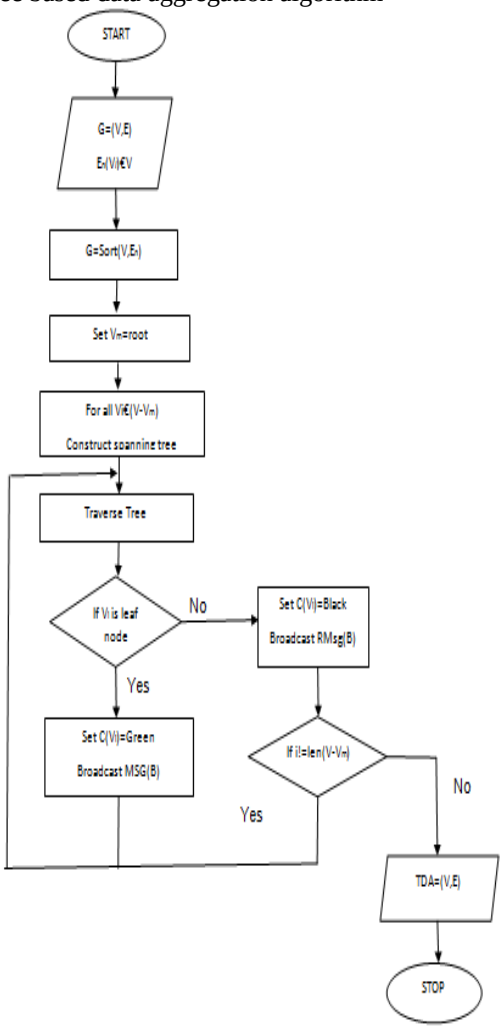
of the network will increase greatly. So, we need to select the number of communications gently to get the trade-off between low weighted delay and high network lifecycle.

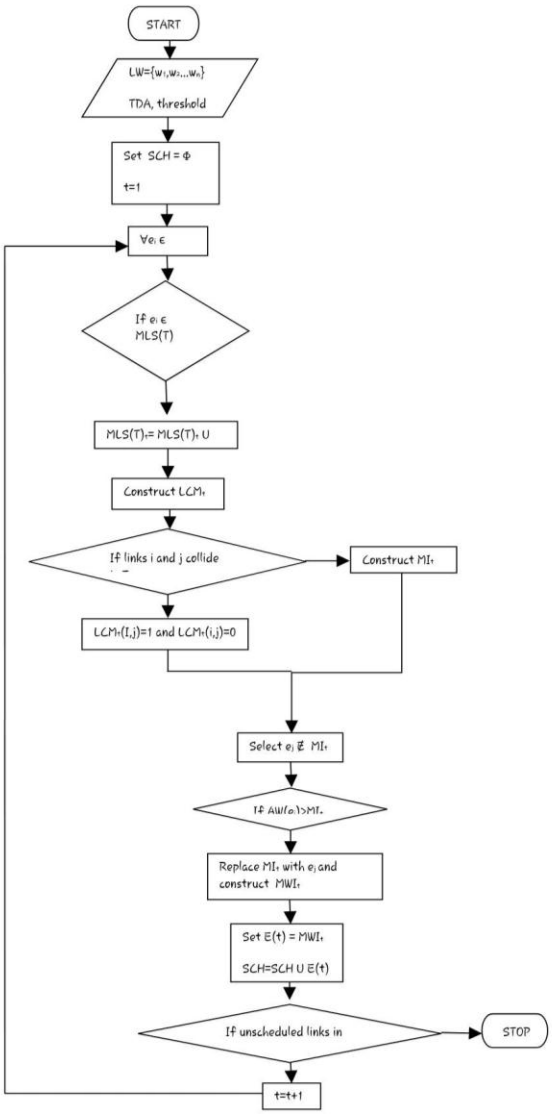
Table. 1 Notations used in the paper

VARIABLE	DESCRIPTION
TDA	Data aggregation tree
sch	Scheduling
MSG	Message
Rmsg	Received Message
MI	Maximal independent set
MWI	Maximal weight independent set
AW	Accumulated weight
MlS	Marginal link set
LCM	Link collision matrix

FLOW CHART OF ALGORITHMS

i.Tree based data aggregation algorithm





IV. RESULTS AND DISCUSSION

Network simulators are tools used to simulate discrete events in a network and which helps to predict the behaviour of a computer network. Generally the simulated networks have entities like links, switches, hubs,applications, etc. Once the simulation model is complete, it is executed to analyse the performance. Administrators can then customize the simulator to suit their needs. Network simulators typically come with support for the most popular protocols and networks in use today, such as WLAN,UDP,TCP,IP, WAN, etc.

The performance measures are energy efficiency and network lifetime.These change with subject to the algorithm and application used in WSN.

1. Energy Efficiency

If the nodes are far from the base station and each and every node have to separately send the data to the base station, the energy utilization will be high without aggregation. So the aggregation effectively uses the energy.

2. Network Lifecycle: It is calculated by determining when first node dies. If energy consumption is effectively used, the lifecycle of the network will be increased. It depends on the amount of data aggregation performed also. Aggregation is the main parameter to increase the network lifetime.

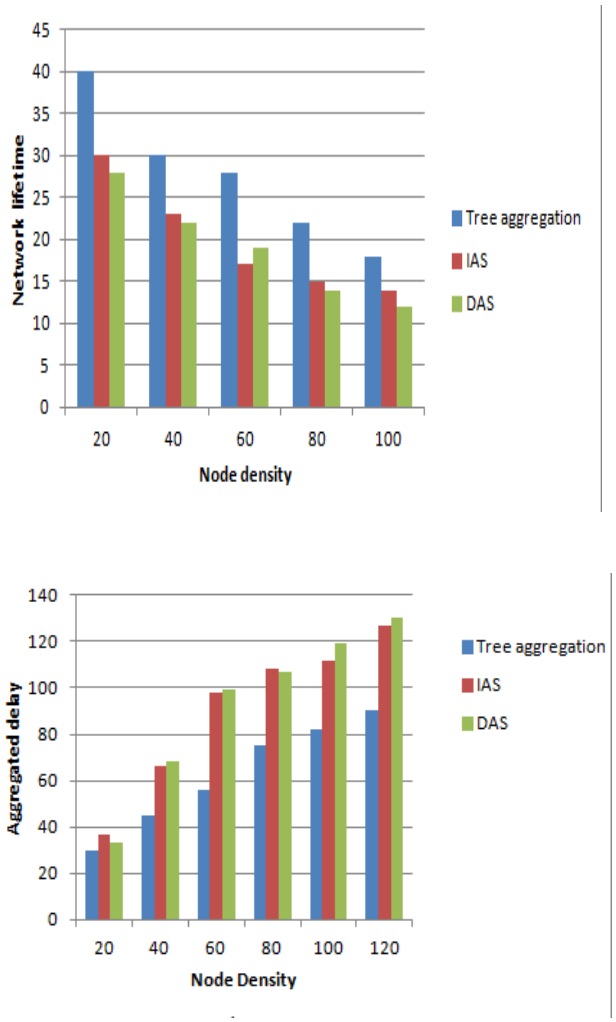


Fig.3 Graph 2

V. CONCLUSION

Data Aggregation is extremely important as in wireless sensor networks redundant data is normally found by the sensors, hence utilization of energy is more. When the energy utilization is reduced the security of the network and the lifecycle are affected. In this paper we are proposing a data aggregation tree and algorithm to solve to problems. We have prolonged the lifecycle by minimizing the max energy consumption done by the nodes. To attain a high network cycle we select only the low weighted node delay in the algorithm thus consuming less energy.

REFERENCES

[1] RRajagopalan, P.K.Varshney."data aggregation techniques in sensor networks: survey", IEEE communications surveys and tutorials,Vol.8 Issue 4

[2] P Patil,U Kulkarni."analysis of data aggregation techniques in wireless sensor networks",International Journal of Computational Engineering and Management,Vol.16 Issue 1.

[3] Hu Yanhua,Zhang Xincai. "Aggregation tree data aggregation algorithm in wireless sensor network". International journal of online and biomedical engineering,Vol.12,http://dx.doi.org/10.3991/ijoe.v12i06.5408

[4] Goel P K, Sharma V K. "Data Aggregation Security in Wireless Sensor Network". International Journal of Advanced Research in Computer Science, Vol.3,Issue 5

[5] Li H, Lin K, Li K. Energy-efficient and high-accuracy secure data aggregation in wireless sensor networks[J]. Computer Communications, 2011, 34(4): 591-597. http://dx.doi.org/10.1016/j.com com.2010.02.026

[6] Ibrahim Atoui et al. "Tree-based data aggregation approach in wireless sensor network using fitting functions".Sixth International Conference on Digital Information Processing and Communications

[7] Katiyar V, Chand N, Soni S. Clustering algorithms for heterogeneous wireless sensor network: A survey[J]. International Journal of Advanced Networking and Applications, 2011, 2(4): 745-754.

[8] Boyinbode O, Le H, Takizawa M. A survey on clustering algorithms for wireless sensor networks[J]. International Journal of Space-Based and Situated Computing, 2011, 1(2-3): 130-136. http://dx.doi.org/10.1504/IJSSC.2011.040339

[9] Przydatek B, Song D, Perrig A. SIA: Secure information aggregation in sensor networks[C]//Proceedings of the 1st international conference on Embedded networked sensor systems. ACM, 2003: 255-265.

[10] Mahimkar A, Rappaport T S. SecureDAV: A secure data aggregation and verification protocol for sensor networks[C]//Global Telecommunications Conference, 2004. GLOBECOM'04. IEEE. IEEE, 2004, 4: 2175-2179.

[11] Cai D, He X, Han J. SRDA: An efficient algorithm for large-scale discriminant analysis[J]. Knowledge and Data Engineering, IEEE Transactions on, 2008, 20(1): 1-12. http://dx.doi.org/10.1109/TKDE.2007.190669

[12] Sugandhi N, Manivannan D. Analysis of Various Deterioration Factors of Data Aggregation in Wireless Sensor Networks[J]. IJET, Vol.5, No1, ISSN, 2013: 0974-4024. Sun Y, Luo H, Das S K. A trust-based framework for fault tolerant data aggregation in wireless multimedia sensor networks[J]. Dependable and Secure Computing, IEEE Transactions on, 2012, 9(6): 785-797. http://dx.doi.org/10.1109/TDSC.2012.68

[13] Wu J Q, Guo J H. Improved pattern-based encrypted data aggregation scheme for clustered wireless sensor networks[C]//Design, Manufacturing and Mechatronics: Proceedings of the 2015 International Conference on Design, Manufacturing and Mechatronics (ICDMM2015). World Scientific, 2015: 475-481.

