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DATA AGGREGATION STRATEGY IN CLUSTER BASED WIRELESS SENSOR NETWORK FOR SOIL MOISTURE DEFICIT MONITORING IN IRRIGATED AGRICULTURE

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ABSTRACT

The aggregation is very important aspect of sensor networks. An effort has been made to suggest and simulate different aggregation strategies. The aggregation strategies are based on the strategies of data sensing and dissemination interval. The combined effort of cluster head and sensing nodes participate in the aggregation of data and transmit it to the sik node. The simulation is done on ns2 with hierarchical wireless sensor network topology and data packet structure of tinyos and micaz motes.

INTRODUCTION

The data aggregation is very important aspect in WSN. Rajgopalan et al [1] have classified the routing protocols on the basis of topology, Network flow and QoS based. In flat topology the aggregation can take place through push diffusion and pull diffusion. In the push diffusion scheme, the sources are active participants and initiate the diffusion while the sinks respond to the sources. The sources flood the data when they detect an event while the sinks subscribe to the sources through enforcements. The pull diffusion can be implemented by SPIN . In case of pull diffusion , it is a data centric routing scheme which is based on the data acquired at the sensors. The attributes of the data are utilized message in the network. This aggregation can be implemented by the Directed Diffusion as discussed earlier. The pull diffusion is further divided into Two Phases and Single Phase pull division. Directed diffusion represents two phase pull diffusion.

The hierarchical based topologies involve cluster based aggregation. LEACH protocol is a routing protocol but can also act as aggregation protocol. It is distributed and sensor nodes organize themselves into clusters for data fusion. A designated node (cluster head) in each cluster transmits the fused data from several sensors in its cluster to the sink. This reduces the amount of information that is transmitted to the sink. The data fusion is performed periodically at the cluster heads. Younis et al. [2] have proposed HEED whose main goal is to form efficient clusters for maximizing network lifetime. The main assumption in HEED is the availability of multiple power levels at sensor nodes. Cluster head selection is based on a combination of node residual energy of each node and a secondary parameter which depends on the node proximity to its neighbors or node degree. CLUDDA [3] performs data aggregation in unfamiliar environments by including query definitions within interest messages. The interest messages of a new query initiated by the sink contains the query and also a detailed definition of the query. The query definition describes the operations that need to be performed on the data components in order to generate a proper response. The PEGASIS which is earlier described as routing protocol can also be used as a chain based aggregation protocols. In case of cumulative aggregation or tree based aggregation protocols, Ding et al. [4] have proposed an energy aware distributed heuristic (EADAT) to construct and maintain a data aggregation tree in sensor networks.

The algorithm is initiated by the sink which broadcasts a control message. The sink assumes the role of the root node in the aggregation tree. Tan et al. [5] have proposed a power efficient data gathering and aggregation protocol (PEDAP). The goal of PEDAP is to maximize the lifetime of the network in terms of number of rounds, where each round corresponds to aggregation of data transmitted from different sensor nodes to the sink. PEDAP is a minimum spanning tree based protocol which improves the lifetime of the network even when the sink is inside the field. In case of network flow based data aggregation techniques Kalpakis et al. [6] have studied the maximum lifetime data gathering with aggregation (MLDA) problem employing efficient data aggregation algorithms. The goal of the MLDA problem is to obtain a data gathering schedule with maximum lifetime where sensors aggregate incoming data packets. In QoS based aggregation schemes AIDA [7] and ESPDA[8] are prominent. The applied independent data aggregation (AIDA) performs lossless aggregation in which the upper layer decides whether information compression is appropriate at that time. The AIDA architecture consists of a functional unit that aggregates and de-aggregates network packets. In addition, there is a control unit that adaptively controls timer settings and tunes the degree of aggregation. The transmission and control overhead is reduced by aggregation of multiple network units into a single AIDA aggregate. In ESPDA, the sensor nodes send the pattern codes to the cluster head for data aggregation. The sensor data is transmitted to the sink in an encrypted form without being decrypted anywhere in the transmission path. ESPDA aims at achieving energy efficient data aggregation with secure data communication. Each sensor node executes the pattern generation (PG) algorithm to generate the pattern code. The cluster head uses a pattern comparison algorithm to analyze the patterns.

Although researchers have proposed and worked on many strategies they cannot be applied universally in all applications. Actually data aggregation is mostly application specific. The application in consideration in this paper is soil moisture deficit monitoring.

2.0 WSN Data Aggregation Strategies

As data aggregation on cluster heads or nodes is application specific, we have categorised the strategies as follows

a) **CPSD** :

Continuous Packet Sensing and Dissemination , In this the data sensed , packaged and disseminated instanteneously. The sensing is done continuosly and dissemination is immediate. In this there is no aggregation at the node or cluster head level. The data goes to the middleware via access point. The aggregation happens in the middleware

b) CPCD :

Continuous Packet Collection and Dissemination . In this case although data is sensed continuously but a certain dissemination interval may be kept to lower the network traffic. Till then data are collected and stored into a memory buffer . This requires sensor node to have a memory buffer equal to the size of packets in consequetive dissemination events.

c) **PPCD**

Programmed Packet Collection and Dissemination. In this case two parameters i.e sensing interval and dissemination interval are configured. This will further reduce the load on the network. In the problems where the data changes less frequently, we can adopt this strategy.

d) **PPAD**

Programmed Packet Averaging and Dissemination. This is more memory and energy efficient then above strategies. The data gathered at a particular sensing interval is averaged out and only one value is stored instead of packet collection. This reduces the memory requirement on sensors. It is suitable for the applications which require averaged data rather than instantaneous one.

e) **PDAD**

Programmed and Demand Based Averaging and Dissemination. This strategy will require WSN to disseminate data on Demand. In clustered network the representative spatial representative data is stored on the cluster heads. In this one needs to specify an On Demand Parameter to be broadcasted into the WSN through access point and in return the access pint will returned data collected from cluster head in case of clustred WSN or from the individual nodes in un-clustered topology

6) ***PETD***

Programmed Event and Threshold Based Dissemination. This is avery special case in which the problem in consideration is not concerned about all the sensed data but an event which occurs in the domain. This event is a function of data. The function can be maximum, minimum, average, of the sensed data. A threshold value is fixed . On sensing this threshold value the node immediately report it to cluster head or to the access point. This strategy is applicable in developing an alarm system or a warning system for some natural parameters like fire,earthquake etc.

It is observed from most of the research that aggregation is dealt with routing. Most of the routing protocols like COUGAR [9], AQUIRE [10] or LEACH[11] have a aggregational model attached with them. As aggregation is mostly application specific, combining it with routing defeats its purpose. The strategies we proposed can be combined with common routing protocols.

3.0 THE PROBLEM OF MOISTURE DEFICIT MONITORING IN AGRICULTURE

In case of irrigation random placement of sensor is not desired as the the area is larger and moisture status the sensed parameter does not vary rapidly in time but take a considerable duration. It varies from crop to crop and season to seaon. Also looking at the cost and the placement effort required to place sensors, predefined locations must be decided.

In case of canal irrigation , the subchak is the basic unit to calculate the irrigation demand while in pressurised irrigation the spacing of lateral and manifolds decide the layout and placement of sensors . In case of subchaks in canal irrigation the sensors are placed at a predefined locations to cover the entire area

While in Pressurised irrigation (drip irrigation) three sensors are placed in the line of laterals, one at the head second in the center and third one in the tail. The The details of calculations for sensors is given in our paper [10].

For purpose of simulation Subchak is taken as one cluster block and and in case of drip irrigation a block of 10 lateral is must be taken as a cluster block.

In our paper [12] we developed a routing protocol LATHAR which was designed and coded for the proble of moisture deficit monitoring in irrigation. NS2 simulator was used to simulate the problem. In this paper all the popular routing protocols with newly developed LATHAR was tested for the aggregation strategies mentioned above.

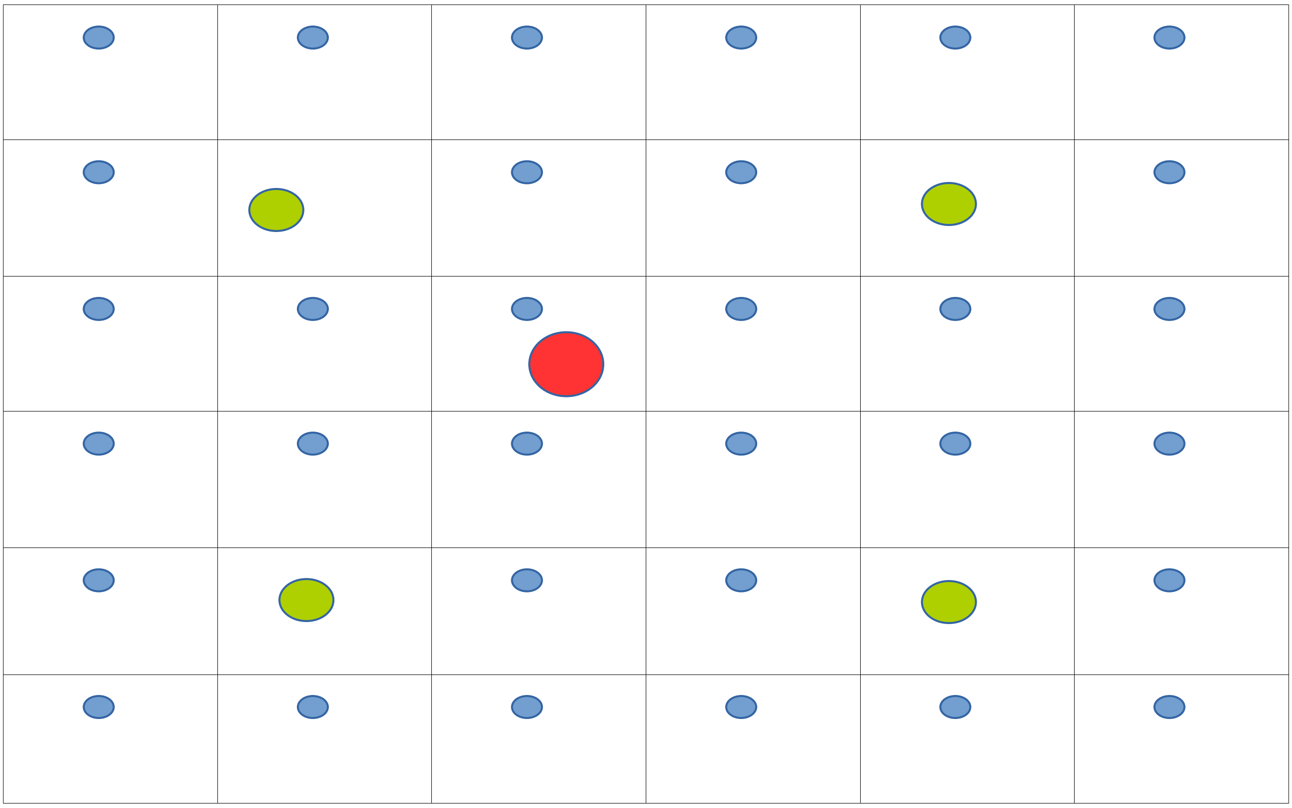
4.0 NS2 MODIFICATIONS

NS2 simulator was modified by adding complete module of irrigation is added in which all the components of WSN like sensor node, sensed data, Routing protocol, link layer, Mac, Routing Agent and Sensor Application were added. C++ classes of Aggregation and On Demand Parameter Passing are also added to the module The aggregation strategy is passed from the front end TCL scripts. The class hierarchy was described in our paper[11].

4.0 SIMULATION SCENARIO

The simulation parameter are given as under

- ✓ Channel Type: Wireless Channel
- ✓ Radio-PropagationModel: TwoRayGround
- ✓ Network Interface Type: WirelessPhy/802_15_4
- ✓ MAC type: Mac/802_15_4
- ✓ Interface Queue Type: DropTail/PriQueue
- ✓ Link Layer Type: LL
- ✓ Antenna Model: Omni Antenna
- ✓ Queue Length: 50
- ✓ Network Layer Protocol: AODV/DSDV/DSR/TORA/LEACH/GATHAR
- ✓ **Aggregation strategies : CPSD, CPCD, PPCD, PPAD, PDAD, PETD**
- ✓ Size of the Topography: 700 X 500
- ✓ The Constant Simulation Parameters are,
- ✓ Active Data Senders: 75% Sensor Nodes
- ✓ Sensor Data Size: 64 Bytes
- ✓ Fused Data Size: 512
- ✓ Sensor Data Interval: 1 Data Packet per 15 min
- ✓ Channel Error Rate: 0.15
- ✓ Total Simulation Time: 10
- ✓ The Variable Simulation Parameter has Total Sensor
- ✓ instructionsPerSecond_ 8000000
- ✓ *Nodes : 50, 75, 100, 125, and 150*

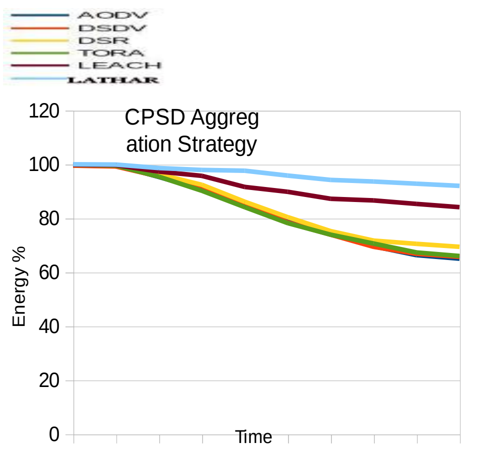


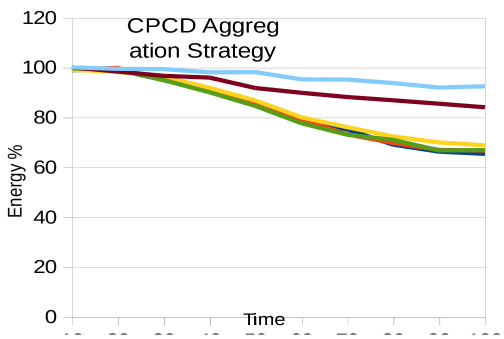
SINK NODE **CLUSTER NODE** **SENSOR NODE**

5.0 RESULTS

1) **Simulation Result at the cluster node**

Graphs of Total Energy remaining in node verses Aggregation strategies





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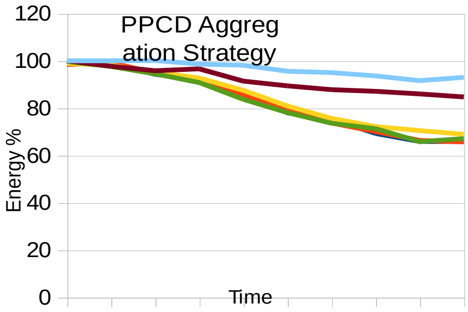
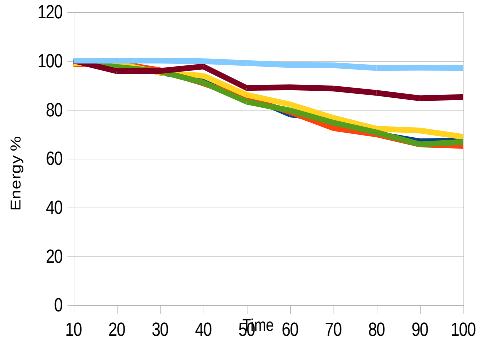
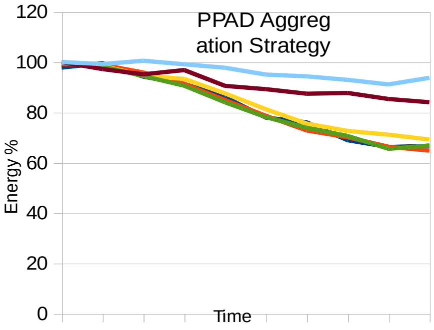
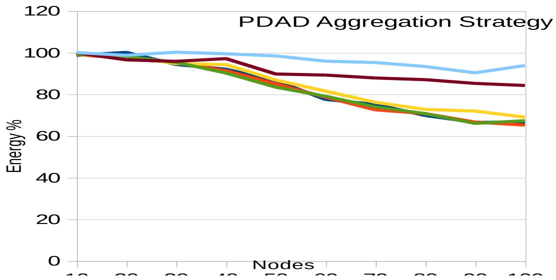


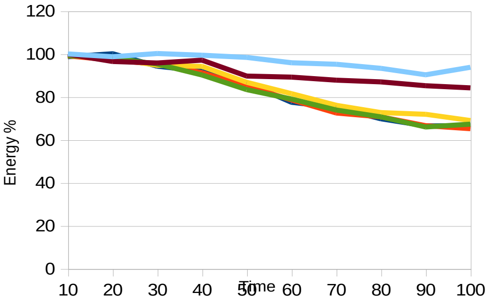


PETD Aggregation

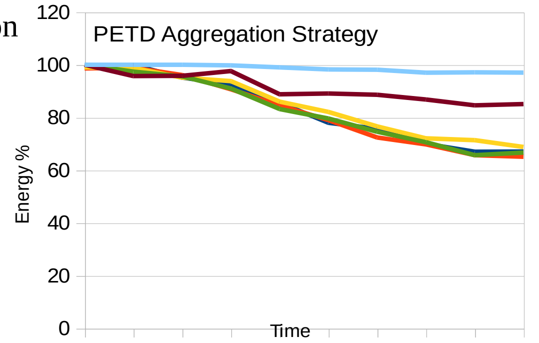


For simulation with multiple nodes the energy saving is as follows





PDAD Aggregation



In the following result the simulation done on WSN with different no of nodes are shown.. Looking to the result of individual cluster heads the result of PDAD and PETD seems to be the best . So only two strategies are chosen to be presented here.

6.0 CONCLUSION

Looking to the results of the simulation given above it is concluded that when using WSN for moisture deficit monitoring, the strategies like PDAD and PETD seems to be the best either on the cluster nodes or on entire WSN and can be adapted for data aggregation for moistute deficit in irrigated agriculture

References

1. Rajagopalan, Ramesh and Varshney, Pramod K., "Data aggregation techniques in sensor networks: A survey" (2006). Electrical Engineering and Computer Science. Paper 22.
2. O. Younis and S. Fahmy, “HEED: a hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks,” IEEE Transactions on

Mobile Computing , vol .3 , no. 4, Dec 2004, pp. 366-79.

3. S. Chatterjea and P.Havinga, "A Dynamic data aggregation scheme for wireless sensor networks," Proc. Program for Research on Integrated Systems and Circuits , Veldhoven, The Netherlands, Nov. 2003.

4. M. Ding, X. Cheng and G. Xue, "Aggregation tree construction in sensor networks," 2003 IEEE 58th Vehicular Technology Conference , vol.4, no.4, October 2003, pp 2168-2172.

5. H. O. Tan and I. Korpeoglu, " Power efficient data gathering and aggregation in wireless sensor networks," SIGMOD Record , vol. 32, no. 4, December 2003, pp 66-71.

6. K. Kalpakis, K. Dasgupta and P. Namjoshi, "Efficient algorithms for maximum lifetime data gathering and aggregation in wireless sensor networks," Computer Networks , vol. 42, no. 6, August 20 03, pp.697-716.

7. T. He, B.M. Blum, J.A. Stankovic, and T. Abdelzaher, "AIDA: Adaptive applicationindependent data aggregation in wireless sensor networks," ACM Transactions on Embedded Computing Systems , vol. 3, no .2, May 2004, pp. 426-457

8. H. Cam, S. Ozdemir, P. Nair, D. Muthuavinashiappam, "ESPDA: Energy- Efficient and secure pattern based data aggregation for wireless sensor networks," Proceedings of IEEE Sensors , no.2, 2003, pp 732-736.

9. Y. Yao, J. Gehrke, The cougar approach to in-network query processing in sensor networks, in: SIGMOD Record, September 2002.

10. N. Sadagopan et al., The ACQUIRE mechanism for efficient querying in sensor networks, in: Proceedings of the First International Workshop on Sensor Network Protocol and Applications, Anchorage, AK, May 2003

11. W. Heinzelman, A. Chandrakasan, H. Balakrishnan, Energy-efficient communication protocol for wireless sensor networks, in: Proceeding of the Hawaii International Conference System Sciences, Hawaii, January 2000.