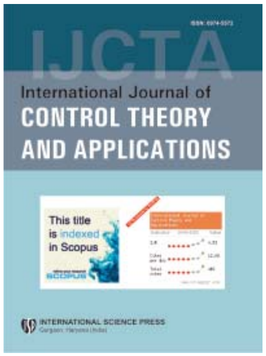

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Redundancy Awareness using Storage Area in Sensor Networks

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Abstract: Wireless Sensor Networks (WSNs) is a class of wireless ad hoc networks in which sensor nodes sense, process, and communicate data acquired from the physical environment to an external Base-Station (BS). But the fundamental challenge in the design of Wireless Sensor Networks (WSNs) is to maximize their lifetimes by reducing the redundant data's thereby detecting the redundant information. Energy-efficient communication is necessary to increase the lifetime of the sensor network. Reducing duplicate packets is a serious issue in wireless sensor networks. There are lot of techniques to eliminate redundancy within packets. The main purpose is to detect the packet level redundancy and then to eliminate it. As the nodes are continuously transferring data's from sender to receiver and also the sensor nodes consume lot of energy for transmission the data redundancy happens.It must be avoided sometimes in order to avoid the loss of needed packets for some critical applications. The extensive redundancy elimination algorithm in the proposed work is to focus on the identification and elimination of the packet level redundancy with less energy consumption thereby receiving the data's with reduction of duplicity.Here a Storge based Redundancy Aware Method is compared over the thought of existing congestion control Hierachical Tree Alternative Path Method (HTAP) thereby managing the duplicate packets from sensor nodes during transmission and achieve reduction in network load as per packet basis. Here an NS3 Simulator is used which demonstrates Packet Index Based Redundancy Awareness in terms of energy consumed by the nodes during transmission. The overburden of nodes during transmission in HTAP is compared with this method thereby providing a better solution for consuming less energy by the nodes and achieving reduction in data transmission.

Keywords: *Data Redundancy, Aggregation, HTAP, NS3.*

1. INTRODUCTION

Wireless sensor networks constitutes many small, low-cost sensing devices (detectors) that monitor the physical surroundings. These sensing devices are characterized by limited energy, processing power, and bandwidth capabilities and subsequently collects and relay collected data to clients. The leader node among a group of nodes collects data from surrounding nodes and then sends the summarized information to upstream nodes (manyto-one flows). It finds that some neighbouring nodes near to the cluster notify the sink about the same effect at the same time.These nodes have approximately the same values because of redundant and highly correlated data.This causes some impact interms of system operation, solutions in energy depletion, network overloading and congestion. To lighten the importance of redundancy on data accuracy and sensing reliability in WSNs there arise some important methods. Some methodologies are there which reduces the redundancy or even remove them totally are often demanded to gain a counterbalance between the benefits and disadvantages while maintaining the system lifetime in WSNs. The above reason leads to the study and implementation of several clustering and data aggregation approaches since the energy consumption of the mesh can be minimized if the total of information that needs to be transmitted is minimized[3]. The idea behind data collection is to aggregate the information coming from different sensor nodes en route, eliminating redundancy, minimizing the number of transmissions and thus saving energy [5]. In [6] many data collection techniques in sensor networks have been studied. There are two types of data aggregation techniques.They are spatial data aggregation and temporal data aggregation.Spatial data aggregation aggregates data from different sources in a sensor network. Combination of data at different periods of time is done is done with temporal data aggregation. introduces data similarity measurement in order to better the operation of data collection while preserving data accuracy, sensing reliability as well as the energy effciency of sensor nodes.To measure the similarity between the data kernel based methods have been used sometimes. The kernel based similarity measurements are popular in the machine learning and data mining communities.Also it is used in different other techniques such as clustering, anomaly detection, classification, regression, and kernel based principal component analysis. The remainder of the paper is formed as follows: Section 2 presents key concepts of similarity functions, kernel based methods and spatial data correlation.Section 3 provides an overview of some recent Spatio-temporal techniques in the field. In Section 3, an algorithm that extends our previous work is proposed to detect and reduce redundancy in order to obtain minimum communication cost and energy consumption.

2. RELATED WORKS

In wireless sensor networks, broadcast and data aggregation are the most fundamental and useful operations. Broadcast algorithms have been studied extensively in the literature since the 80’s [9],[10],[11], [12],[13], [14],[15], [16],[17],[18], [19],[20]. Data aggregation, by comparison, is still relatively new but its importance cannot be overemphasized. Data aggregation, sometimes called convergecast is about a sensor network with a base station such that all (or some) nodes collects data and report to the base station via wireless communication. Annamalai et al [8] designed a heuristic algorithm for both broadcast and converge cast. The converge cast tree constructed in their algorithm can be used for broadcast as well. Upadhyayula et al in [21] aimed at reducing energy and latency designed another heuristic algorithm for converge cast alone. For these two works mentioned above, all used heuristic approaches and ran simulations to verify their results without doing theoretical analysis. On the theoretical side, Kesselman and Kowalski [22] designed a randomized, distributed algorithm that has latency O(logn). In their model, they assume each node can vary its transmission range to reduce links. Chen et al [7] designed a $(\Delta-1)$-approximation algorithm for data aggregation, where Δ is the maximum degree of the network graph. They also proved that the minimum data aggregation time problem is NP-hard. Practical issues of data aggregation, especially about the MAC layer, have also been studied in the literature. Huang and Zhang [17] studied packet loss and focused on reliability issues in data aggregation. Zhang et al [24] addressed the issue of bursty converge cast in real-time applications and focused on improving channel utilization and reducing retransmission incurred channel contention. Krishnamachari et al [25] viewed data aggregation from another aspect by considering the case where there is a subset of nodes whose data need to be sent to the base station and regarding aggregating these data as a way to save energy. Intanagonwiwat et al , in a short paper [26], evaluated the impact greedy aggregation to increase the amount of path sharing and reducing energy consumption. Yu et al [27] also considered scheduling packet transmission and energy-latency trade-off. Their goal was to reduce sensor nodes energy dissipation subject to some latency constraints.

3. PROPOSED SYSTEM

The proposed algorithm which is a traffic control algorithm called Storage Area Based Redundancy Aware Algorithm in wireless sensor network which includes Topology Control, Creation of Hierarchical Tree and Redundancy Awareness based on packet index. Each of these components can achieve certain level of energy efficient routing through each nodes of the wireless sensor networks.

3.1. Redundancy

Redundancy is the provision of additional or duplicate resources, which can produce similar results. There are three types of redundancy in WSNs. They are Spatial redundancy, Temporal Redundancy, Information Redundancy.

1. **Spatial Redundancy :** Spatial redundancy represents the possibility of obtaining information for a specific location from different sources which involves the replication of network resources in the coverage area.Here the information for a specific location may be available from multiple sensors. Types are:

   a) **Physical Redundancy:** To measure a variable in a specific location using more than one sensor an attribute of WSN called physical redundancy is used.

   b) **Analytical Redundancy:** An attribute which can estimate a variable in a specific location using mathematical models analytical redundancy is used.

2. **Temporal Redundancy:** An attribute which is much related with both sensing tand communication is called Temporal Redundancy.

3. **Information Redundancy :** An attribute which is related with repetition in the structure of messages in the network and in the measurement storage at the level of base stations is Informationn redundancy

4. WORK FLOW

The work includes five basic steps inorder to find the similarity of packets among nodes.They are shown in the block diagram as,

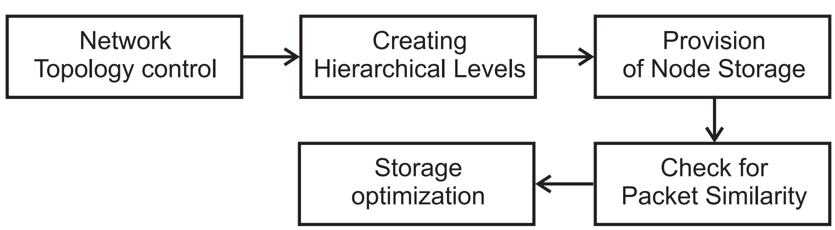

Figure 1

4.1. Control of Topology

Topology control is done inodrder to face situations like interference, to find maximum number of routes from nodes to BS, for usage of maximum power to communicate with distant nodes directly etc.The Hierarchical Tree Alternative Path Algorithm is a resource control algorithm which employs the network's extra resources or the nodes which are unused by clearly guaranteeing a number of alternative redundant paths are essential for the packets to reach the base station.The paths must be carefully selected in case of congestion and to improve the performance characteristics.The first scheme applied before selecting alternate path in HTAP algorithm is topology control.So inorder to preserve connectivity a topology control algorithm which is effective and with minimal use of power is needed thereby maintaining an optimum number of nodes as neighbors to each node.Here a Local Minimum Spanning Tree algorithm (LMST) [32] is selected as the initial topology control algorithm on the network which preserves network connectivity with degree of any nodes in resulting topology is restricted to six.Each node in the tree build its local minimum spanning tree by their own using Prim's algorithm [33] and keeps on the tree only those neighboring nodes which are one hop away. In addition, the resulting topology is possible to use only bi-directional links.

4.2. Fomation of Hierarchical Levels

Establishment of path and Flow creation are the two important functions in Hierarchical Tree Creation. The tree creation starts at the source node. Each of the nodes in the tree can be connected to at most six nodes such that they are only one hop away from itself at the end of the discovery message to its neighbors at this phase. The nodes that receives this packet are considered as child nodes to the source node with level 1.The same pattern continues with next level of nodes and the next level nodes are formed and this procedure is iterated till all the nodes receives this message and stops when it reaches the sink.At the end different disjoint paths with level discovery messages reaches the sink.This node responds with NACK or negative acknowledgement packet which indicates that it cannot route any more packets. After flow creation flow establishment is done. Flow Establishmant is thereby creating an association between the transmitter and receiver

4.3. Creation of Storage Area

Storage space is created for transmitting and receiving nodes inorder to retain more datas with higher resolution. If datas are addressed by the content than by indexing the nodes to collect datas, doesnot know where the datas are stored or what data exists.For this reason efficient indexing and retrieval of new packets are needed.

4.4. Packet Similarity Comparison

Datas send from source to the next level node.If a packet with a particular packet index is send, the source table is updated and if it reaches the next level node,the acknowledgement value is true.After the positive acknowledgement the data packet with the particular packet index is deleted from the soure storage area.The receiving table has old index of already received packets.If the index of the packet from the source repeats after a particular timestamp and if the current packet index equals the stored index in the receiver storage area ignore the flood packet.If it is not equal to the packet index which is already stored in the storage space accept the new packet index.

4.5. Storage Based Redundancy Aware Method

All nodes have their node table with their node id and acknowledgement.Source node has source table and storage area.All the other nodes has node table, index table and storage area.Set a queue with starting index of the queue to 0. The packets which are flooded from the source are broadcasted to the queue.If current packet index is equal to the stored packet index in the queue then the current packet is ignored. If not increment the size of the queue. If the currentnode receives ack with congestion level full update neighbour table, search neighbor table.Find the nodeid with minimum congestion-level and send the data packet. If the currentnode receives congestion update message, update neighbour table.Else if the currentnode receives date packet and accepting them.Increment the buffer by one. If the size of the buffer is full, send the acknowledgement packet with level of congestion as full .Storage optimization is done if the packet index of the source table is true,destroy the packet from storage area created for the corresponding node.If not retain the packet in storage area.Set the threshold of the neighbour node to prespecified value. If neighbour node threshold is less than corresponding node threshold apply an alternative path for the packet to reach the destination.

5. SIMULATION

In the simulations the latencies affected by varying four parameters are studied: the total number of nodes in the network (|N|), the number of sources (|S|), the number of available channels λ, and the parameters α, β for interference range and carrier sensing range respectively. The simulations are conducted in a 100 × 100 2-D freespace by randomly allocating |N| nodes. The transmission range of each node is fixed to 20 and 30. We present average of 100 separate runs for each result shown in the following tables. In each run of the simulations, for given |N| and |S|, we randomly place |N| nodes and the base station in the free-space, and randomly select |S| sources.

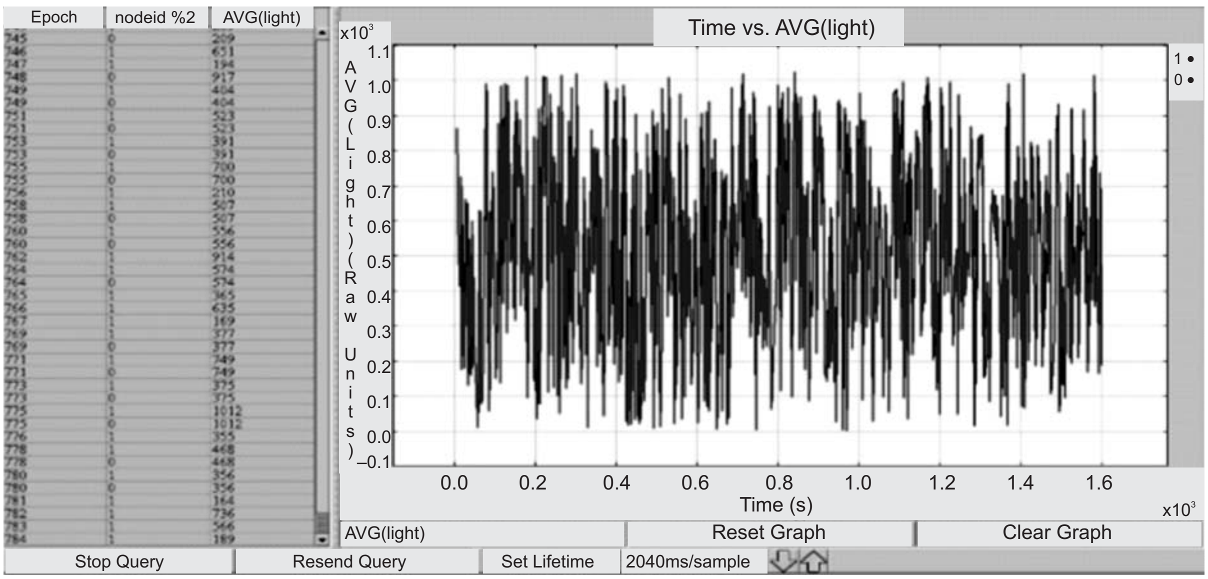

Figure 2: Simulation window for energy consumption before redundancy aware storagearea

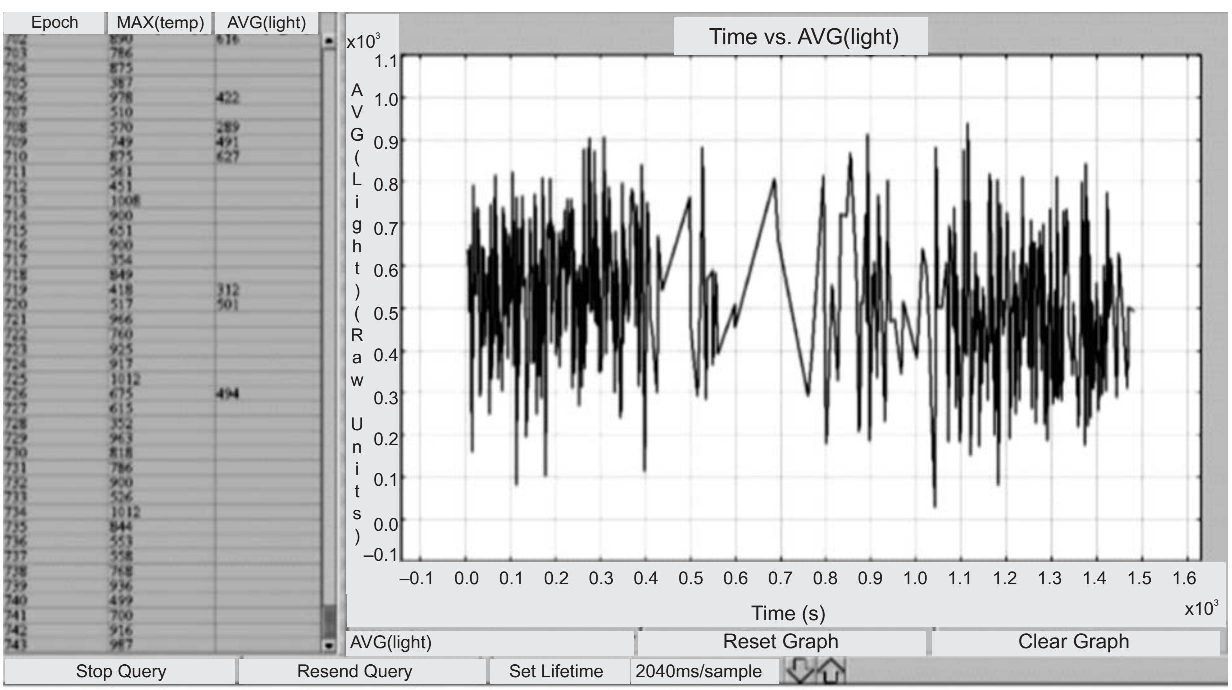

Figure 3: Simulation window for energy consumption after redundancy aware storage area

Table 1
For analysing the energy consumption of local communication the following simulation parameters are considered and the values are tabulated

S. No.	Parameter	Value
1.	Area of the network	500x600
2.	No.of nodes	30
4.	No. of cooperative nodes	4
5.	Initial Energy	5J
6.	No.of bit transmitted by each node	1kb
7.	Data after compression by cluster head	1kb
8.	Distance from th cluster to AP	75 m

6. CONCLUSION

In many wireless sensing networks, a high degree of spatial correlation exists among the readings of di□erent sensors due to their dense deployment. By allowing the nodes to corporate to carry out joint data from aggregation, the amount of data communicated within the network can be reduced. This can help to conserve energy and extend the sensors's lifetime. In this paper, we introduce similarity measurement to detect similarity among aggregated data in order to reduce redundancy using alternative path. Our experiments show that it's possible to reduce the communication overhead between nodes while ensuring a reasonable data quality and accuracy. By taking advantage of the spatial correlation and introducing the similarity measurement a significant energy savings can be achieved which increases the network longevity. Our future work is to enhance our algorithm and experiment it on complex topologies with clustering/routing methods since our experiments has focused on a simple case topology.

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