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SURVEY ON DATA AGGREGATION TECHNIQUES IN WIRELESS SENSOR NETWORKS

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Abstract:

In Wireless Sensor Networks, sensor nodes are deployed in a region for sensing the environmental information. This type of network is applied in many applications such as monitoring and tracking. The sensor nodes are very small in size, have limited memory, less processing capacity and very low battery power. Some sensor nodes sense the same kind of information that leads to redundancy at sink node, thereby wasting most of its energy in processing repeated data packets. Data aggregation is a process in which intermediate node receives multiple input packets performs aggregation and produce single output packet. So data aggregation is the important factor of energy constraint of Wireless Sensor Network (WSN). In this paper a broad survey on different types of data aggregation techniques are discussed.

Key Words: Wireless Sensor Networks, Data Aggregation, Base Station & Event Oriented Data Aggregation

1. Introduction:

Data aggregation is the process of collecting and combining the required data for the various sensor nodes. The WSN is the low cost and low energy network and hence the design of data aggregation algorithm must be based on the energy constraint. The main target of the aggregation algorithm is to gather source data and aggregate it in an energy efficient manner for increasing the lifetime of the network. In addition data aggregation algorithms must focus on redundancy and security. Data gathering is defined as the systematic collection of sensed data from multiple sensor nodes deployed in the WSN. Simply it is the process of gathering and combining, which is the attempt to collect the most critical data from sensors and make it available to the sink in energy efficient with minimum latency in a secured manner. A data aggregation scheme is energy efficient if it maximizes the functionality of the WSN [1]. If we assume that all sensors are equally important, we should minimize the energy consumption of each sensor. As soon as a query is sent by the Base Station (BS) to a sensor, the first step followed is to handle the query. Sensor nodes are deployed in remote environment to a multi-hop WSN over a wide range, For the nature of WSN collect the sensed date from various sensor node for making the some decision so that we need a aggregation technique, each and every sensor node sends its data to the sink node through the neighbors node so there is a chance for repeating the same date. Because of that we need a aggregation algorithm for checking the redundancy. The unwanted sensor node send some meaningless data periodically and send some fault data also for that purpose we need a aggregation algorithm for checking the correct data , that is secure data aggregation algorithms. Data aggregation techniques result in energy conservation which is the most important property of WSN. Many practical applications like environmental monitoring, military applications, scientific research etc., are exploring the use of WSNs. Such applications require transferring a huge amount of relevance, sensed data from one point of the network to another. Since WSNs are mostly equipped with low power batteries, battery life is a major constraint in any real-time application. This necessitates the use of energy efficient data dissemination protocols for aggregation of the sensed data. There are two types of Data aggregation are Address-Centric (AC) and Data-Centric (DC). In AC routing protocol, query is routed to a specific address or a given sensor based on the address specified in the query. Each source independently Address Centric Routing sends data along the shortest path to sink ("end-to-end routing"). Data is then sent from this specific location to the BS. The source with the address specified in the query, sends its data directly to the BS[2]. In DC routing, based on the condition specified in the query, all sensors satisfying that condition, need to respond and therefore, the query is broadcast to all the nodes (within range) in the network. The packets are combined from neighboring nodes satisfying a given condition are combined at the cylindrical node, before being sent to the BS. This is defined as in-network processing of data. The cylindrical nodes perform data aggregation before sending the final data packet to Base Station. By employing data aggregation, redundant data are removed before being sent to the Base Station thus contributing to substantial savings in the energy and the bandwidth. The sources send data to the sink, but routing nodes en-route can look at the content of the data and perform aggregation on multiple input packets [2].

2. Review of Literature:

In 2007 Su W. Bougiouklis [5] proposed an algorithm for reduces traffic and enhances the performance of the sensor networks. Information quality is improved by fuzzy logic methods using the fusing uncertain data from multiple sensor nodes. The strengths of the approach is cluster-based, less computational power is required when compared to other computational methods. Thus energy can be saved efficiently. In addition, only few data samples are required in order to extract final accurate result. In 2009 RabindraBista et.al [3] proposed an energy balanced and efficient data aggregation scheme for WSNs, called designated path (DP) scheme. DP scheme determined a set of paths and run them in round-robin fashion so that all the nodes can participate in the workload of gathering data and transferring the data to the sink. However dissipated energy was increased. In 2010 Ying Guo et.al [4] has proposed distributed algorithm by exploiting Cloud Membership model of fuzzy logic to aggregate the information of events in sensor networks. Event oriented Data Aggregation (EDA) can be used in sensor networks for the target of event detection. This algorithm decreases the energy consumption of data delivering and fulfills the application target of event detection, which is the motivation of EDA. Here, the cost of computing energy is counted which is very low when compared to

the communication cost. In 2010 Yasir Faheem and Saadi Boudjit [6] proposed a distributed sink location update and a tree-based data gathering mechanism for mobile sink WSNs called SN-MPR. This mechanism deployed Multi-Point Relay (MPR) forwarding for sink location updates and queries. However there was a delay in data delivery. In 2010 Babar Nazir and Halabi Hasbullah [7] addressed hotspot problem and proposed Mobile Sink based Routing Protocol (MSRP) for Prolonging Network Lifetime in Clustered Wireless Sensor Network. It resulted in a balanced use of WSN energy and improves network life time. In 2011 Chi Yang et al [8] developed an approach to suppress the in-network aggregate data based on the order compression techniques. In 2012 Songtao Guo and Yuanyuan Yang [9] proposed a data gathering cost minimization (DaGCM) framework with concurrent data uploading, constrained by flow conservation, energy consumption, link capacity, compatibility among sensors and the bound on total sojourn time of the mobile collector at all anchor points.

In 2012 Hevin Rajesh D, Paramasivan B [10] has designed a fuzzy based secure data aggregation algorithm. This algorithm consists of 3 phases. In phase1, the sensor nodes are grouped into various clusters and each cluster has one elected cluster head. In phase2, the cluster head collects the data from its members. Along with data, the each member attaches its current power level. In phase 3, Fuzzy logic is applied to select the best nodes for aggregation. The parameters trust level, power level and distance to the cluster head of each node are taken as input and fuzzy rules are formed. After applying the rules, the output will be the treated as the best node or Normal node or Worst node. The cluster head will try to aggregate the packets of the best node and normal node, rejecting the worst node. Finally, the aggregated data from all the cluster heads will be sent to the sink. In 2012 Hevin Rajesh D, Paramasivan B[11] has proposed one more algorithm with fuzzy if-then rules considering the parameter distance, power consumed and trust for evaluating the nodes. For the 3 inputs distance, power consumed and trust, the resulting possibilities are best node, Normal node, Worst node. Hence the input can take two values less and high, so the total number of output in this case is eight. The selection criteria is such that a node should have lower distance and power consumption values but with highest trust values. In 2013 S. Kannadasan and N. Sivakumar Bhapith [12] has proposed a algorithm to detect the shortest path between the neighbor nodes in the network to transmitted the power and improve the network life time of the network using Fuzzy Logic. It includes three phases to improve the network performance using adaptive transmission technique. In Neighbor Identification phase network nodes are represented by the vertices and also direct connectivity between the nodes by the edges which combinatorial structure are called as network structure. In Shortest Path detection phase, networks can be represented by weighted graphs. In Transmission Power phase, the nodes are read the number of edges from the source node to the neighbor node. Based on the number of edges calculate the total transmitted power consumed value. Finally, we calculate the total power consumed of the whole networks. In 2013 Nithyakalyani S and Suresh Kumar S [13] have proposed a novel approach to reduce the consumption of energy in every sensor node and thereby increasing the entire life time of WSN. This novel algorithm is a combination of Voronoi and modified fuzzy C-Means clustering algorithm called as Voronoi Fuzzy(VF) clustering algorithm is nominated by considering nodes residual energy, distance between Cluster Head(CH) and its neighbor's sensor node and quality of service. Furthermore data aggregation is employed in each Cluster Head (CH) to reduce the amount of data transmission which effectively extends to network life time.

In 2014 Mohammadreza Soltani et al. [14] have proposed data fusion approach for resource efficiency in large WSN. Data fusion is used to determine a reduced node set to be active in the network, resulting in reduction of network resource consumptions. In 2014 Miao Zhao and Yuanyuan Yang [15] proposed to utilize mobility for joint energy replenishment and data gathering. A multi-functional mobile entity, called SenCar was employed, not only as a mobile data collector roaming over the field to gather data via short-range communication but also as an energy transporter that charges static sensors on its migration tour via wireless energy transmissions. In 2014 Ali Addi Seyedkolaei and Ali Zakerolhosseini [16] has proposed a work with three levels are used to determine CHs in each round and also transmission sink to suitable place for prolong network lifetime to an acceptable limit. Here they use fuzzy logic in three level to evaluate the priority of sensors to become a cluster head and also transmission sink to suitable place to reduce energy consumption. In first level the qualified nodes are selected based on their residual energy and density in them. Then in the second level, seek for the best node based on the average energy consumption metric. In third level the sink is more based on two parameters energy of cluster heads and distance of cluster heads to sink. In 2014 Alisha Bhatia and Rohit Vaid [17] have proposed a new technique that includes two main phases. In first phase, a mobile base station over circular path is defined in such a way that maximum connectivity will be there. The center to the circular path will be selected along with the radius specification to that path. In second phase, prioritization will be done to each communicating node and this research work is the improvement over the existing clustering architecture to increase the network communication and the network life. The improvement is defined based on the base station is moving in a radial path and selection of the cluster head over the network. In 2014 Lithiya sara babu, Uma Maheswari [18] has proposed a algorithm to detect false data injected by a data aggregator while performing data aggregation. Here every node will be monitored along with naives bayes detector and fuzzy logic model, by using two detector for finding the fault data easily and increase the life time of the network. In 2015 Davvo lazdi, Jemel H. Abawajy, Sare Ghanavati[19] has proposed a fuzzy-based data fusion approach for WSNs that increases the Quality of Service(QoS), maximizing the network lifetime by minimizing the energy consumption is presented. By virtue of distinguishing and aggregating only the true values of the sensed data, this proposed approach is able to reduce the transmission as well as the processing of the entire sensed data. It is also able to eliminate redundant data and consequently reduce energy consumption thus increasing the network lifetime. In first step a data fusion approach to improve the performance of a WSN with respect to the level of QoS generated about the events of interest. In second step minimize energy consumption by transferring only the calculated result of the events instead of the entire fused data .In Third step show that the proposed approach is robust in terms of the events of interest with respect to the sensor node failures as it combines all received

data from the sensor nodes. In 2015 Shiliang Xiao et al. [20] have exploited the tradeoff between data quality and energy consumption in order to improve the data aggregation precision in case of heterogeneous per-node energy constraints.

3. Conclusion:

A comprehensive study of data aggregation algorithms for wireless sensor networks has been presented in this paper. Different algorithms focus on optimization performance measures such as network data accuracy and energy consumption. Efficient routing and data aggregation are the main focused areas of data aggregation algorithms. Most of the aggregation techniques consider the energy consumption and security. The hard computing paradigms were replaced by the soft computing techniques like genetic algorithms (GA), fuzzy logic models and particle swarm techniques for getting the better result in every problem. In WSN the data aggregation the quality of information can be improved, by using fuzzy logic methods which can fuse uncertain data from multiple sensor nodes. The conventional mathematical computational methods such as addition, subtraction, multiplication and division require more computational power when compared to the fuzzy logic methods. Final accurate results can be obtained by using only few data samples. The problems are described by human language and are thus effectively controlled. Hence the data aggregation algorithm using fuzzy logic method mostly gives better performance.

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