International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 3, Issue4 (July-August 2015), PP. 319-323

USE OF WIRELESS SENSOR NETWORKS TO MONITOR ENVIRONMENTAL PARAMETER: A REVIEW

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***Abstract*— Wireless sensor networking is envisioned as an economically viable paradigm and a promising technology because of its ability to provide a variety of services, such as intrusion detection, weather monitoring, security, tactical surveillance and disaster management. The services provided by wireless sensor networks (WSNs) are based on collaboration among small energy constrained devices known as sensor nodes. The large deployment of WSNS and the need for energy efficient strategy necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime. In this paper we review the previous work done in the field of crucial event monitoring in wireless sensor networks.**

***Index Terms*— Event Monitoring, WSN, Sleep Scheduling, Actor Networks**

I. INTRODUCTION

Wireless sensor networks are used to monitor environmental parameters and detect important events in various applications. They consist of groups of sensor nodes that are connected with wireless links. Wireless sensor-actor networks consist of actor nodes to trigger appropriate actions when critical events occur. These networks should have a lifetime long enough to fulfil the application requirements in the order of several months, or even years. In Wireless Sensor Networks (WSNs), the critical challenge lies in minimizing the message overhead to improve the bandwidth efficiency which reduces the overall power consumption and thus raises the network operational lifetime. A common scenario of sensor networks involves deployment of hundreds or thousands of low-cost, low power sensor nodes to a region from where information can be collected periodically. In snooze scheduling scheme, data distribution is done by creating a routing tree. Altering the snoozing nodes to collect data by waking up these nodes in time are done through the routing tree. The collected information can further be processed at the sink for end-user queries. In order to reduce the communication overhead and energy consumption of sensors while gathering, the received data can be combined to reduce the message size. This can be done by aggregating the data.

Wendi Rabiner Heinzelman et al [21] had proposed the first clustering protocol called Low Energy Adaptive Clustering Hierarchy (LEACH).This protocol runs with many rounds, with each round contains two states. One is cluster set up state and the other is steady state. The time of second state is usually longer than the time of first state for saving the protocol payload.

II. MEDIUM ACCESS CONTROL PROTOCOLS

Medium Access Control (MAC) protocols that have been recently designed for sensor networks have primarily focused on optimizing throughput efficiency with less energy consumption by setting the sensor radios into a snooze state as often as possible.

Wei et al [1] designed the first Medium Access Control protocol in the name of Sensor-MAC (S-MAC) for sensor networks. In SMAC, nodes create a snooze schedule for themselves that decides at what times to turn on their receivers (typically 1 10% of a frame) and when to set themselves into a snooze mode. Neighboring nodes are not essentially required to orchestrate snooze schedules. But, they must share their snooze schedule information with others through the transmission of periodic SYNC packets. When a source node wishes to send a packet to a target node, it waits until the destination’s wakeup period and sends the packet using CSMA with collision prevention.

Based on S-MAC, several protocols have been developed for different deficiencies and restrictions of the original S-MAC protocol. In Timeout (T-MAC) protocol the authors Dam and Langendoen [2] proposed about message transmissions. In this, messages are transmitted in bursts at the beginning of the frame, rather than allowing them throughout a predetermined active period. The nodes set their radios into snooze mode until the next scheduled active frame.

Schurgers et al [3] proposed Sparse Topology and Energy Management (STEM) protocol. In STEM, all sensors are left in a snooze state while monitoring the environment but not sending data and are only activated when traffic is generated.

III. Data Collection In WSN

Tan and Korpeoglu [4] proposed a distributed, self organizing, vigorous and energy proficient data gathering algorithm for sensor networks operating in environments where all the sensor nodes were not within direct communication range of each other. The algorithm proposed was based on Localized Minimum Spanning Tree (LMST) structure, in which nodes could construct from the position of their 1-hop neighbours. The major drawback in this scheme was higher message overhead and it requires more time to gather the data.

Bachrach and Taylor [5] had presented the most significant localization technique which outlined the technical foundations and also the trade-offs in algorithm design. Since there was no specific algorithm that gives a clear favourite across the spectrum, localization was still a new and exciting field with new algorithms and reduced hardware. The concern over this approach was that it did not address new sensor network requirements such as mobile nodes and ultra-scale sizes. Takahiro Hara [6] has proposed a technique to quantify the influences of mobility on data availability from various perspectives. But the main drawback was that it is difficult to address the match movement patterns in real networks and construct typical mobility models.

Shuai Gao and Hongke Zhang [7] proposed a new data gathering scheme, called the Maximum Amount Shortest Path (MASP), which increased network throughput and energy conservation to optimize the assignment of sensor nodes. Maximum Amount Shortest Path was formulated as an integral linear programming hitch and then solved with the aid of a genetic algorithm. A two-phase communication protocol was designed to implement the MASP scheme.

Zhao Miao and Yang Yuanyuan [8] had considered data gathering in WSNs by utilizing numerous mobile collectors and Spatial- Division Multiple Access (SDMA) technique. The sensing field was divided into several non-overlapping regions, each having a Sen Car. Each Sen Car took the responsibility of gathering data from sensors in the region while traversing in their transmission ranges. Sensors directly sent data to their associated Sen Cars without any relay in order to achieve uniform energy consumption. Further, the authors proposed a region-division and tour- planning algorithm to provide a nearly good solution to the trouble. The downside of the project was that it was more expensive to build the framework.

IV. Minimum Spanning Tree and Data Aggregation

A Spanning Tree T, is a single spanning tree in which the aggregation structure assumed for any aggregation group, is simply the sub-tree of T induced by the group. The performance of spanning tree for a given set is calculated by evaluating the cost of induced sub-tree with the cost of a best possible aggregation tree for that set. Spanning Tree and its sub-tree is encouraged by a subset of nodes. It is not obvious to discover such a group-independent tree with good guarantee. Two natural candidates for Spanning Tree are the Minimum Spanning Tree (MST) and the Shortest-Paths Tree (SPT).

Khamforoosh [9] proposed a new method for routing in WSNs. In this paper he has attempted to add nodes which had the minimum distances from each other instead of using the conventional routing methods. In this method, the nodes are divided into clusters according to LEACH algorithm and then cluster heads create minimum spanning tree according to Prim algorithm.

Darin England et al [10] had presented both centralized and distributed algorithms to construct the topology and then demonstrated its effectiveness through analysis and simulation of two classes of distributed applications: One was Data collection in sensor networks and the other one was Data dissemination in divisible load scheduling. They proved that their robust spanning trees achieved a desirable trade-off for two opposing metrics, where conventional forms of spanning trees did not.

Chitradevi et al [11] had developed a statistical based robust estimate to design a resilient in-network aggregation scheme which detected and isolated the outliers from computed aggregate value. The compromised nodes could inject false data in to the network which deteriorated the accuracy of the aggregated data. Research on resilient data aggregation with data integrity and accuracy became a major issue. This protocol was well suited for any data distribution. But it did not show effectiveness over the algorithm for data aggregation.

Upadhyayula and Gupta [12] addressed the setback of performing the Data Aggregation enhanced Converge cast (DAC) in an energy and latency efficient manner. The assumption that all the nodes in the network had a data item and there was a priori known application dependent data compression factor (or compression factor), c, that approximated the useful fraction of the total data collected. This paper presented two DAC tree construction algorithms. One was a variant of the Minimum Spanning Tree (MST) algorithm and the other one was a variant of the Single Source Shortest Path Spanning Tree (SPT) algorithm. To achieve low latency, these algorithms used the b-constraint, which put a soft limit on the maximum number of children node in a tree. But this scheme did not describe clearly about the scenarios of various network densities. Deying Li, Qinghua Zhu [13] presented a clash free, many-to-one data aggregation scheduling in wireless sensor networks.

Sharaf and Beaver [14] proposed a group-aware network configuration method, which “clusters” among the identical path sensor nodes that belong to the similar group. It imposed a hierarchy of output filters on the sensor network with the goal of both reducing the size of transmitted data as well as minimize the number of transmitted messages. More specifically, it proposed a framework to use temporal coherency tolerances, in conjunction with in-network aggregation, to save energy at the sensor nodes while maintaining a specified quality of data. The downside of the project was that, while maintaining the quality of data with user specified references, the energy consumption was somewhat high.

Wagner [15] proposed a technique which gives significance to security for data aggregation in wireless networks. Current aggregation schemes were designed without considering security in mind. So there were easy attacks against them. It examined several approaches for making these aggregation schemes more resilient against certain attacks. He proposed a mathematical framework for formally evaluating the security issue. But it did not provide a secure aggregation over the sensor networks.

V. Connected Dominating Set For Sensed Data Aggregation

Kalpakis and Dasgupta [16] enabled the development of distributed networks for wireless communication using small, inexpensive nodes with the sensing and computing capability. Further, Sensor networks were envisioned to revolutionize the paradigm of collecting and processing information in diverse environments. The basic operation in such a network was the systematic gathering and transmission of sensed data to the base station for further processing. During data gathering, sensors have the ability to perform in-network aggregation (fusion) of data packets before en-routing to the base station. The lifetime of such a sensor system was the time during which we could gather information from all the sensors to the base station. It presented polynomial time algorithms to solve the data gathering problem, with and without data aggregation. The downside of this approach was that the data gathering problem occurred with depth constraints for individual sensors.

Krishnamachari, Estrin et. al.[17] modelled a data-centric routing and compared its performance with conventional end-to end routing schemes. They examined the impact of sourced estination placement and communication network density on the energy costs and delay associated with data aggregation. It showed that data-centric routing offered significant performance gains across a wide range of operational scenarios. They also examined the complexity of optimal data aggregation, showing the useful polynomial-time special cases. The system presented was for the resource- constrained and event-based, that might suggest important design lessons for scalable event-based systems.

Wu.J, Wu.B and Stojmenovic [18] proposed an easy and efficient distributed algorithm for calculating connected dominating set in ad- hoc networks, where node connections were determined by their geographical distances. In general, nodes in the connected dominating set consumed more energy to handle various bypass traffic than nodes outside the set. To prolong the life span of each node and hence the network the energy consumption in the system was balanced in such a way that nodes should be alternately chosen to form a connected dominating set. Activity scheduling, dealt with the way of rotating the role of each node among a set of given operation modes (e.g. dominating nodes versus dominated nodes). But it did not perform in-depth simulation under different settings. Although host mobility gave sufficient information, it consumed more time.

VI. Power Constraints On Scheduling Of Aggregated Data Delivery

Tan and Korpeoglu [19] proposed two new algorithms named as Power Efficient Data gathering and Aggregation Protocol (PEDAP), which were near optimal minimum spanning tree based routing schemes, where one of them was the power-aware version of the other. The sensed data must be gathered and transmitted to a base station where it was further processed for end-user queries. Since the network consisted of low-cost nodes with limited battery power, power efficient methods were employed for data gathering and aggregation in order to achieve better network lifetime. The main concern was that, it supports only direct communication and the algorithms also performed well, when the base station was inside the field.

Tan, H.O. and Korpeoglu et. al. [21] proposed a localized, self organizing, robust and energy-efficient data aggregation tree approaches for sensor networks, which was called Localized Power-Efficient Data Aggregation Protocols (L-PEDAPs). They were based on topologies, such as LMST and RNG that approximated MST and capably computed using only position or distance information of one-hop neighbours. The projected solution was also adapted to believe the remaining power levels of nodes in order to boost the network lifetime.

VII. Conclusion

Wireless Sensor Networks (WSNs) have received research attention at present. The energy-constraint sensor nodes in Wireless Sensor Networks operate on restricted batteries, therefore it is a very significant issue to use energy economically and diminish power consumption. To exploit the network life span, it is crucial to extend each individual node's life span through reducing the transmission energy consumption, so that numerous minimum energy routing schemes for conventional mobile wireless sensor network have been developed for this reason. In this paper we reviewed the different proposals and techniques wich can be applied in monitoring critical events in wireless sensor network.

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