Energy Efficient Data Collection and Routing Algorithm in Wireless Sensor Network: A Survey

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ABSTRACT

The wireless sensor networks are being deployed at escalating rate for various application fields. Wireless sensor networks (WSN) are particularly useful for obtaining data concerning events limited to a well-defined geographic region, such as a disaster site or an agriculture dataset. Power saving is a critical issue in wireless sensor networks since sensor nodes are battery-powered. Therefore, developing secure and energy-efficient routing algorithm to guard WSNs against these attacks while efficiently utilizing the energy of the deployed nodes has become essential. Many of researchers have working on energy consumption in Wireless Sensor Network (WSN). This paper surveys the current status of different algorithm and protocol. We proposed approach for to design Data aggregation and routing algorithm in Wireless Sensor Network to save energy.

Keywords: Wireless Sensor Network, Data aggregation, Routing.

1. INTRODUCTION

Wireless sensor networks (WSNs) are composed of a large number of sensor nodes that cooperatively monitor physical or environmental conditions and transmit collected data to the sink node. This type of network has become popular due to its applicability that includes several areas such as environment, homeland security, industry, domestics, agriculture, meteorology, health, space, military and many other applications that can be critical to save lives and assets. Several physical properties can be monitored, including temperature, humidity, pressure, ambient light, sound, vibration, and motion. Sensor nodes are energy-constrained devices. Energy consumption is generally associated with communication, which is often the most expensive activity in terms of energy [1].

In conventional sensor networks, there is a single stationary sink (a base station), that has unlimited power supply serving as a gateway between sensors and users. This stationary sink data gathering paradigm however suffers from the following two major drawbacks. The first drawback arises from unbalanced energy consumption among the sensors. The second drawback is the required network connectivity. It is necessary that a network consisting of a stationary sink and sensors is connected; otherwise, the data generated by the sensors that lie in a component of the network not containing the sink cannot be transferred to the sink and is ultimately lost [2].

In the past decades, wireless sensor network (WSN), one of the fastest growing research areas, has been attracted a lot of research activities. Due to the maturity of embedded computing and wireless communication techniques, significant progress has been made [3]. Wireless sensor networks (WSNs) consist of tiny sensors densely deployed either at random or in an organized fashion, that communicate with each other to monitor a field of interest. WSNs find their application in many areas that include battlefield surveillance, environment or wildlife monitoring, and event detection [4].

2. LITERATURE SURVEY

In this section, we overview of some existing Methodology

Leandro A. Villas *et.al*. used a spatial correlation algorithm for efficient data collection. In that work they consider the problem of constructing a spatial correlation aware dynamic and scalable routing structure for data collection and aggregation in WSNs. Although there are some solutions for data aggregation in WSNs, most of them build their structures based on the order of event occurrence [1].

Liu Xiang *et.al*. used a novel data aggregation scheme that exploits compressed sensing (CS) to achieve both recovery fidelity and energy efficiency in WSNs with arbitrary topology. They make use of diffusion wavelets to find a sparse basis that characterizes the spatial correlations well on arbitrary WSNs, which enables straightforward CS-based data aggregation as well as high-fidelity data recovery at the sink. Based on this scheme, they investigate the minimum-energy compressed data aggregation problem [5].

Weifa Liang *et.al*. used sensors for data gathering, they formulate a novel constrained optimization problem, namely, the capacitated minimum forest (CMF) problem, for the decision version of which they first show NP-completeness. They also devise approximation algorithms and provide upper bounds for their approximation ratios. Finally they evaluate the performance of the proposed algorithms through experimental simulation [6].

YoungSang Yun *et.al*. used Distributes algorithm for life time maximization of wireless sensor network. The algorithm is distributed, and in addition, mostly uses local information. Such an algorithm can be implemented by parallel or distributed execution and the overhead of message passing is low. They embed the algorithm into a network protocol so that the sensor nodes and the sink can run it directly as part of the network operation [7]

Chi-Tsun Cheng *et.al*. used a delay-aware network structure for WSNs with in-network data fusion. They used structure organizes sensor nodes into clusters of different sizes so that each cluster can communicate with the fusion center in an interleaved manner. An optimization process was used to optimize intra-cluster communication distance [8].

Benazir Fateh *et.al*. used Mixed Integer Linear Programming (MILP) formulation to minimize energy in real time wireless sensor network for obtaining the optimal solution. Dense deployments of wireless nodes and shared wireless channel pose severe interference constraints. There are several scheduling schemes interference-aware message scheduling with the objective of energy minimization [9].

Jiliang Wang *et.al*. used modified Collection Tree Protocol (CTP). Used for path quality measurement in the network. By combining the QoF measurements within a node and over a link, we are able to comprehensively measure the intact path quality in designing efficient multi-hop routing protocols [10].

Xiumin Wang *et.al*. used distributed geographic K-anycast routing (GKAR) protocol for WSNs, which can efficiently route data from a source sensor to any K destinations (e.g., storage nodes or sinks). To guarantee K-delivery, an iterative approach is adopted in GKAR where in each round, GKAR will determine not only the next hops at each node, but also a set of potential destinations for every next hop node to reach [11].

Yu Gu *et.al*. used polynomial-time optimal algorithm for scheduling in wireless sensor network. They build a unified framework for analyzing this joint sink mobility, routing, delay, and so on. They also discuss the induced sub problems and present efficient solutions for them show the benefits of involving a mobile sink and the impact of network parameters [12].

Rashmi Ranjan *et.al*. used Duty Cycle and Network Coding for improving the life time of wireless sensor network. The sensor nodes in the bottleneck zone are divided into two groups: simple relay sensors and network coder sensors. The relay nodes simply forward the received data, whereas, the network coder nodes transmit using the proposed network coding based algorithm [13].

Ying Liu *et.al.* used the topological structure of sensor network. They further focus on the optimal topological design of sensor networks, which targets for improving the performance of distributed estimation. Based on spectral analysis, they shown that this design problem is equivalent to finding an optimal topology that maximizes the Eigen ratio of the second smallest and the largest Eigen values of the respective network Laplacian matrix. To tackle this optimization problem, a computational algorithm combining a local greedy algorithm and tabu search is proposed, in which the constraint on the distance of two communicated sensors is incorporated [14]

Chih-Min Chao *et.al.* used structure-free and energy-balanced data aggregation protocol. SFEB features both efficient data gathering and balanced energy consumption, which results from its two-phase aggregation process and the dynamic aggregators' election mechanism [15].

Architecture of Wireless sensor Network

Wireless sensor node is composed of sensor module, processor module, wireless communication module and energy supply module. Sensor module is responsible for monitoring intra-area information collection and data conversion, processor module was in charge of controlling operation of all sensor nodes, memorizing and processing the data collected by itself; wireless communication module takes charge of conducting wireless communication with the data central node energy supply module offer sensor nodes energy they need in operation, usually adopting micro cell.

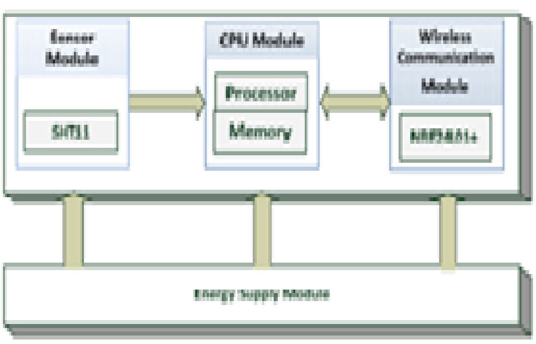

Figure 1.3: Hardware System

Capacity of Data Collection

Now formally define delay and capacity of data collection in wireless sensor networks. Assume that each sensor at regular time intervals generates a field value with b bits and wants to transport it to sinks. We call the union of all values from all n sensors at particular sampling time a snapshot of the sensing data. The goal of data collection is to collect these data from all sensors to the sinks. It is clear that the sink prefers to get each data as quickly as possible.

Definition 1. The delay of data collection D is the time used by the sink to successfully receive a data, i.e., the time needed between completely receiving one data and completely receiving the another data at the sink [16].

Routing Protocol

In this section we discuss about some routing protocol for wireless sensor network, several network layer protocols have been talk about their utilize sensor's energy to extend the life time of deployed wireless sensor networks (WSNs).

Data- Centric Protocols

Data-centric routing protocols are negotiation-based and application-specific protocols. In data-centric routing, the sink node forwards queries to selected regions and waits for data replayed for the sensors in the specified regions. While data is being requested through queries, attribute-based naming should be utilized to identify the characteristics of required data. Several data-centric protocols have been proposed in the literature including Flooding and Gossiping.

Flooding and Gossiping are two classical algorithms to convey data in sensor networks without any routing protocols and topology maintenance. In Flooding algorithm, when a sensor receives a data packet, it broadcasts the data packets to all neighbors within its transmission range. Each sensor receiving the packet repeats the same process until the packet reaches its either destination or time to live. Even though Flooding algorithm is straightforward to implement, it has several disadvantages including *implosion, overlap, and resource blindness.*

Directed Diffusion (DD)

Directed Diffusion (DD) is a routing protocol for distributed activities where a large number of limited resource nodes locally coordinate to achieve a sensing task. The DD protocol has two main features: *Interests* and *Gradients*. The *Interest* is a named data or task description to define the sensor events that an originator is interested in, and it has a list of several attribute-value pairs including type, region, rate, duration, and time stamp. It is applicable to large networks and time-critical applications. In addition, the idea of dynamic clustering brings extra overhead. Furthermore, the cluster heads send data to the sink through high power link which make these clusters consume their energy faster.

Location-Based Routing Protocols

Location-based routing protocols are a family of routing protocols in which each deployed sensor node should know its local location information by some means, for instance, GPS [26]. In addition, it also may require that each sensor node is aware audio and visual information collection modules that have the ability to retrieve multimedia data, store or process data in real time, correlate and fuse multimedia data originated from heterogeneous sources, and wirelessly transmit collected data to the desired destinations. Optimal energy and application-specific QoS-aware routing for WMSNs have gained considerable research attention recently. The authors in [33] claim that classic multipath routing approaches are vulnerable to black holes attacks, mainly due to their deterministic nature. They also proposed mechanisms that generate randomized multipath routes. Besides routes randomization, the generated routes are also highly dispersive and energy efficient, making them quite capable of circumventing black holes.

Energy-Efficient Secure Routing Protocol (EESRP)

It is designed to provide both security and energy efficiency through developing two protocols: Roulette-Wheel Routing Protocol (RWRP) and Secure Routing Protocol (SRP). The RWRP is developed to forward data packets from a source to the sink node. The forwarding decision of each node is independent from other nodes (i.e., the node does not collect information from other nodes to make the decision). Thus, the node decision cannot be deceived by other nodes. SRP is interested in securing data during its traveling from a source to the sink.

Dual Sink Secure Routing Protocol (DSSRP)

It is an enhanced version from the EESRP to prolong the network life time by using two sinks. Like the EESRP, DSSRP provides its functionality through two protocols: Next Node Selection Protocol (NNSP) and Network Protection Protocol (NPP). NNSP and NPP are a modification version of RWRP and SRP to adapt the operation for two sinks, respectively.

SRPMND

SRPMND stands for Secure Routing Protocol with Malicious Node Detecting and Diagnosing for Wireless Sensor Networks. It uses μTESLA authentication protocol to protect packets sink node against the modification, forging, and replay. Also, the protocol implements an acknowledgment mechanism to detect the malicious nodes. For example, if the node did not hear an acknowledgment within a specific period of time, this means that the packet is forwarded to a malicious node. Therefore, a secure route can be created when each node on the path forwards its packet and waits for an acknowledgement until the packet reaches the sink.

Table 1shows the overview of some algorithm which is cluster based and tree based data aggregation and energy efficient

Scheme	Route structure	Objective	Spatial correlation	Data Aggregation	Aggregation nodes	Overhead	Scalability	Drawback
LEACH	Cluster-based	Maximize lifetime	No	Yes	Clusterheads	Medium	Low	Low scalability
SPT	Tree	Shortest-path	No	Yes	Opportunistic	Low	High	Data

								redundancy
CNS	Tree	Aggregate closer to the sink	No	Yes	Aggregator node	High	Medium	Only one aggregation point
DAARP	Tree-based cluster	Maximize overlap routes	No	Yes	Clusterheads And intermediate nodes	Medium	Medium	Static routes
DDAARP	Tree-based cluster	Maximize overlap routes	No	Yes	Clusterheads and intermediate nodes	Low	Medium	Requires global knowledge
DST	Based on straight line segments and cluster	Maximize overlap routes and minimize control overhead	No	Yes	Cluster heads and intermediate nodes	Very low	Very high	Requires position information
EEDC	Single hop	Eliminate control Overhead	Yes	No	Cluster heads	Very low	Very low	Centralized and single-hop network
CAG	Tree-based	cluster Eliminate data redundancy	Yes	No	Cluster heads	Very high	Medium	Maintenance data-centric
YEAST	Based on straight Line segments and cluster	Maximize overlap routes and minimize control overhead	Yes	Yes	Clusterheads and intermediate nodes	Very low	Very high	Requires position information

Table 1: overview of some algorithm which is cluster based and tree based data aggregation and energy efficient

Wireless sensor networks (WSN) are event based systems that rely on the collective effort of densely deployed several micro sensor nodes which continuously observe physical phenomenon. The main objective of the WSN is to reliably detect/estimate event features from the collective information provided by sensor nodes. Therefore, the energy and hence processing constraints of small wireless sensor nodes are overcome by this collective sensing notion which is realized via their networked deployment. While the collaborative nature of the WSN brings significant advantages over traditional sensing, the spatio-temporal correlation among the sensor observations is another significant and unique characteristic of the WSN which can be exploited to drastically enhance the overall network performance. The characteristics of the correlation in the WSN can be summarized as follows:

Spatial Correlation: Typical WSN applications require spatially dense sensor deployment in order to achieve satisfactory coverage. As a result, multiple sensors record information about a single event in the sensor field. Due to high density in the network topology, spatially proximal sensor observations are highly correlated with the degree of correlation increasing with decreasing internodes separation.

Temporal Correlation*:* Some of the WSN applications such as event tracking may require sensor nodes to periodically perform observation and transmission of the sensed event features. The nature of the energy-radiating physical phenomenon constitutes the temporal correlation between each consecutive observation of a sensor node. The degree of correlation between consecutive sensor measurements may vary according to the temporal variation characteristics of the phenomenon [17].

3. CONCLUSION AND FUTURE SCOPE

In this paper we introduce some algorithm for energy efficient data collection and routing algorithm is wireless sensor network. In the literature, data aggregation algorithms typically do not take into account the sensor nodes’ energy to choose the representative nodes. When they do take, they present a high cost in terms of control messages and do not efficiently exploit the spatial correlation. It is also observed spatial correlation having some disadvantage as compare to temporal correlation.

So in future we used temporal correlation algorithm for energy efficient data collection.

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