A Survey on Data Collection in Wireless Sensor Network

V. Shrinithi¹, R. Rohini², R. M. Arivuchelvi³

¹PG student, ²,³Assistant Professor, Vivekanandha College of Engineering for Women, Tiruchengode, India

Abstract—Wireless sensor networks are the networks which can sense, analyze, and then communicate the data. The data collection at sensor nodes consumes a lot of energy but sensor nodes are energy constraints. Most of the WSN architectures consist of stationary nodes which are heavily deployed over a sensing area. In recent times, several WSN architectures based on mobile elements (MEs) have been proposed. The usage of Mobile elements resulted in a newer mode in order to minimize and provide a energy consumption in wireless sensor networks (WSN). Most of them develop mobility to deal with the problem of data collection in WSNs. Most of them develop mobility to address the problem of data collection in WSNs. WSN with MEs was explained and provide a complete arrangement of their architectures, based on the position of the MEs. On the basis of these issues, we provide an general survey of the related literature.

The scheduling of mobile elements need to address the traverse pattern and also the time of data collection from respective sensor nodes. Wireless Sensor Network with MEs and provide a complete arrangement of their architectures, based on the role of the MEs. Mobile element trajectory control scheme to reduce the sensed data collection delay against obstacles. It will reduce the data collection delay and balance the energy consumption in WSN.

Keywords – Data collection, Mobile Elements, WSN, Data forwarding, Sensor.

I. INTRODUCTION

A Wireless Sensor Network (WSN) consist of independent sensor which is spatially distributed to monitor physical or environmental conditions such as temperature, echo, weight etc. The development of WSNs was encouraged by military applications. However, WSNs are used in civil applications, including environment, traffic and habitat monitoring, healthcare and home. A sensor node consists of battery, analog to digital converter, sensing device. All the components have their own role. Due to all these components there are some factors that affect the design of sensor networks, these factors include fault tolerant, availability and production cost.

WSNs consist of a large number of sensor nodes, which are battery-powered minute devices. These devices perform three basic tasks: (i) sample a substantial measure from the nearby environment, (ii) process the acquired data (iii) shift them through wireless communications to a data collection point called sink node or base station.

An analysis and performance of the various existing methods for data collection in sensor networks has been performed.

Implementation of all the basic ME Scheduling algorithm is performed to analyze their characteristics. Then, rendezvous-based system is implemented and its performance is determined. The main aim is to analysing these algorithms for sensed data collection using an enhanced ME-based approach, which minimize the loss in the system, improves the performance of the WSN and besides enhancing the lifetime of the network.

Fig 1: wireless sensor network

The aim of scheduling algorithms is that there should be no delay of the sensed data, practical solutions will concentrate on minimizing the data collection delay. Because, when there is an increase in the number of sensor nodes, obviously the data collection delay will increase. To reduce the sensed data collection delay against obstacles, Mobile Element Trajectory Control schemes are handled.

Data collection is the fundamental functions of WSN. In that, the sensed data is collected at all or some of the sensor node and forwarded to the central Base Station (BS) for further processing. The Mobile Element can act as mechanical carriers collect data from all the nodes and transfers to the BS. The problem of scheduling the mobile element such that none of the buffers overflow is termed as the Mobile Element Scheduling problem.

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II. APPLICATION

WSN are mainly used in Military, Environmental monitoring, Health applications, Monitoring of weather conditions, Traffic monitoring etc. One of the most important applications of wireless sensor networks is Data Collection. Data collection is a primary task in wireless sensor networks. In data collection where the sensed data are collected at sensor nodes and forwarded to a central base station for further processing. In many applications of wireless sensor networks, the data collection is an intelligent choice due to the constraints in communication bandwidth and the energy budget. The key idea of data collection approach is to divide a sensor network into clusters, and determine local data correlations on each cluster head. By using battery powers and wireless infrastructure, sensor nodes can be very small and easily attached at specified locations and without disturbing the surrounding environments. It makes WSN a competitive approach for data collection comparing with its wired counterpart.

III. LITERATURE SURVEY

A. Energy Efficient Data Collection

Chong Liu, Kui Wu, Jian Pei proposed energy efficient data collection framework [1] for the spatiotemporal correlation among sensing data. In this, the whole network is divided into several sub-regions with each covered by a cluster of nodes. The clusters are based on the sampling data, and scheduling is based on the cluster is much more accurate than scheduling based purely on the sensing range of sensor nodes. It can efficiently save the energy without losing surveillance reliability. With PLAMLIS algorithm the data restoration accuracy is improved and the energy consumption decreases.

B. Distributed Algorithm for CDS

Khaled M. Alzoubi Peng-Jun Wan Ophir Frieder proposed a distributed algorithm for minimum connected dominating set [2]. It provides improvement in approximation factor is 6.91 which is due to the refined analysis of the relationship between the size of a maximal independent set and a minimal CDS in the unit disk graph. Each node first broadcasts to its neighbors and the entire set of its neighbors, and after receiving the adjacency information from all neighbors it declares itself as dominator, if and only if it has two non adjacent neighbors. These dominators form the initial CDS, And the dominator declares itself as a dominatee if it is locally redundant.

C. Opportunistic Routing in WSN

Lachlan L.H Andrew proposed Opportunistic source coding and opportunistic routing protocol for correlated data gathering in WSN [3]. It improves data gathering efficiency by exploiting opportunistic data compression and cooperative diversity associated with wireless broadcast. It reduces the power consumption by nearly 32% compared with greedy scheme.

D. Cluster Based Routing Driven density

Sundeep pattem, Ramesh Govindan proposed cluster based routing driven density, which organizes the nodes into clusters [4], and within each cluster each sensor data is routed to a cluster head, redundant data is suppressed. There were also a number of full transmissions.

E. Steiner Minimum Tree with Minimum number of Steiner Points

Feng Wang, and Jiang chuan Liu proposed steiner minimum tree with minimum number of steiner points. The minimum number of relay nodes to connect all sensor nodes becomes to use minimum number of steiner points and to connect all the given vertices. The main idea of approximation algorithm is to conduct the minimum spanning tree algorithm on the given vertices and insert an intermediate stage when the remaining edges between the given vertices are longer than the communication range. In the inserted stage, a steiner point (with three edges) is added to connect three connected components into one. If the steiner point can connect each component with one edge whose length is equal to the communication range. Otherwise if an edge longer than the communication range being selected by the algorithm, and minimum number of steiner points are also added on the edge to break it into smaller ones with length less than or equal to the communication range.

IV. DISCUSSIONS

The number of papers that we have reviewed for wireless sensor network in data collection techniques has different strong and weak points about data collection delay and energy consumption. All the data collection algorithms have to comply with a few basic requirements. The thing that are needed as follows

A. Sensor Node: A sensor node is the core component of a WSN. Sensor nodes can take on multiple roles in a network.

B. Clusters: Clusters are the organizational unit for WSNs. The dense nature of these networks require the need for them to be broken down into clusters to simplify tasks such a communication.

C. Base Station: The base station is at the upper level of the hierarchical WSN. It provides the communication link between sensor network and end-user.
D. Data Collection: Data collection is the fundamental functions of WSN. In Data Collection, the sensed data is collected at all or some of the sensor node and forwarded to the central Base Station (BS) for further processing.

E. Energy: The energy is an important parameter in area source limited network such as the WSN as the lifetime of battery is very much limited.

F. Latency: Latency is defined as the transport delay in receiving the data from the actual time in the real time network. Latency refers to the “Time Delay” measured in milliseconds, between the initial input and output. Latency requirement depends on the applications.

V. MOBILE ELEMENTS

Mobile Element can act as the mechanical carrier which move around in the sensing field, collecting the data from sensor, transmitting them to the base station. The usage of Mobile elements resulted in a newer mode in order to minimize and provide a energy consumption in wireless sensor networks (WSN). At the same point, due to the inherent and slower movement of mobile elements makes the data collection latency to become higher. Hence the scheduling of mobile elements need to address the traverse pattern and also the time of data collection from respective sensor nodes. Many research works have been conducted on the approximation and usage of heuristic algorithms has been applied with the help of traveling salesman problem using neighborhoods.

A progressive optimization approach that combine-skip-substitute (CSS) scheme to obtain optimal solutions within small range of lower bound. The existing work also considered realistic multi-rate features of wireless communication to minimize the data collection latency with multi-rate CSS (MR-CSS) scheme. Using this, the Mobile Elements (ME) to communicate with further-away sensor nodes at lower data rate and reduce their tour length. The progressive approach finds shortest tour to collect amount of data from all sensor nodes in shortest time using wireless communication with uniform and fixed communication range.

A. Combine-Skip-Substitute (CSS)

The nonzero wireless communication range between the ME and sensor nodes and inspired by the fact that the communication ranges of nearby sensor nodes may overlap with each other, the CSS scheme employs three steps to progressively shorten the tour of the ME. (i) TSP tour formulation. (ii) combine collection site. (iii) skip and substitute.

(i) TSP tour formulation

TSP tour formulation is based on set of sensor node in sensing field and collect the data from all sensor nodes. It may reduce the search space to obtain the optimum solution.

(ii) Combine collection site

It covers sparse network and it is based on fixed communication range, but without overlapping the communication disk. Welzl’s algorithm compute only the sensor node on the path. But Decisional Welzl’s algorithm to combine the collection sites of nearby sensor node into a new collection site when possible. And it computes subset of sensor node.

(iii) Skip and substitute

ME may also able to collect the data while traveling along the tour segment. It is used to find largest possible path covers all the sensor nodes.

B. Multi-Rate CSS

Data rate constraints considered within the smaller communication range, so the tour length will be shortened. But resultant tour is always feasible at a lower data rate. All Data collection jobs are finished within shortest time and MEs returns to Base Station at the end. In MR-CSS the tour efficiency not increased, so the network performance not improved.

VI. WIRELESS SENSOR NETWORK WITH MOBILE ELEMENT

Mobile Element can act as the mechanical carrier which move around in the sensing field, collecting the data from sensor, transmitting them to the base station. The main components of WSN with mobile elements are standard sensor nodes are the sources of information. Such nodes perform sensing as their main task. They may also forward messages in the network, depending on the adopted message pattern.

Base stations are the destinations of information. They collect data sensed by sensor nodes either by visiting sensors and collecting data from each of them or through intermediate nodes. They can use data coming from sensors autonomously or make them available to interested users through an Internet.

Special support nodes perform a specific task act as intermediate data collectors. They are not sources nor destinations of messages, but use mobility to support data collection.

Note that mobility might be involved at the dissimilar network components. For example, nodes may be mobile and sinks might be static. In any case, we define a WSN-ME as a network where as a minimum one of the beyond mentioned components are mobile.

VII. DATA COLLECTION IN WSN WITH MES
Data collection is the fundamental functions of WSN. In that, the sensed data is collected at all or some of the sensor node and forwarded to the central Base Station (BS) for further processing.

In this we will outline the different phases of the data collection process and the main issues involved. The description can be easily completed, where sensor nodes are also mobile.

In general, a contact happens when two or more nodes are in their mutual communication range. The amount of time the nodes are in contact is defined as the contact time.

The dashed circle in Figure 2 Since nodes cannot be involved unless they are in contact, and discovery as the process which allows a node to detect a contact, that is the presence of an ME in its communication range. On the other hand, we define data transfer as the message exchange between nodes which are in contact.

The base station is at the upper level of the hierarchical WSN. It provides the communication link between sensor network and end-user.

The definition of data transfer covers only single-hop transmissions, which involve two or more nodes, where at least one is mobile, and the residual contact time as the amount of time which is actually used for data transfer during a contact. The residual contact time is shorter than the contact time, since a node has to determine the presence of an ME before starting the message exchange. Finally, we indicate as routing the process of data forwarding in the direction of an ME, that is the selection of the path or the sequence of pair-wise message transmissions to the intended destination.

**VIII. MOBILE ELEMENT TRAJECTORY CONTROL SCHEME**

To reduce the sensed data collection delay against obstacles, Mobile Element Trajectory Control schemes are handled. It partitioned the deployment area with fixed cell decomposition where the beacon trajectory is divided into global and local trajectory. Using depth-first-search shortest global trajectory is approximated whereas the local trajectory is obtained by greedy strategy. Use of smaller cell size leads to longer beacon trajectory and more localizable sensor nodes.

Mobile beacon assisted localization algorithms are evaluated with multiple simulation scenarios. Simulation indicates that mobile element trajectory control decreases the delay cost, maintain better accuracy with beacon-based localization method and consider both local and global trajectories of the mobile element.

Main objective is follows:

- **A. Mobile Element Obstacles in Sensor Networks**
- **B. Global and Local Trajectory Control**
- **C. Path Plan for Obstacle Avoidance**

**A. Mobile Element Obstacles in Sensor Networks**

Cell decomposition partition a given region into disjoint sets. In a deployment area of sensor network is configuration space. Each element of disjoint sets after decomposition is called cell. The cell decomposition method classified as exact and approximate.

Exact cell decomposition is to decompose the configuration space into a collection of non-overlapping cells to the union of all the empty cells exactly equal configuration space. Approximate cell decomposition is to construct a collection of non-overlapping cells to the union of all the empty cells approximately covers configuration space. If all cells have equal size it is fixed cell decomposition. Otherwise, adaptive cell decomposition.

**B. Global and Local Trajectory Control**

Deployment area is modeled by connectivity graph after cell decomposition and Global trajectory-planning present the shortest path traversing all vertices of connectivity graph. Greedy method make path containing less backtrack. After visiting a vertex next vertex to visit one with most adjacent and non-visited vertices and the vertex with minimal degree is the vertex to visit firstly and degree of vertices adjacent to current visiting vertex is decreased by 1. If current visiting vertex has no non-visited neighbors the algorithm backtracks to its parent vertex. Otherwise selects non-visited neighbor with minimal degree to visit.

**C. Path Plan for Obstacle Avoidance**

Unknown nodes in configuration space are useless nodes (cannot provide useful information), others are useful nodes with decrease of cell size. The number of empty cells and localizable unknown nodes increase rapidly. So, Trajectory is short to save energy of ME against obstacles.

**IX. CONCLUSION**

In this paper we have widely characterized data collection in Wireless Sensor Networks with Mobile Elements (WSN-MEs).
First we provided a general definition of WSN-MEs, then we presented a complete arrangement of their architectures, based on the role of the MEs. In CSS scheme the overall structure of wireless sensor networks are considered. So long time is needed to reduce the data collection delay. To reduce the sensed data collection delay against obstacles, Mobile Element Trajectory Control schemes are handled. It Consider both local and global trajectories of the wireless sensor network. So, Trajectory is short to save energy of ME against obstacles.

REFERENCES


