A SURVEY ON EFFICIENT DISPATCH OF MOBILE SENSOR IN WIRELESS SENSOR NETWORK

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Abstract — Dispatching of Mobile sensors in an efficient way is one of the major problems in larger wireless sensor networks for obtaining the event locations to reduce the energy consumption and to increase the lifetime of wireless sensor network. This work presents a survey on efficient dispatch of mobile sensor in the wireless sensor network. In recent years many approaches and schemes have been proposed for the consumption of energy efficiency in the wireless sensor network. In general, mobile sensors are used to capture the events occurring in the sensing region by either deploying or without deployment of static sensor. The relevant techniques for sensor dispatch problem are examined in the literature survey.

Keywords— Wireless Sensor Network, Sensor Dispatch, Sensor Deployment.

I.   INTRODUCTION

The recent advancements in computer technology, wireless communication technology and digital electronics enhance the design and development of low cost and low power multifunctional sensor nodes that are small in size [1]. Wireless sensor network is slowly becoming an integral part of our life. Wireless sensor network is composed of a large number of sensor nodes, which are densely deployed in either inside physical phenomena. The main characteristics of a *Wireless sensor network are*

- Power consumption constraints for nodes using the battery
- Ability to cope with node failures
- Mobility of nodes
- Heterogeneity of nodes
- It is adaptable for large scale of deployment
- Ease to use

Wireless sensor network is used in many areas
- Military applications
- Habitat monitoring
- Environmental monitoring
- Home automation

Sensor node equipment contains a radio transceiver along with an antenna, microcontroller, an interfacing electronic circuit, an energy source, and battery powered equipment. Sensor nodes sense the nearby environment and perform simple communication and computation within a sensing region. Each sensor node performs sensing, processing, transmission, mobilizes and powering units. In general, sensor nodes are battery powered. Balancing the power in multiple mobile sensors is a critical task in wireless sensor network. One of the ways to resolve it is by the efficient dispatch of mobile sensors in the sensing field. The two objectives of efficiently dispatching mobile sensor in wireless sensor network are

- Minimizing the total energy consumption, of moving mobile sensors
- Maximizing the average remaining energy, of mobile sensors

The cost and detection capability of wireless sensor is mainly affected by sensor deployment. The sensor dispatch problem and sensor placement problem are the two major effects in sensor deployment. This paper is a detailed study about Sensor Dispatch Problem in wireless sensor network. The sensor dispatch problem is finding the subset of sensors in a set of mobile sensor that has to be moved to a respective area of interest in the sensing field in a wireless sensor network.

Fig.1 and Fig.2 shows the example of how the mobile sensors are dispatched to the event locations. Let 1, 2, 3, 4, 5 be the mobile sensor and A, B, C, D be the event locations the sensor placement algorithm is applied on the event locations and energy costs are calculated for the event locations. The weighted bipartite graph is constructed and weights are assigned to it. With the help of the weighted value the sensors are dispatched to event locations. Fig.2 represents how the sensors are dispatched. Finally the sensors are moved to an event location and perform the in-depth analysis of an event (such as temperature, pressure, humidity).
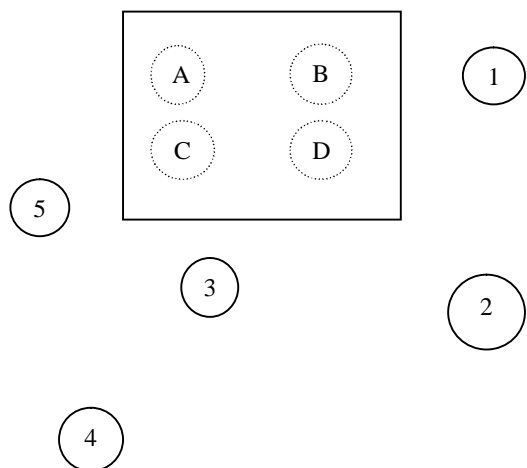
Fig 1: Sensor and Event Location

II.   LITERATURE REVIEW

2.1 Centralized heuristic method

You-Chiun Wang, Wen-Chiun and Yu-Chee Tseng [2] proposed improvement in wireless sensor network by efficient scheduling and dispatching of mobile sensor to the event locations and balanced the energy consumption and hence tits overall lifetime is maximized. For efficient scheduling of mobile sensor two methods are proposed. They are centralized and distributed heuristic to extend the lifetime. Centralized heuristic method [3] minimizes the energy of moving mobile sensor with balancing their energy consumption. When mobile sensors are more than event location, the sensor dispatch problem is translated to a maximum matching problem by constructing weighted bipartite graph as assuming vertex set contains mobile sensor and event locations. While matching two vertices it adopts the "bound" concept which chooses the edges with not too large weights. Hence energy balanced goal is achieved. When mobile sensors are lesser than event locations, then, grouping of event locations into clusters adopts the matching approach. Estimating the cluster cost and cluster event locations are the issues in the centralized approach. In order to overcome these issues three schemes are introduced. They are

- K-mean clustering scheme
- Maxmin clustering scheme
- Balanced clustering scheme

K-mean clustering scheme [4] is used to form a group with the event locations depending on the relative distance in the sensing area and the group is formed with the closest locations.
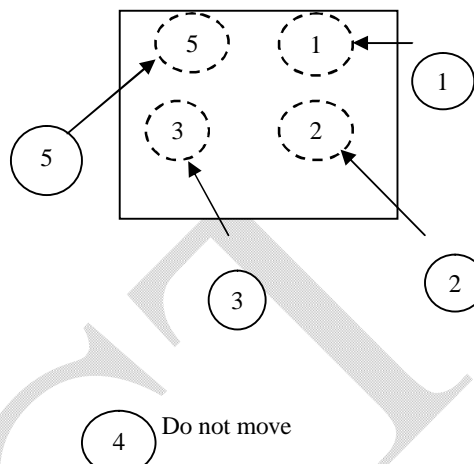

Fig 2: Sensor dispatched to the event location

Maxmin clustering scheme [5] avoids the inefficiency of k-mean clustering scheme. It splits some clusters iteratively and some other clusters are merged to get the better clustering result. Balanced clustering scheme [6] is a combination of k-mean clustering scheme and maxmin clustering scheme. Balanced clustering scheme provides balanced clusters with minimum cost. In distributed heuristic method [7] consider grid structure and adopts the concept of grid quorum for reducing the message complexity and hence obtains the information of mobile sensor. When there is less number of mobile sensors, the clustered event locations are considered as fixed grids and when there are large numbers of mobile sensors, grid structure is used to extend the system lifetime. Hence compared to the greedy scheme [8] both heuristics results in a longer system lifetime

2.2 Pareto optimality

You-chiun wang [16] proposed a scheduling scheme for dispatching mobile sensors to event locations. A simple solution is proposed by handling event locations using divide and conquer concept [10] but has two drawbacks. First the overall moving distance of all mobile sensors is not reduced. Second, mobile sensors moving to a longer distance leads them to exhaust energy quickly. An efficient solution to the mobile sensor dispatch problem was proposed by adopting the concept of pareto optimality and constructed a weighted bipartite graph and translated the mobile sensor dispatch problem to a matching problem and then calculated the dispatch schedule of

mobile sensor by finding the maximum Pareto optimal matching. The Pareto optimality [11] approach extends the system lifetime compared to divide and conquer strategy.

2.3 Priority based scheme

You-chiun wang, wen-chiun wang ,yu-chee Tseng[12] proposed an efficient method to use mobile sensors to capture the events without any deployment of static sensors in the environment . After the occurrence of an event, the static sensor first informs the mobile sensors to fully scan the environment to find out the event locations in the sensing region and hence dispatching a mobile sensor, based on the priority dispatch scheme[13]. The mobile sensor visits the event location based on the highest priority in the priority based scheme yielding shorter waiting time and assignment of priority based on event strength for lower priority, with shortest distance which makes a mobile sensor move for longer distance and hence uses the Hamilton cycle[14]. So the total moving time of the mobile sensor is minimized and the energy is balanced. This problem is viewed and expressed as a traveling salesman problem [15] that considering the priority of visiting event locations.

2.4 Centralized sensor dispatch

You-Chin Wang, Wen-Chih Peng, Min-Hsien Chan, and Yu-Chee Tseng [16] proposed two methods to dispatch mobile sensors to an event location and maximize their lifetime by balancing the load which adopts the concept of centralized sensor dispatch algorithm (Central SD) and distributed grid sensor dispatch algorithm. A central sensor dispatches the mobile sensors to maximize the system lifetime by considering a server to collect the locations of mobile sensors and events. The algorithm schedules the mobile sensor to visit event locations and to reduce the total moving energy distance and balancing the moving distance of each mobile sensor. They can have similar energy cost to visit the event locations and hence the system lifetime is extended. In grid sensor dispatch algorithm [17] grid structure is created in which the collection of information and message exchanging are distributed into grids with reduced message transmission time and computation complexity. Hence the proposed algorithm has a longer system lifetime compared with the iteratively optimized algorithm.

2.5 Sensor placement

You-Chiun Wang, Chun-Chi Hu, and YuChee Tseng [18] author focused on efficient placement and dispatch of sensors in wireless sensor network. In general sensor deployment issues are sensor placement and sensor dispatch. This paper describes about both the issues. The sensor placement issue is about the placement of minimum number of sensors in a field to capture the desired coverage and connectivity. The dispatch problem, explains about finding a set of mobile sensors from a group of sensors to achieve a certain objective by satisfying the coverage and connectivity properties. In the existing system, they have not considered about the arbitrary relationship between a sensor communication distance and its sensing distance. In this paper gives general solutions for the sensor placement problem and allows arbitrary relationships between a sensor communication distance and its sensing distance. Hence the overall lifetime is efficiently extended.

2.6 Two phase dispatch heuristic

You-Chiun Wang [19] proposed a method for dispatching of mobile sensors to event locations by scheduling the traveling path. In general scheduling of travelling path is a critical issue, hence proposed a two phase dispatch heuristic that adopts the concept of Pareto optimality and spanning tree was proposed. In Pareto optimality, constructed a weighted bipartite graph and calculated a maximum matching and assigned mobile sensor to an event location. The unassigned locations are found and mobile sensor is assigned to an event location using the spanning tree algorithm. Finally, two phases heuristic are reduced the moving cost of mobile sensor while keeping their energy consumption balanced.

III. CONCLUSION

In this paper, comprehensive survey of dispatching mobile sensor in wireless sensor network is presented in the literature. In general, weighted bi-partite graph is constructed for solving the sensor dispatch problem. There are several techniques used for solving the problem. In distributed algorithm the event locations are clustered and a grid structure is maintained and hence efficiently dispatched. The recent methods are pareto optimality and spanning tree construction. All the techniques used are commonly featuring to extend the lifetime of sensor networks and balanced the energy consumption of mobile sensors.

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