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An Improved Energy Efficient Scheme for Scheduling Mobile Sensors in a Hybrid Wireless Sensor Networks with Obstacle Avoidance

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Abstract: ***Advancement of robotic technologies as well as wireless communication led to the development of hybrid sensors which consist of static sensors and mobile sensors. Static sensors are the traditional sensors used for sensing physical and environmental characteristics while mobile sensors have powerful sensing capabilities so that it can move anywhere at any time. Each static and mobile sensors can analyze multiple attributes of events. However, such a high mobility may cause scheduling problems. The critical issue is the dispatching of multi attribute mobile sensors to the multi attribute event location appearing in sensing field while considering obstacles and also balance the energy consumption and increase the lifetime of wireless sensor network. Here an improved MAM sensor dispatching algorithm is proposed for developing an energy efficient solution.***

Keywords: Multi Attribute Mobile Sensors, Wireless sensor networks, Hybrid Sensors, Static sensors.

1. Introduction

Developments in wireless communication led to the development of low power , inexpensive , infrastructure-less , computing resources called sensor nodes. These nodes can used to monitor physical or environmental conditions, such as temperature, humidity, pressure, motion , measure and gather information. Inorder to measure the properties chemical , mechanical , thermal , biological , optical and magnetic sensors can be attached to sensor nodes. Due to the limited memory and difficult to deploy in critical locations, a radio is implemented. These radios helps to transfer the datas to base station.

A Wireless sensor typically have no infrastructure . It is a collection of sensing devices that can communicate with each other. It consist of numerous sensor nodes. These sensor nodes are working together to monitor a region to obtain data about that particular location. The design of a WSN depends on the application, and it must consider factors such as the environment, the application's design objectives, cost, hardware, and system constraints. Based on the application and the type of sensors used, actuators can be incorporated in the sensors.

The figure 1. Shows the sensor node deployement.

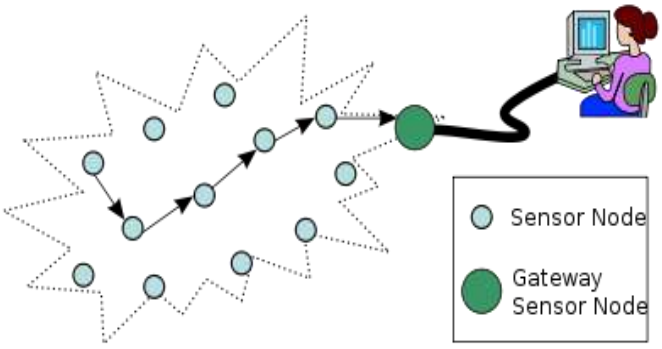

Figure 1. Sensor node deployement

This paper considers a hybrid wireless sensor consisting of static and mobile sensors. Static sensors are the conventional sensors used for sensing physical and environmental conditions where as mobile sensors consist of a collection of sensor nodes that can move on their own and interact with the physical environment and can conduct indepth analysis. Mobile nodes have the ability sense, compute, and communicate like static nodes. Mobile WSN applications include but are not limited to environment monitoring, target tracking, search and rescue, and real-time monitoring of hazardous and so on. Mobile sensor nodes can achieve a higher degree of coverage and connectivity compared to static sensor nodes. In the presence of obstacles in the sensing field, mobile sensor nodes can plan ahead and move appropriately to obstructed regions. The challenging issues regarding the mobile sensors are how we can efficiently dispatch the mobile sensors so as to extend the lifetime in the presence of obstacles . That means an Improved MAM Sensor dispatch algorithm is proposed for solving MAM sensor dispatch problem [1]. Here we have to calculate the many to

many assignments between MAM sensors and event locations. Obstacles are also considered here. For that an Improved MAM Sensor dispatch algorithm is proposed.

The rest of this paper proceeds as follows. In section 2 the related works are discussed. The Improved MAM sensor dispatch algorithm with obstacle avoidance is discussed in section 3. Section IV discusses the performance evaluation. Finally the proposal is concluded in section V.

2. Related Works

Researches provide different solutions to develop several mechanisms to dispatch the movement of multi attribute mobile sensors.

The scheduling of mobile sensors in a hybrid wireless sensor networks is always a critical issue[1][2]. In an existing systems, each static sensor can detect only one attribute of event, while a mobile sensor can analyze multiple attributes of events. Static sensors monitor the environment and report where events appear. Mobile sensors are dispatched to reach these event locations to perform more in-depth analysis. Inorder to reduce the energy consumption of mobile sensors, a two-phase heuristic is proposed for assigning mobile sensors to event locations. But here the problem is that the time taken to analyze different attributes may be different. Other problem is it will work without the presence of obstacles. Zou and K. Chakrabarty proposed the mobility management algorithms of mobile sensors and reviewed some existing WSN platforms [3]. The authors discuss that static sensors can hardly cover the entire target region and cannot ensure the network connectivity [4]. In this case, how to deploy mobile actuator to mitigate this network architecture is a challenge. Dispatch of mobile sensors in sensing field with obstacles. Static sensors monitor the environment and report events occurring in the sensing field, and then mobile sensors move to these event locations to conduct more advanced analysis. How to dispatch the mobile sensor to the event location without colliding with any obstacles and in a shortest path is a big challenge. So a Dijkstra's algorithm [5][6] to solve scheduling for the mobile sensor in the presence of obstacles is proposed. The authors assume that no static sensors are deployed for sensing field because of the problem between coverage and communication [7][8] ranges. Therefore, a number of mobile sensors are assigned to collect sensing data through routes.

Current research papers have addressed only the scheduling of mobile sensors [9][10]. They are unable to provide a solution when the event locations contains more attributes. Along with this obstacles are also not considered. . This paper aims to propose a technique for solving these problems.

3. Problem Statement

Traditional works are only based dispatching the multi attributes in an event location which have only single attributes. However, analyzing different attributes of events may take different amounts of time. So we have to schedule the mobile sensors in such a way that the overall time need to complete the whole assignment should also be minimum. Other problem is that existing algorithm works in an obstacle free environment.

4. Improved MAM Sensor Dispatch Algorithm With Obstacle Avoidance.

The dispatching of multi attribute mobile sensors to the multi attribute event location is considered here. Also scheduling the mobile sensors in the presence of obstacle. In a real environment obstacles of any shape and size will be present.

Initially the static sensors identifies the event location. Here the events also have multiple attributes. Once static sensors identifies the event location then the mobile sensors move to the corresponding event location. and provide more in depth analysis. The travelling path may contain different types of obstacles. Sensor nodes are also battery oriented so balancing energy is a critical issues in hybrid wireless sensors. That means mobile sensors have only limited energy and it should analyse the event locations with minimum movements.

The goal is to schedule the mobile sensors in an event location with minimum number of movements while considering the obstacles. A set of attributes and a hybrid WSN consisting of static and MAM sensors are given [1][2]. Sensors can use GPS to obtain their own locations. Each event is associated with more number of attributes. Each event reported by static sensor is associated with different attributes. MAM sensors are equipped with multiple sensing devices and can visit event locations to perform more in-depth analysis. Here we are scheduling MAM sensors without sufficient energy to event location in E from M.

The proposed algorithm works as below

Step 1 : Initially all MAM sensors and event locations are converted in to vertices. {Edges only connect vertices between M and E}

Step 2 : For every $m_i \in M$ and $e_i \in E$, there exists an edge (m_i , e_i) between them if and only if m_i , e_i have similar attributes

Step 3 : Calculate the weight of each link .
Step 3.1 : if the weight is present outside a particular threshold it is regarded as obstacles. Then along with the link weight this weight also be calculated.

Step 4 : A graph G is constructed with (M,E)

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Step 4 : In case of G = NULL , the algorithm is terminated. Since no MAM sensors have the correct attribute to analyse events in E.

Step 5 : In case of G = 1, m_i joins and update the weight , processing time of different attributes in an event location and also the obstacle weights.

Step 6 : The process continues until it terminated.

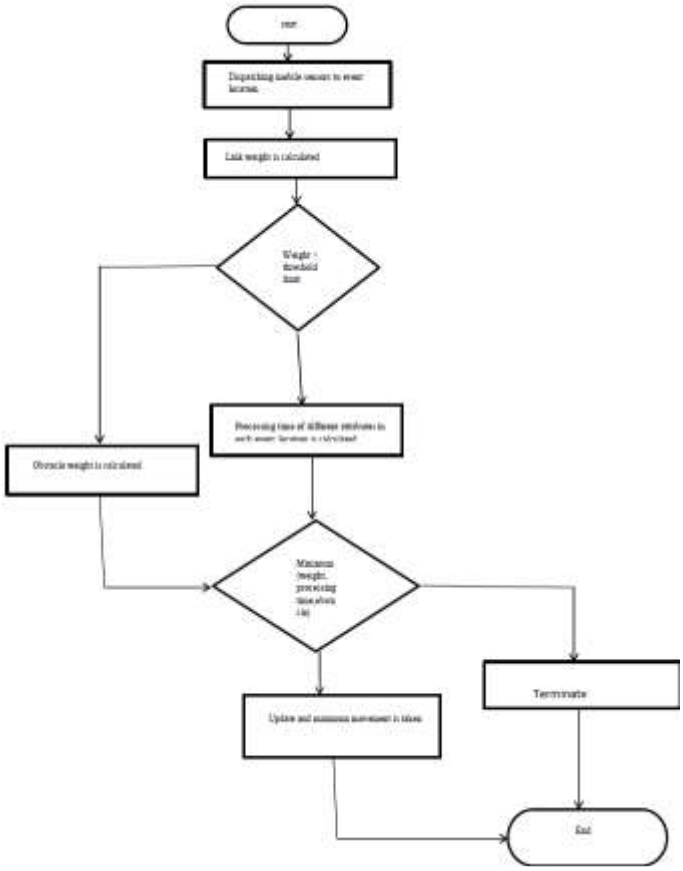

Figure 2. Flowchart of proposed model

The proposed algorithm works as given above. Initially each mobile node is assigned to their corresponding event location. Then edge weight is calculated. If the weight is above a specified threshold then obstacle is identified. Based on the minimum weight the edge is selected. Once it reaches an event location the processing of different attribute is done. That means here each event locations have different number of attributes. After that it moves to other event location which is more optimal. This dispatching is done based on the minimum weight , obstacle weight and the processing time of different attributes present in each location. If two mobile sensor have same attributes then only one should be taken since they can be communicated to another mobile node when they are within range of each other Finally the whole event will be analysed with minimum movement in an energy efficient way.

5. Performance Evaluation

To measure the performance of the scheme ONE simulator is used. It is a java based simulation tool. It has an ability to interact with other programs and data sources. The sensing field is deployed with 1000 static sensors and mobile sensors. Experiment shows that the proposed scheme is more efficient than all others existing ones.

6. Experimental Results

The average system lifetime of the proposed system is given in Figure 3. Existing system is compared with Improved MAM Sensor Dispatch Algorithm.

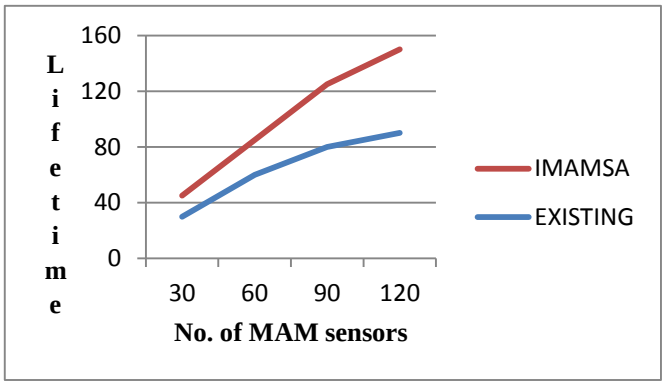

Figure 3. System life time Vs No. of MAM Sesors

The energy consumption of the proposed system is given in Figure 4. Existing system is compared with Improved MAM Sensor Dispatch Algorithm.

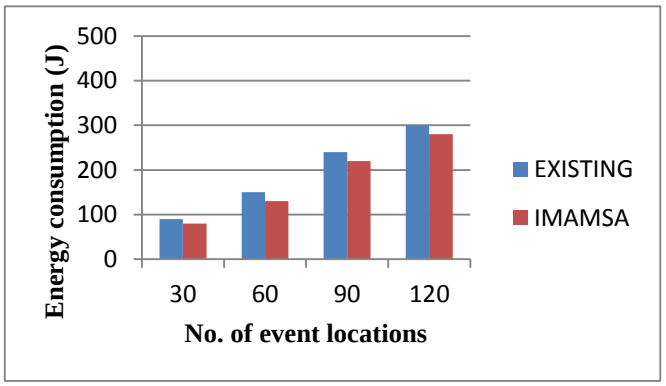

Figure 3. Energy consumption Vs No. Of event locations

7. Conclusion

Mobile WSNs consist of a collection of sensor nodes that can move anywhere and interact with the sensing regions at any time. They have a powerful computing and sensing capabilities so that they can move to the specified locations and can perform critical operations. The sensing region may contains many obstacles. However, due to mobility and obstacles they are more prone to scheduling problems. To resolve this problem , an energy efficient

algorithm is proposed. Here each multi attribute mobile sensors can move to their corresponding multi attribute event location and can conduct more in depth analysis so that it can perform all mission critical applications. The processing time for different attributes present in event locations are also analysed. Along with this obstacles are also considered.

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