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# Polling Point Path finding Algorithm for reducing Latency in Wireless motion Detecting Sensor networks

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**Abstract**

A new mechanism is proposed to find the shortest path for mobile data collections in the wireless motion detecting field of Wireless Sensor Networks (WSNs). The wireless network consists of moving vehicle called "Movcar" for mobile data collection which directly visits the sensor heads to gather data. Direct collection of data packets eliminates relays, collisions and consumption of energy, but the disadvantage is latency. To overcome the latency problem, polling point path finding algorithm which is a greedy approach is used in mobile data gathering mechanism. First, selects the neighbouring polling point by using Path Finding Algorithm (PFA), then the MovCar travels to the each selected polling point for gathers data and then forwards the data to the sink node. Path Finding Algorithm (PFA) is used for direct collection of data from neighbouring polling point. Thus reduces the data collection latency and consumption of energy during data collections and also increases the network lifetime. Compared with the existing travelling salesman problem and shortest path problem, the proposed path finding algorithm reduces the travelling distance of Movcar and also reduce time.

*Keywords: Wireless Sensor Network, Movcar, polling point, Sink, Mobile data collection, Latency.*

*Reviewed by **ICETSET'16** *organizing committee*

## 1. Introduction

Advanced technology of wireless sensor networks (WSN's) is incorporated in various applications such as environment checking, occasion recognition and following target **[1&4].** WSNs consist of an expansive number of sensor devices, which are battery powered modest gadgets. The sensors perform three essential assignments which are sense a physical amount from the environment, handle the obtained data and transmit through wireless connections to a data gathering point called sink. The sensor devices energy is consumed on two stages. Sensing the field and transferring data to the mobile base station. In homogeneous network, sensed data from the sensor devices and forwards the data to the sink in one hop correspondence. The distance between the sensor and sink is longer, need expends extensive energy for data transmission, since the data will be transmitted through a few relay hubs, which has to transfer numerous packets from sensors far from the mobile data collector. Accordingly, after these sensors fall flat, other sensors cannot achieve the data collection and the network gets to be disconnected, but the majority of the sensor nodes can still works for a long time. Introducing mobile device into the network for data collections called MovCar is suitable for such applications. A MovCar begins a data gathering visit from the sink and start travels a whole network for gathering detected data from adjacent nodes while moving and finally transfers data to the sink. An essential lessens of energy utilization at sensor nodes contrasted with ordinarily utilized multi-hop sending approach, in the way delaying network lifetime. The deadly disadvantage because of the utilization of a MovCar is expanding the latency of data collections in WSN. To reduce the latency of data collection, the travelling way length of a MovCar must be shorten. Utilization of a MovCar for collection of data in the wireless sensor network includes making a way along with the MovCar can recover all data from all sensors while minimizing by and large travel costs. Propose a Path finding algorithm for sequencing the shortest moving path of MovCar such that the data can be assembled from all sensors in the network with least length.

## 2. Related works

A brief outlines of some related works away at the data collection plans in WSNs. Data collecting plans in WSNs can be generally characterized into three classifications. Relay routing, Hierarchical infrastructure and mobile data collections. In the accompanying, a quick examine of some complicated scheme in every classifications.

In the first classification, the packets of data are sent by sensors to the base station by utilizing relay nodes **[12&3]**. Minimizes the sum of raw data by using the way to the compression of data sends to the sink by relay. Along the path routing nodes need to transfer numerous packets from sensors far from the data gatherer. Therefore the relay nodes get failed quicker than other nodes, such that the data can't have the capacity to achieve data sink.

In the second classification, a WSN was sorted out into a hierarchical infrastructure for better adaptability in which sensors are sorted out into clusters which is lower layer of the network and cluster head is higher layer of the network. Cluster head assemble detecting data from sensors in relating clusters and sends data to the outside data sink **[15&16].** In such network cluster heads consumes more energy than other nodes. In the way sensors node can get to be cluster and to keep away from “hot spots” **[3]**. Since each sensor nodes might perhaps turned into a group head, each of them must be “powerful” enough to handle approaching and active outgoing traffic which expands the general cost of the sensor network, and also brings high overhead because of continuous exchange of data among sensors.

In the third classification, the mobile data collecting plans have been proposed in **[11, 9, 2&10]** to defeat these issues in static various hierarchical networks. Such plans are unique kind of mobile collector presented in network for data collection. Mobility design, we can be further classified two subclasses namely Uncontrolled mobility and controlled mobility. In the accompanying, the quick examine some commonplace plans in every subclass. In the main subclass, the mobile collector either moves arbitrarily or along a settled track. In the second subclass, the mobile collector can move freely to any area in the network and its way can be arranged. In **[2&10],** open transportation vehicles were received as mobile collector. The sensor networks conveyed in a urban region, open transportation vehicles for example, cars and buses, which dependably move along fixed path, can be connected with transceivers to go about as mobile base stations. Randomly moving data mules compared with the moving way and timing prediction was discussed in this case. To acquire more adaptable data collection ways for mobile collector, **[5]** proposed a moving path planning algorithm for mobile collector by a method of divide and conquer. Recursively decides the defining moment for load balancing and composes every piece of the network into a cluster. **[6]** Introduced a mobile data collecting plan with SDMA procedure, where mobile collector called SenCar furnished with two receiving antennas. Data collector visit and gathers data from two sensors when SenCar comes nearer to the transmission range of sensors. Decreases the data transferring time can be achieved but the moving time of the SenCar increases, accordingly data collecting inactivity increments. Mama and Yang **[7]** proposed mobile data collecting in wireless sensor networks with limited transfer jump. The mobile data collector chooses subset of sensors will be as polling points that support privately collected data with limited transfer jump and transfer the data when mobile collector arrives. The advantage of the technique is to reduce the data collecting latency at the expense of support overflow because of more number of relay hubs. The different data collecting plans in WSNs was discussed. The propose system contains new mobile data collecting mechanism which minimizes both energy utilization and data collecting latency.

## 3. Preliminaries

The proposed system considers the mobile data collecting in wireless sensor networks. A MovCar can visit the transmission scope of each static sensor, such that detecting data can be accumulated by single hop correspondence with no relay and crashes. Before portray the data collecting plans, first characterize a few terms that will be utilized as a part in the mechanism.

### *3.1 Candidate polling points*

The Omni-directional antennas transmission range was plate formed zone around the transceiver. According to the consideration of the neighbour set of sensor comprises of all sensors inside of the plate formed around this sensor. Knowing of the one-hop neighbours of each sensor in the network, the location of every sensor can be a candidate polling point. If don't have an idea about the one hop neighbours of sensors in the network, the candidate polling point can be acquired by after sensors are conveyed one MovCar need to investigate the whole detecting field. While investigating, MovCar can show “Hello” messages occasionally with the same transmission power as sensors. Every sensor encrypt the “Hello” messages effectively sends with an “ACK” message to identify the MovCar where it is. After getting the “ACK” message from the sensor, the Movcar marks its present area as a candidate polling point and includes the ID of the sensor into the neighbour set of this candidate polling point. Moreover, the neighbour finding stage, each sensor can likewise find its one-hop neighbours by intimating the “Hello” messages to all. The sensor reports the IDs of its one-hop neighbours to the MovCar by including the data into the “ACK” message, after that the location of the sensor can likewise turn into a candidate polling point.

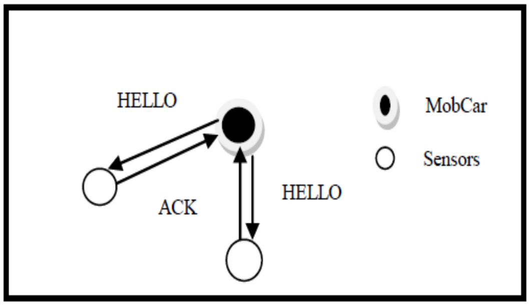


**Figure 1. Finding neighbour**

Figure 1is an example of neighbour finding is explained. The finding neighbours of MovCar by sending “Hello” and “ACK” between MovCar and sensor.

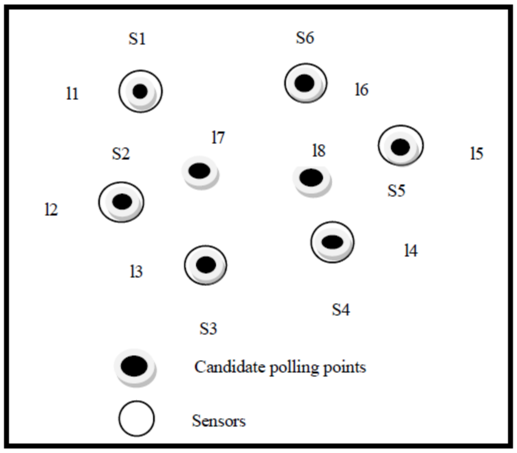


**Figure 2. Polling points and neighbours polling points**

Figure 2 shows the meaning of polling points, neighbour set and candidate polling point set by an sample, where there are six sensors s1, s2, s3, s4, s5 and s6 conveyed at positions l1, l2, l3, l4, l5 and l6. At the investigation stage, the MovCar finds the neighbour sets of l7 and l8 was included into the candidate polling point set. Since s1, s2, s3, s4, s5 and s6 likewise report their one-hop neighbours to the MovCar by sending “ACK” to the MovCar, l1, l2, l3, l4, l5 and l6 likewise get to be candidate polling points. The neighbour sets of l1, l2, l3 and l7 are {s1, s2, s3} and neighbour sets of l4, l5, l6 and l8 are {s4, s5, s6}

In description, a candidate polling point set can contain two sorts of focuses in the network: the positions where sensors are sent and the points where the MovCar has checked the wireless connections in the middle of it and its one-hop neighbours. After the finding stage, every sensor has data of all its one-hop neighbours and the MovCar gets the data about the neighbour set of each polling point in the network. Consider the issue of finding the polling points from the candidate polling points, a MovCar polls close by sensors one by one to accumulate data at data collecting stage. After getting the polling message, a sensor just transfers the data to the MovCar specifically without crashes and relay. And also characterize the positions where the MovCar polls sensors as polling points.

At the point when a MovCar moves to a polling point, movcar polls adjacent sensors with the same transmission power as sensors, such that sensors that get the polling messages can transfer packets to the MovCar in one hop. After receiving data from sensors on the polling point, the MovCar moves straight to the following polling point in the visit. Consequently, every data collecting visit through a MovCar contains of various polling points and the straight line portions joining them. For instance, let PT= {pt1, pt2 . . . ptn} signify an arrangement of polling points and DS be the data sink. At that point, the moving visitor through the MovCar can be passed by DS → pt1 → pt2 → · · · → ptn → DS. In this way, the issue of deciding the ideal visit can be considered as the issue of finding the position of polling points and the request to visit them. Before a MovCar begins a data collecting visit, it needs to decide the positions of all polling points and which sensors it can poll at each polling point.

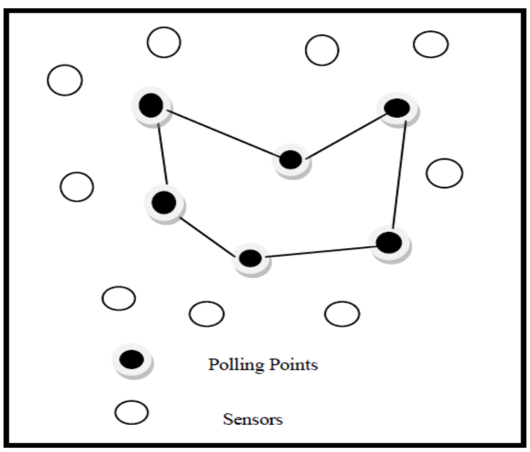


**Figure 3. Selection of polling points**

In Figure 3 shows an illustration of polling point selection issue. In the figure polling points chose from the network then MovCar collects data from polling points with no relays and crashes which covers all sensors.

*3.2 Data gathering with MovCar*

In little scale wireless sensor organizes, the data can be collected by single MovCar. A MovCar could be a portable robot or a vehicle outfitted with an intense transceivers, battery and huge memory. The MovCar begins the data collecting visit from the data sink, navigate a whole network, furthermore, collects the detected data from polling points.

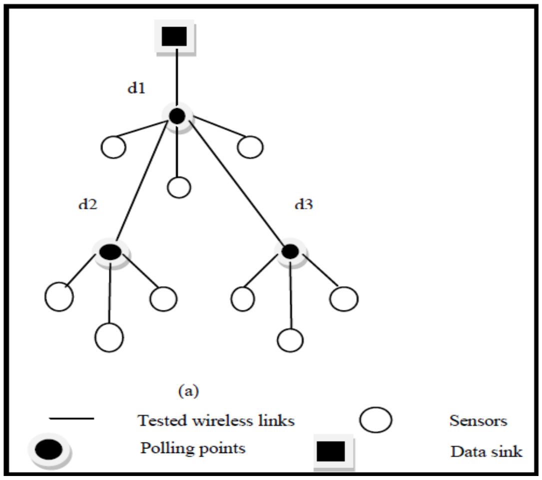


**Figure 4. Neighbour set of p is covered with an average cost d/3.**

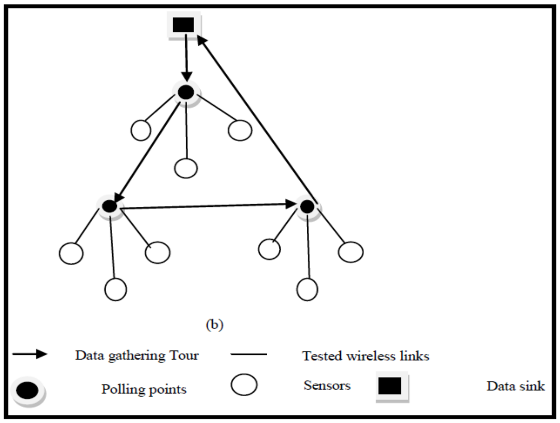


**Figure 5. Data collection tour obtained by path finding algorithm.**

While moving and transfers data to the sink. Path finding algorithm is utilized to find the polling points from the candidate polling points and after that arrangement the data gathering visit through a MovCar. The data collecting visit begins from the sink taken after by the choosing of polling point from the candidate polling point by using the value α explains in the following formula.

$$\alpha = \frac{\cos t\{nb(c)\}}{|nb(c) \cap Ucurr|}$$

**Formula 1. Cost calculation**

Formula 1 explains the estimation of α is the proportion of cost which is the distance cost{nb(c)} of source and candidate polling points to the quantity of neighbours covered by candidate polling points nb(c). At last, the candidate polling points with least α worth will be chosen as polling point. The essential thought of proposed path finding algorithm with single MovCar is to find a polling point from the candidate polling points and its relating neighbour set of sensors can be covered in the data collecting visit at every stage. The algorithm will end after all sensors are covered. The algorithm tries to cover each revealed neighbour set of sensors with the base normal cost at every stage. It can be depicted as follows. Let PLcurr be the arrangements of all polling points, C contain set of all candidate polling points, and UCcurr be the arrangement of remaining uncovered sensors at every phase of the algorithm. Compute the x and y directions of every sensor in the arrangement and put into the arrangement of x [], y [].The neighbour set of every candidate polling point put into the arrangement of nb(c). The quantity of neighbours of every candidate polling point is put into the arrangement of non(c). Let α=cost {nb(c)}/|nb(c) ∩UCcurr|, which indicates the normal cost to over every uncovered sensor in nb(c). The polling point is selected from candidate polling points with least α esteem. Eliminate the polling points from UCcurr and included into PLcurr. Eliminate neighbour arrangement of polling points nb(c) from UCcurr. The algorithm ends when all sensors are covered in the network. After finding the polling points, the base data collecting visit can be acquired by utilizing Travelling Sales man Problem.

MovCar picks p1 as the first polling point, since it can covers the nearest neighbour nodes which are uncovered with least normal cost d1/3. After that, p2, p3 will be chosen as the second and third polling points with the normal cost d2/3 and d3/3, individually. At last, the short visit can be approximated on all selected polling points and sink achieved by travelling salesman problem.

*3.3 Path finding Algorithm with MovCar*

Step 1: Create an empty set PLcurr.
Step 2: Create a set Uccurr containing all sensors.
Step 3: Create a set C Containing all candidate polling points.
Step 4: Get the node's coordinates and stored into set of x [], y [].
Step 5: Calculate the distance between the node and stored into the set of cost [][].
Step 6: Create a set nb(c) containing neighbour sets of candidate polling points.
Step 7: Create a set non(c) containing number of neighbours of candidate polling points.
Step 8: Select sink node as the root node of the tree.
Step 9: **while** UCcurr ≠ Ø
Find a polling point c ∈ C, which minimizes
α= cost{nb(c)}/|nb(c) ∩UCcurr|
Cover sensors in nb(c)
Add the corresponding polling point of nb(c) into PLcurr.
Remove the corresponding polling point of nb(c) from C.
Remove sensors in nb(c) from UCcurr.
**end while**
Step 10: Find an approximate shortest tour on polling points in Pcurr by TSP.

## 4. Result analysis

So as to assess the execution of proposed algorithm, we performed a simulation in NS2 and collects data by brought mobility into the network.

*4.1 Parameters*

Proposed system consists of mobile data collector, collects data from all sensors in the network with no relays and crashes. This technique performed by utilizing path finding algorithm that is proposed in this paper. To assess the proposed algorithm, utilized network Simulator (NS-2) ver. 2.34 **[16],** which is an open-source network correspondence test network utilizing the parameters given in Table I.

TABLE I
SIMULATION PARAMETERS

| Parameter | Description |
|---|---|
| Channel | Wireless |
| Radio Propagation | Two-ray ground |
| Antenna Type | Omni antenna |
| MAC Layer | 802.11 |
| No of nodes | 100,200,500,1000 |
| Topology | Random |
| Deployment area | 300m×300m to 1000m×1000m |
| Transmission range | 60m |

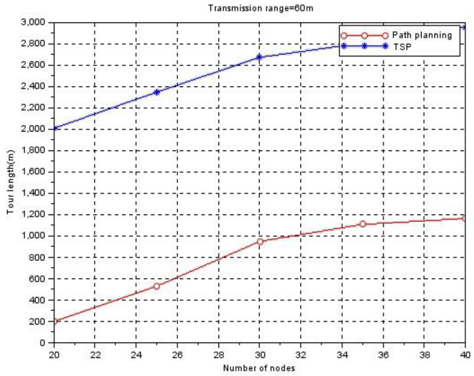


**Figure 6. Number of nodes Vs Visit length (m)**

Figure 6 plots the normal visit length for transmission range equivalent to 60 m and the quantity of sensors equivalent to 20, 30, and 40. Figure 6 demonstrates that the visit length of the proposed algorithm is lesser than the tsp. Figure 7 demonstrates that the visit length increments with expansion in the range of detecting field.

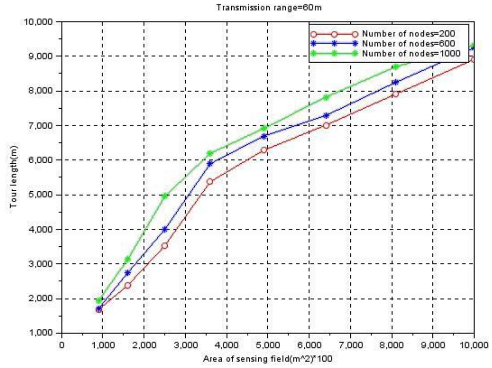


**Figure 7. Range of detecting length Vs visit length**

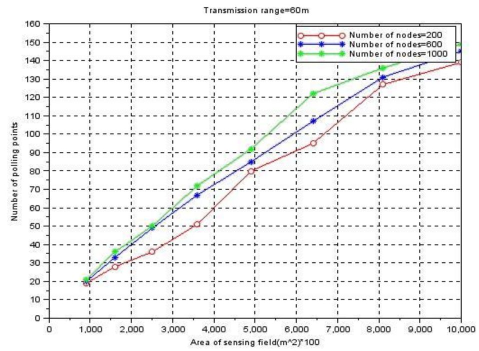


**Figure 8. Range of detected field Vs Number of polling points.**

Figure 8 explains that the Number of polling points increments with the expansion in the range of detecting field. Figure 7 and 8 plots the execution of path finding algorithm for all possibilities of number of nodes equivalent to 200, 600, and 1000 and the range of detecting field equivalent to 300 m× 300m to 1000 m× 1000 m.

## 5. Conclusion and Future work

Proposed system describes the mobile data collecting component for wireless sensor networks and also presented a mobile collector, called MovCar, which works like a moving base station in the network. Path finding algorithm is utilized to find polling points. A MovCar begins the data collecting visits time to time begins from sink visits each polling point and gathers the data from them which covers all sensors and after that send the data to the sink in this way lessening the data collecting latency and energy utilization and henceforth lifetime of the network gets expanded. The results exhibit that the proposed data collecting components can incredibly shorten the distance of visiting the sensor nodes and also increase the network lifetime. For future research, find the least length visit by employs the computing techniques like genetic algorithm (GA), Antcolony optimization to improve the performance.

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