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Cluster-Based Collection point Energy Efficient Routing Protocol for the Mobile Sink in Wireless Sensor Network

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Abstract

In order to extend the lifetime of a network, the advantages of using the sink mobility have been considered in wireless sensor networks (WSNs). In the field of sensing, all types of obstructions could be existed in physical environments. To determine the shortest route with an obstacle-avoiding, a research challenge is executed based on a procedure of efficient dispatch the mobile sink. For finding out the shortest route of obstacle-avoidance, an existing system is developed for mobile sink as an algorithm of heuristic tour planning. The traditional algorithms are tough to resolve owing to the scheduling problem's complexity in WSNs with obstacles that includes more tour time. An efficient scheme based on collection data-point is proposed to overcome this problem. A collection point algorithm is presented according to the data collection for the mobile sink to discover the route for cluster heads and for collection of data from CH's and store it. From the initial phase, a periodic data-gathering route is started by the mobile sink and the data is collected from collector point in a single hop's range. In the final phase, it is returned to the initial stage. The method's effectiveness is verified through the simulation results based on NS2 software.
INDEX TERMS: *Energy-efficient Routing, Wireless Sensor Networks, Cluster-based, Obstacles, Collection Point Scheme, Mobile Sink, Scheduling.*

I. Introduction

Based on different aspects, the Wireless Sensor Networks (WSNs) have been implemented that involves military surveillance, environmental monitoring, health monitoring, and others as Internet of Things (IoT) [1]-[5]. For WSNs, the most essential problem is energy efficiency. The supplying of power is restricted for sensor nodes and it's very tough to replace with any other. As the nodes are relayed on the data collection based on nodes of sensor that are distant away from the sink, more energy is consumed by the nodes are existed closer to the base station or sink when compared to other available nodes in the network. When the failure of sensors is done that is closed to the sink, the collected data by other sensors couldn't be transmitted to the sink or destination. Although a lot of energy is included in most of the nodes, the overall network is disconnected further. The essential challenges of WSNs are involved reducing the sensor nodes' consumption of energy and improving the network's lifetime.

To increase the WSNs' lifetime, various kinds of methods are developed. An algorithm of cross-layer optimized geographic node-disjoint multipath routing is demonstrated in this paper [6]. To decrease the WSNs' energy expenditure to a large extent, mobile nodes can be used in this recent work. WSNs' lifetime is improved consequently. More powerful capabilities and more energy have contained in the mobile nodes than the static nodes. From all static nodes which transmitting across the field of sensing, the data can be gathered by mobile nodes which are embedded with enough energy by mounting on a mobile vehicle. By using mobile nodes, the collection of data can be done from static nodes in multi-hop or one-hop way. Different kinds of approaches have been presented in the papers [7]-[10]. Here, mobile nodes are termed as the mobile sink that usually helps to gather data by travelling in the field of sensing. The sensor nodes'

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communication overhead is reduced by the mobile sink which is nearer to the base station or the sink. The consumption of energy is processed constantly in a uniform way. The network of disconnected and sparse can be handled in a better way by including the sink's movement. With the route's optimum control of the mobile sink, the lifetime of a network can be extended significantly. Different types of obstructions could be contained in the sensing field of physical environments. A research challenge is included specifically relevant to the how to determine an obstacle-avoiding shortest route for the mobile sink.

To discover an obstacle-avoiding shortest route, the mobile nodes will transmit over the network which includes the blockages in this paper. The energy consumption balance should be considered by the mobile sink among nodes when transmitting across the field of sensing. The cluster-based method is demonstrated in the papers [11] and [12] and is used to send out of the mobile sink with efficiency. Two types of sections are categorized in all sensor nodes with the sensing field that includes cluster members and cluster heads based on the cluster-based technique. From corresponding cluster members, the collection of data is done by cluster heads. The environment data is gathered and the data is passed to the mobile sink. Up to some limit of delay, WSNs can be tolerated which is assumed that all data of sensing is collected by mobile sink from cluster heads. From initiating stage, the mobile sink is started its movement periodically and returns to the final stage. From cluster heads, the data of sensing is gathered by the mobile sink during the movement. After the planning of moving path is completed, the mobile sink can be reached closer to the cluster heads and lower energy is conserved. Significantly, lifetime of a network can be improved. The definition of lifetime of a network is nothing but the time interval of initiating the operating of sensor nodes until all static sensors' death. Many obstacles may be contained in the sensing field of physical environments that will complicate the mobile sink's scheduling. Excluding the obstacles' site, the mobile sink can be transmitted to any location. In the presence of obstructions, how the movement of mobile sink with efficiency is a research challenge of this paper.

While solving the making of a mobile sink have taken several steps towards easing the sending of issues on WSNs with barriers. We represented grid scheme that divides sensor area into the same grid cells because of the difficulties in the problem. Grid cells are classified as the basic unit and similar to the touch radius of the static sensors. The division into the same cells of the two-dimensional plane impedes the grid cells. Even grid cells and barriers can be overlapped by obstruction edges. The grid cells can be called barriers when the barriers occupy a portion of grid cell. We therefore achieve the regularization form of barriers to make it easier to schedule the mobile sink. In the form of regularization of obstacles we can then create a detailed graph. The search space for mobile sink will boost scheduling of the sink for the mobile device from all grid cells towards span graph for the grid cells. Therefore we will consider a shortest path to the mobile sink, which avoids obstacles.

The rest of the paper is arranged accordingly. The related work is listed in Section II. Section III deals with the problem description, energy use models and cluster partition. In order to define a shortest obstacles free tour in Section IV, suggest a experiential obstacle free algorithm for sink. Finally, in Section VI, we finish paper.

II.Literature Survey

This scheme proposed by this Author [13] enables sensor nodes to maintain optimum routes with fewer hops to the latest sink location within a sensing sector. There are 'n' number clusters for the entire sensor area. — The cluster is led by a random cluster head, and the cluster head rotation is carried out using LEACH algorithms on the basis of the remaining amount of energy in each node. While accumulate information from head in one hop, the moving platform can be moved in the opposite direction along the edge of the sensor field. The cluster heads may collect information from source before sink reaches them

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by the store and forward mechanisms. The chosen members of the class would obtain a new position on the sink if the sink shifts from the cluster head to the cluster end. The lifespan of the network is increased to use the rules for finding suitable paths to a new sink site and to minimize reconfiguration.

In this author[14], Nodes says that they live in the close environment. Such measurements are then reworked into signals to show those developmental characteristics. The collected information is then routed to a special node, called the base station; normally the base node sends the user information by means of a passage via the web or satellite. In combination with the benefits of wireless communications, the WSNs offer an endless range of applications for both military and civil applications, including robotic landmines, land police testing, target tracking, inferno detection, structural monitors, health, industry, agriculture, home, traffic monitoring.

Different methods aimed at extending the life of wireless sensor networks are proposed in this author[15]. A cross-layer Geographical node separate multi traverse routing algorithm is offered as the paper "Cross-layer optimized routing in duty cycle and energy recovery wireless sensor networks." Recent work shows that the energy expenditure of WSNs is overdriven by the use of mobile nodes. The duration of the WSNs is therefore extended. Mobile nodes provide additional capacity and flexible features comparable to static nodes. Mobile nodes often gather data from every stationary nodes across sensing region with ample energy in a mobile vehicle. Static node information can be collected using a one-hop or multihop approach through mobile nodes.

This author [16], M. In this book Y. Yang, and C. Zhao, and C. The paper uses the following mobile nodes like sink moves across sensing area for purpose of gathering data. Wang, "mobile data collection with a load balanced clustering and dual data uploading in the wireless networks sensor," On the one side, an overhead contact on a mobile sink for nodes near the lower terminal or sink is minimized, may primes toward solid energy consumption. On later side, we treat the disconnected and dispersed network more closely with the sink movement. Therefore, optimal control of the mobile sink route greatly improves the life of the network. The sensing area can have multiple obstacles in physical environments. Therefore, the challenge of a test is to see a problem evading a smallest way for a mobile sink toward extend network lifespan. W. B. A.P. Chandrakasan, B. Heinzelman, H. Balakrishnan,"A procedure planning for wireless systems of small scale sensors, All finder nodes are partitioned into Two gatherings, as per group strategy, in the field of detecting: cluster head along with cluster members. Cluster heads gather information with the essential affiliates of the cluster that can relay ecological information toward mobile dish. They want to accept that WSNs may acknowledge about measure time with goal that every detecting information from cluster heads is gotten by mobile sink. The mobile sink starts from the opening of its daily movement and eventually comes back. The mobile sink collects sensing data from cluster heads throughout its movement. Mobile sink passes near toward cluster heads also uses lower energy until moving path be prepared. The network period is therefore greatly increased. The network time interval is illustrated in this paper because it starts working from the detector nodes until all static sensors are destroyed.

III.Proposed system

A random complete graph G = (V, E) are provided in this problem. Where, the set of the sensor nodes into network is represented using V and set of edges which denotes the travelling duration i.e. (v_i,v_j) amid the node within the network is represented by E and (v_i,v_j) represents the time taken by the mobile element for travelling amid nodes v_i and v_j. Moreover, M & L are provided here where, the set of the available mobile elements is represented by M and the time-deadline constraint is represented by L.

Various collection points in addition to the series of standards implemented for the node levels are considered in this method and later the respective position within the network consumes the remaining energy of the entire nodes. A collection of mechanisms in addition to the data out of the collected points can be applied. Various rounds are included in finding the solution to this issue and reducing the number of the attained rounds in order to amend the travelling time for every round to be less than or equal to *L* is

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the major goal of this method. Moreover, every single node is upon a single round or it is one-hop apart from the node that is comprised within one of the tours.

The heuristic method which is operated with the distribution of the network and the allocation of a mobile element is done within every partition for addressing this issue. The distribution of the nodes are considered in this distribution for avoiding the long-distance travelling with the help of the mobile element. The mobile elements tours are constructed with the identification of the set of nodes in this method. The position of the nodes which doesn't belong to this group must be located at a faraway distance. The Set-Covered-based procedure is used for obtaining this set. After the identification of the node's tour, the splitting of this method is done within 2 parts. The famous k-mean algorithm is employed in the abovementioned step. Individual tour on behalf of every partition are constructed after attaining the partition. Christofides procedure is used to construct the tours within every part. Once, the attained tour is satisfied by the limitation of time-deadline on behalf of every partition and a mobile element is assigned with a tour. In another way, the re-partitioning of this distribution is done and the retriggering of the tour construction stage is performed.

Algorithm: $\boldsymbol{Cluster - based\ Collection\ Points}$
Input:
Set of n sensor nodes S,
Set of cluster heads $CHS \leftarrow \{ch_0, ch_1 .. ch_m\}$
Transmission range T_r
Output
CLP- Set of collection points
Start:
$\boldsymbol{for}\ i = 0\ to\ m$
$CL_i \leftarrow \{\emptyset\}$
$S' \leftarrow S - CLH$ // remove cluster heads from S
$\boldsymbol{for}\ j = 0\ to\ m$
begin
$\boldsymbol{for}\ i = 0\ to\ n$
begin
$\boldsymbol{if}\ dist\left(s_i, ch_j\right) \leq T_r$
$CL_j \leftarrow CL_j \cup s_i$ // add node s_i to the cluster cl_j
End for
$S' \leftarrow S' - cl_j$ // remove nodes joined in cl_j from S'
End for
$L \leftarrow S'$
$CLP \leftarrow CLH \cup L$ //final set of collection points
$CLP \leftarrow Lin - Kernighan(CLP)$//determine shortest path
End

Algorithm:$\boldsymbol{dist\ (P_1, P_2)}$
Input
Two points P_1 and P_2 | $P_i \leftarrow (x_i, y_i)$
Output
distance d between points P_1 and P_2
Start:
$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Return (d)
End

Partitioning of the network graph within K number of clusters in order to minimize distance among nodes within every cluster which is the main objective of this k-mean algorithm. Initially, the selection of K number of nodes is done in a random way by means of primary central nodes of the clusters. Later the

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assignment of every node is done within every iteration. The recalculation of the centre node of every node is done after assigning the entire nodes and it is performed repeatedly starting from beginning depending upon the identification of the novel centre nodes. Once the achieved centre nodes are existing within the 2 successive iteration, the clustering process is stopped.

IV.Result and Discussion

The distribution of the 25 sensor nodes is done across a 1000x500m^2 field, in which there are 4 obstacles. Here, it is assumed that the gaps are not existing within the detecting field and the static sensors with similar capabilities are considered. Meanwhile, in addition to the respective co-ordinates, i.e. (50 m, 50 m), it is agreed that the mobile sink is situated in the top-left corner of the 2-demensional area. The respective periodical obstacle-avoiding movement out of the initial site is begun by the mobile sink and is returned finally. The system parameters implemented in the simulation are shown in **Table 1**. The data collected from the sensor nodes which the deferral tolerant data that can be awaited for mobile sink toward originate also lift them up is accepted for simplifying the mobile sink schedule.

PARAMETER	VALUE
Application Traffic	CBR
Transmission rate	10 packets/sec
Radio range	250m
Packet size	512 bytes
Maximum speed	25m/s
Simulation time	8000ms
Number of nodes	21
Area	1000x500
Grid size	10m
Routing Methods	VGDRA, H-TOUR-P, CP-EERP
Routing Protocol	AODV

Table 1: System parameters

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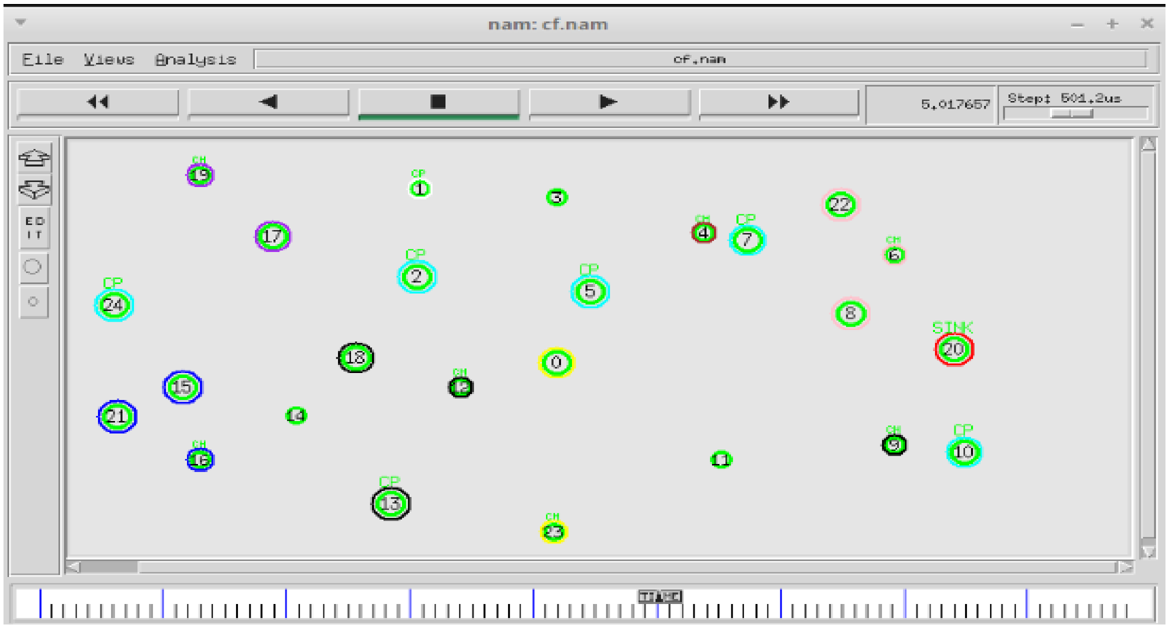

V.Evaluation Results

Heuristic obstacle-avoiding procedure for conducting various investigations within the sensing field having the obstacles are utilized here. The experimental outcomes of this approach are presented in accordance with the lifetime of network into adding toward mobile sink path as shown below.

Figure 1: Network Deployed

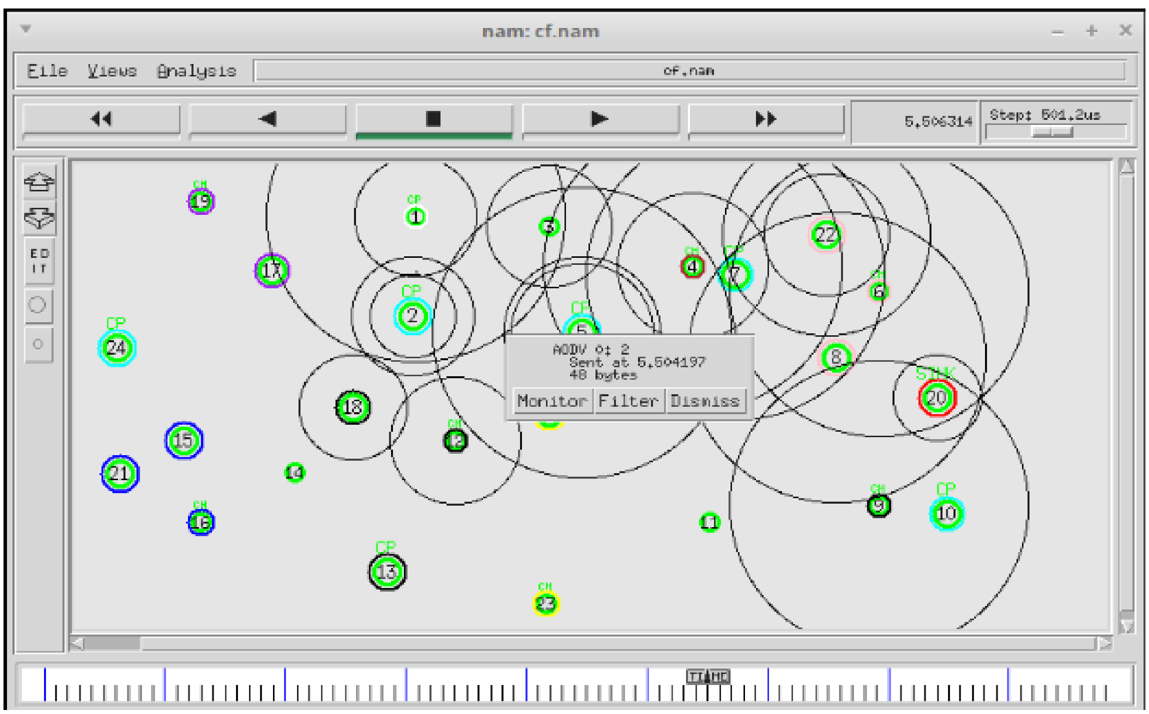

Figure 2: Broadcasting in Network

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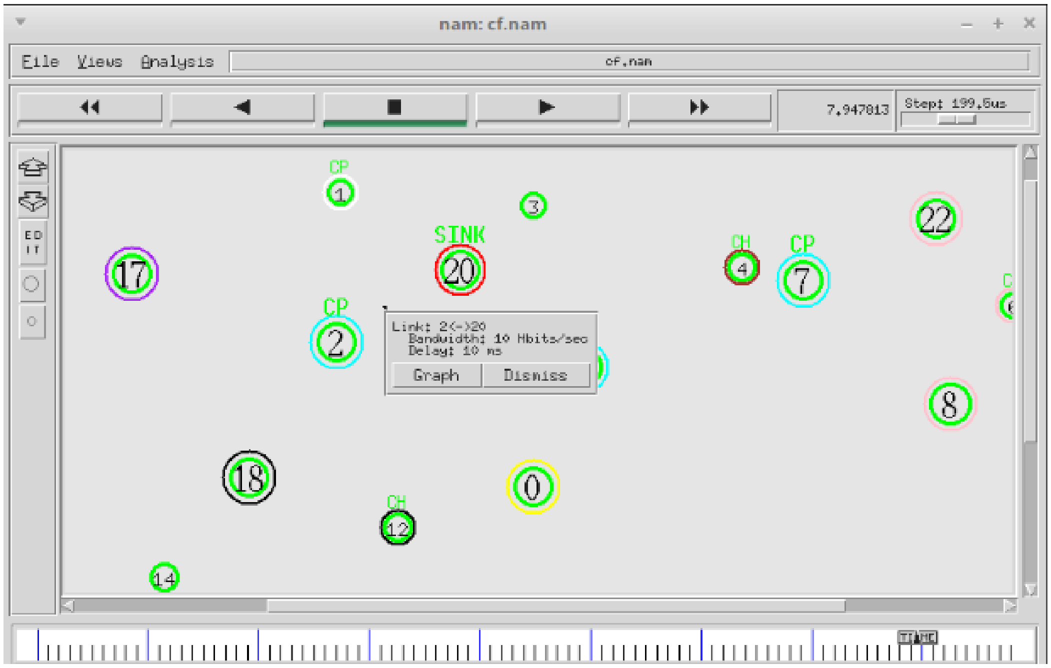

Figure 3: CP-2 to Mobile sink data process

The deployment of the proposed network is shown in **Figure 1**. The proposed method called as the collection point scheme is shown in **Figure 2** where it is added within the heuristic approach. The placement of the entire nodes is done within the network when broadcasting occurs. The processing of data from the collection points to mobile sink is shown in **Figure 3.**

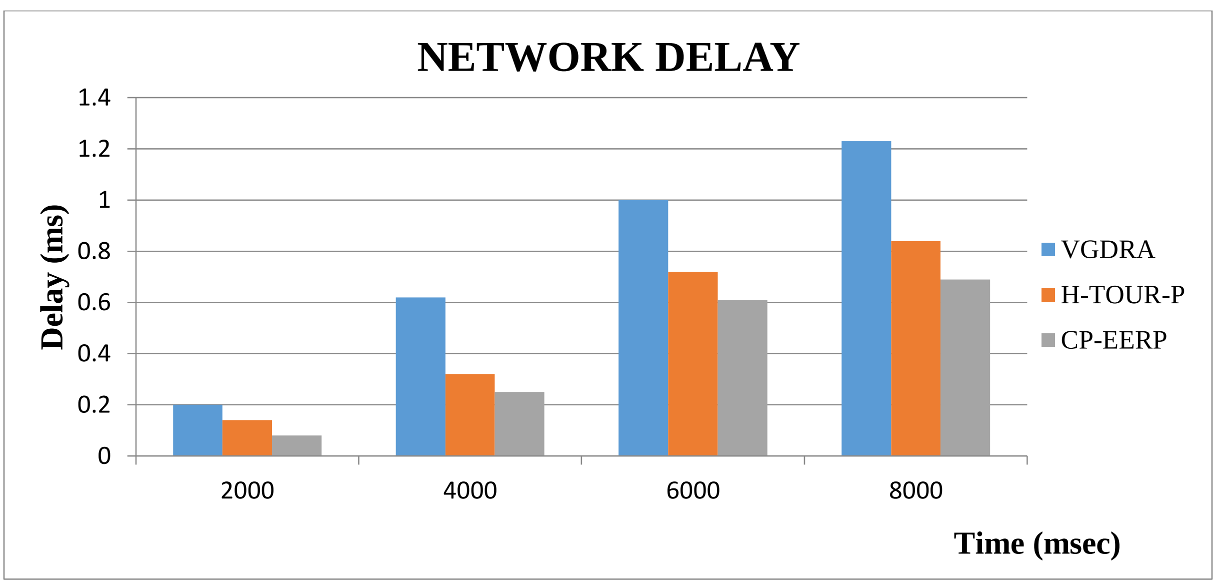

Figure 4: End-to-End Delay

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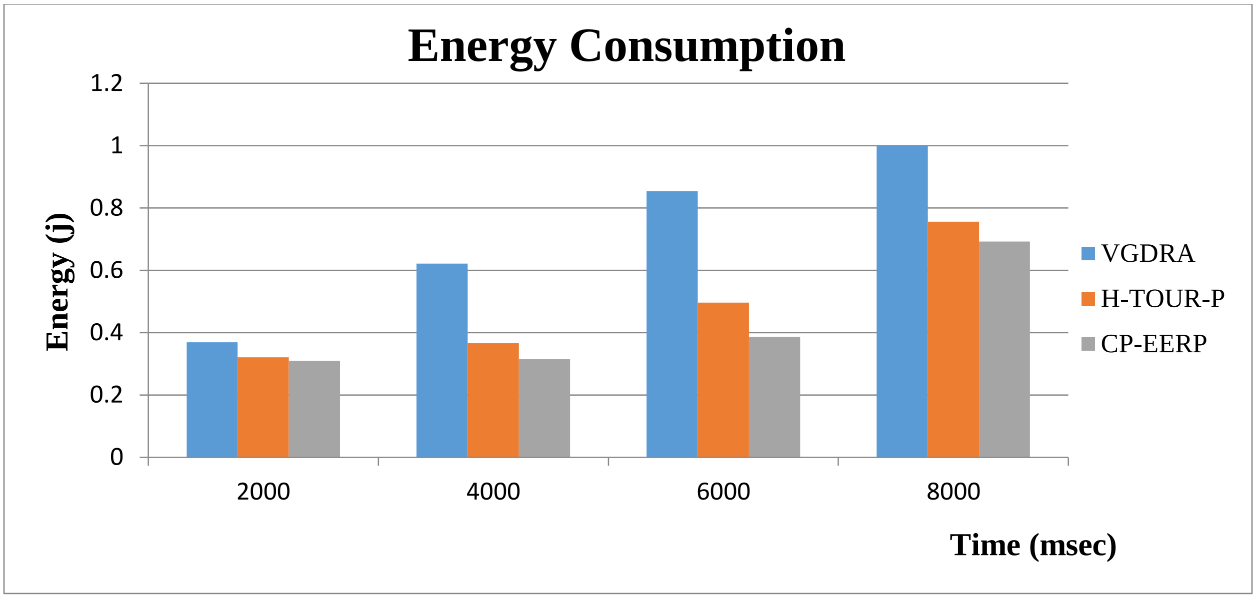

Figure 5: Energy Consumption

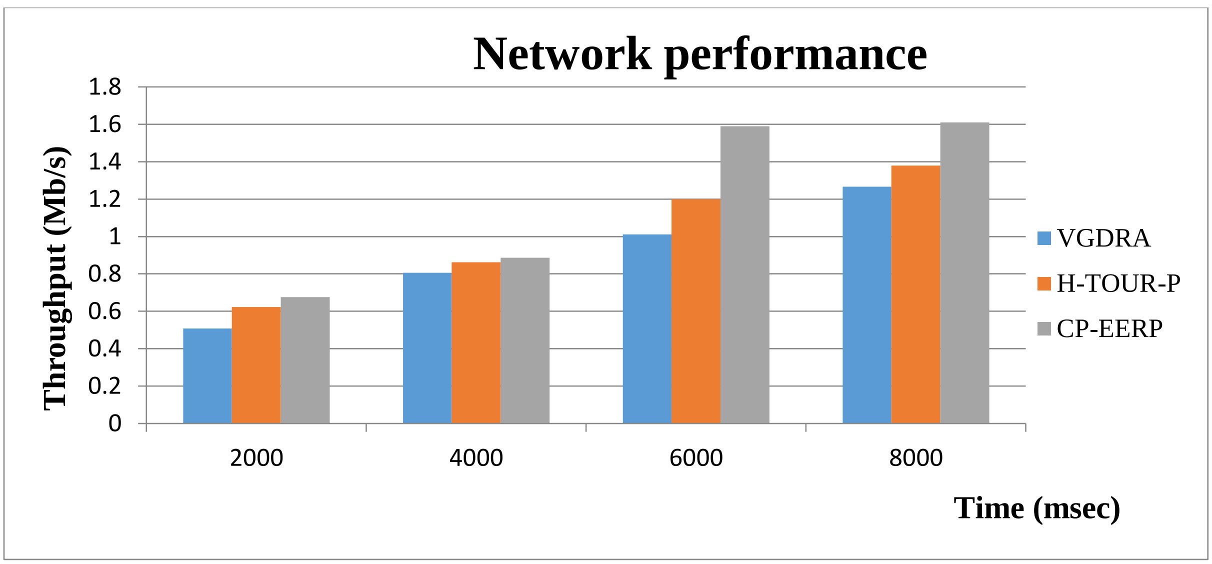

Figure 6: Throughput

The End-to-End Delay in the network be presented into **Figure 4.** The delay within the network can be eliminated by this CP-EERP method compared to the other approaches such as H-TOUR-P, VGDRA. The consumption of energy within the network is demonstrated in **Figure 5**. The problems regarding the consumption of energy can be reduced by this method compared to the previous approaches. The throughput of the network is presented in **Figure 6**. The throughput in the network can be enhanced using this presented method compared to the previous methods such as H-TOUR-P, VGDRA.

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VI.Conclusion

The period of network be extended through using mobile sink in this paper. Various obstacles be present into detecting field within the physical conditions. The grid-based approach for WSN using the obstacles were proposed for rearranging the mobile sink planning. Meanwhile, the spanning graph is developed on behalf of the mobile sink for detecting the obstacle-avoidance shortest route. The connection of the heuristic obstacle-avoidance technique for dispatching the mobile sink is established depending upon the cluster-based model. A collection-Point technique in order to limit the quantity of the obtained visits is proposed and the additional data is collected for increasing the network lifetime. NS2 is used to perform the simulation and this method is more practical in order toward report mobile sink as demonstrated in simulation results. At last, an obstacle-avoidance smallest way on behalf of mobile sinks be identified and the lifetime of network is increased.

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