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The effect of multiple sink on the lifetime of WSN for different grid geometry

Krati Rastogi[1], Kaushik Ghosh [2]
[1]Mody University, Laxmangarh (Sikar), India, Kratirastogi026@gmail.com
[2]Mody University, Laxmangarh (Sikar), India, kaushikghosh.cet@modyuniversty.ac.in

ABSTRACT

A wireless sensor network is a collection of sensor nodes also known as motes. Nodes on-board batteries are very small. Sensor nodes are used in many applications such as for home security applications, health monitoring, and surveillance and industrial applications. Sensors nodes are spatially distributed either randomly or in a systematic manner around the targets to perform operations. The range defined in the network allow nodes to sense and collect the data about the targets and perform many preprocess that collect data before sending to a sink node. In order to send data from source to destination nodes are used but the size of nodes are limited so energy saved in tem too is limited which acts as constraints to them as it bound them in the limit of processing capability with low battery power. Wireless sensor network basically perform operation of sensing or monitoring data from the sensor nodes by collecting data in the given or desired network. Information from various nodes are collected and passed to the decided destination. Data aggregation is performed to collect the data from the nodes present the network and transmit it. With the help of data aggregation we can reduce the energy consumption by eliminating the redundant data, the implosion and overlap of data among the nodes in the network. For era of development in the field of the improvement in the energy of wireless sensor networks (WSN) multiple sink with grids geometry is an excellent technique. This paper we will analyze the effect of multiple sink on the life time of the nodes.

Key words: Data aggregation, lifetime of node, multiple sink, Wireless sensor network.

1. INTRODUCTION

1.1 Wireless Sensor Network

Technology is growing day by day; new technology need time efficient, fast mechanism of self configuration which can be done through Wireless Sensor Network (WSN). WSN is used in many applications such as agriculture [1], smart transportation [2], environment monitoring [3], home automation [4] and health monitoring etc.WSN consist of sensor devices, with low power nodes and are main components of network. A sensor node is a small device that consists of three basic components: a sensing subsystem for monitoring the environment condition, a processing subsystem for data processing, and a wireless communication subsystem for data transmission. But the main constrains of sensor nodes are storage capacity, limited in size and limited processing capability. Some energy is also consumed in transmitting data. The most critical challenge is the sensor node's energy consumption and their lifetimes. So there are lots of difficulties existing in the case of design of an efficient routing scheme in wireless sensor networks. The process of data and queries propagated through the network are called data dissemination. There are different kinds of data dissemination schemes are available in the sensor network. The routing protocols in the wireless sensor network need to be aware of their resources. Power consumption is of two types they are useful and wasteful power consumption. Useful power consumption occurs with transmitting or receiving the data query requests and transmitting query and data to other nodes. Idle listening to network, when collision of data might occur being wasteful power consumption on sending the data to other nodes when it not ready to receive. Sink node act as a central node that has coordination power wit rest nodes of the system. Role for sink node is just like gateway among end user and sensor nodes. Mobility may be defined in various ways for sink node: dynamic or fixed. For fixed, defined route is chosen as defined in the network during deployment. Where as in dynamic mobility of nodes, sink can move randomly even outside the network too.

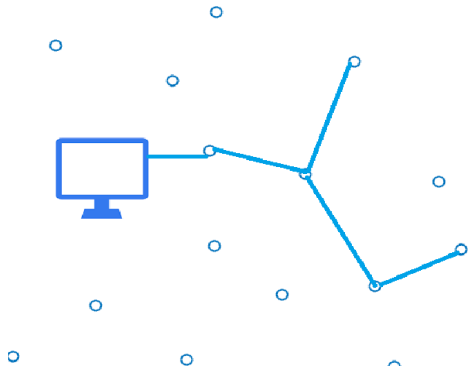

Figure 1: Wireless sensor network

A sensor network used to generate wireless network for sensing or monitoring a specific task in specific region by deploying sensor nodes in a wide area. Nodes are deployed

and exposed to external environment, and not an easy task to replace the batteries. In order to enhance the lifetime of the network there are many routing protocols defined which deals with reliability, mobility, security, real time, void, congestion too. Sensor node consists of operating modes to reduce the power consumption; transmission, reception, idle listening and sleep modes. Nodes near to sink node communicate more ten far in distance for multi hop communication. Hence consumption for the more communicated nodes is more than the far away one, leads to disconnection from the network. Imbalance in the network for power consumption may form holes in the network. To confiscate this problem, use of one or more than one sinks.

Region Division to Grid Cells: grid cell are formed for the region to be monitored. The size of each grid cell plays an important role as communication radius and cell should be proportional. Grid cells are the basically define for multiple sink in the networks with shape of the network for the nodes. In order to minimize the energy consumption of nodes in the network, we define multiple sink in the grids such that they then transmit and gather information according defined for then in the region and shape of the network. Grid cells size is defined and nodes too in the network for performing operations according the shape and number of nodes in the network. This indicates that there is energy consumption from the random deployment rater then defined one with different grid cells.

Basically, there are two categories for senor nodes which are sensor nodes and sink node(s). Sensing the environmental condition(s) for sensor nodes, collecting data and forward that, and pass on data collected from others to the sink node; while the sink node act as the destination for data collection from rest of sensor nodes. Typically, multi-hop communications plays role for transmission from sensor nodes to sink node. Certain routing protocols or algorithms [5] help for data transmission and data aggregation.
Data transmission from nodes to other are huge in quantity might produce several problems in Sensor Networks. Various systems need accurate and precise data in most accurate aggregated form. Replication of data through multiple transmissions by the nodes in the network leads to loss of energy by transmission and storage problem too so data aggregation helps preserves energy. Data aggregation direct intense communication overhead effectively produced due to huge quantity data in the network. Thus there is requirement of developing aggregation function such as sum, average, mean etc to define for the operation as per the need for good data aggregation and the decrease of energy consumption as well as enhancement of network lifetime of a network as long as possible. Data aggregation is the technique used for maximizing the network lifetime. Data aggregation helps to decrease the total range of transmissions in a WSN. Energy plays an important role in WSN, due to limited storage problem of the nodes Transmitting energy is that the most outstanding part of energy consumption during a WSN, data aggregation helps to enhance the network lifetime by reducing the energy losses in the network and there by increases network lifetime. Data aggregation may vary for the applications. With this the technique of data aggregation nodes are designed in the network in such a way that the supply of data from and to the nodes are designed for transmission has some role of reduction in the energy i.e. depletion and may cause to increase lifetime. ADC (Approximate Data Collection) [6] defines data aggregation concept, due to replacement and exchange of battery not an easy task and transmission control of sensor nodes. Result may leads energy utilization a concerning crisis within wireless sensor networks. So, to enhance the network lifetime [7] considering above scenario, to reduce retransmission and utilization aggregation work effectively.

1.2. Fermat-point Model

A geometrical concept, the Fermat point of a designed network, also known as Torricelli point or Fermat–Torricelli point, named after the scientist itself. In this method polygon is formed from the nodes and we are considering triangle in our network.

The Fermat point is that in the triangle the distance from the vertices must be minimum. As the network if formed of many nodes so we take the nodes in such a way first calculate of the triangle formed then the Fermat point is considered to be the third vertex point of the triangle for the next consideration in order to get the minimum distance.

As we can say linking to other vertices, to form the next triangle is done , this technique is taken into consideration as data from those node will be taken and aggregated to collect the data to the Fermat node and conservation of energy can be seen. As in this case if the Fermat point is not the Fermat node then we take the nearest node as the Fermat node according the defined deployment of node the node is chosen.

Fermat-point is a special point and unique point of the polygon in the defined space, as compared as like centroid and inner center. The point which is considered to be at the minimum distance from the vertex of the node of the triangle is the Fermat point of the triangle, minima algorithm is used to calculate the Fermat point of the triangle. In which the minimum time and distance is calculated to find the point.

1.3. Data aggregation in WSN

In this paper we partiality discuss the two main factors like energy conservation and transmission control through data aggregation in WSN. The strategy of data aggregation is that in which data is collected from the various nodes in the network and aggregated to the single node. Aggregation is done through the function in order to reduce the consumption and redundant data in the network, delay in processing of data to other nodes. The existence of data aggregation provides

energy consumption within the network. Basically the position related to source and data to be transmitted within the network along with the various other routing techniques supported by this method of aggregation technique. We can define two ways for placement support: radius and random model. The conjunction in the network regarding the data is also keep on check by this method. As we are dealing with the intense problem of energy consumption this help to reduce some amount of that.

Figure 2: Data Aggregation

1.4. Multiple sinks

WSN is widely distributed network which may keep on increasing according the need of monitoring operation perform on the area decided , which may leads to increase of sensor nodes in the network and direct burden on the battery to store the data and transmit to other node leads to duplicity and conjunction in the network all around. For the increase of network with more amounts of sensor nodes deployed in the network need of multiple sink in network which help to reduce the load of the network and data acquired will be free from duplicity. Many techniques, e.g., MAC protocol design, multiple sinks, mobile sinks, distributed congestion control algorithms, and data aggregation techniques, have been proposed to cope with the network lifetime improvement in wireless sensor networks. This technique deals which deployment of many sinks in the network at defined place of the network and rest of the sensor nods which are deployed in the network are allowed to collect the data and process further to it in order to reduce the transmission to all the node present in the network. The above define method include other protocols and data aggregation or Fermat point concept to collect the data from sensor node and send data to sink which categorize to reduce the multiple transmission ,directly related to the energy consumption and transmission control of the network.

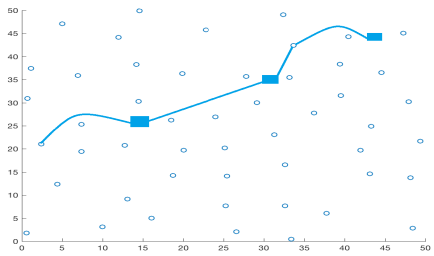

Figure 3: Multiple sinks in network

2. RELATED WORK

Wireless sensor network major task is to collect data from surrounding and perform the desire operation on the collected data. For the collection of data transmission and sensing of data in the network is done through sensor node that collect the data and sends it to the base station for the monitoring operations. Transmission can be done in many ways directly from source to the base station or through various sources present in the network taking help of then and performing transmission depends on the placement or location of the base station from the source node. That is considered to be single hop transmission or multi hop transmission. If the placement is near then single hop and far then automatically the nodes present in between are used for the transmission of data. So the energy consumption for the transmission of nodes leads to reduce as they participate for the transmission rather than non participated one, and for multiple hops as transmission is done many times seems to more consumption of energy.

LEACH low energy adaptive clustering hierarchy, Hierarchical based routing protocol used for energy consumption proposed by [6]. Clustering based approach based famous designed protocol famous for improvement in network efficiency. In this routing protocol network, clusters are form from the sensor nodes .A cluster head is selected from the cluster to act as router to base station. The selection of cluster head is done on the basis of energy level i.e. adaptive based up on their residual energy. The transmission of data in the cluster from sensor nodes is done to the cluster head and which on further transmits it to the next cluster or to the base station.

Many clustering algorithms have been proposed for Wireless Sensor Network whose main focus is on energy efficiency, deployment of sensor nodes and coverage of the scenario. Leach Algorithm was one of the earliest proposed algorithms for WSN clustering for energy efficiency, cluster head is elected in each round in a cluster based on certain probability which forwards the data packet of each sensor in that cluster to sink and cluster head changes in each round.

In WSN a priority based routing protocol i.e. clustering base which was proposed in [8], priorities were given to those who has heavier traffic as compared to other sensor node using Imbedded Markov Scheme analysis is done. Power consumption reduction is also seen less using the

gravitational algorithm using the clustering multiple sink and it was seen that the consumption is least as compared to the single sink in the network. Integer linear programing approach was used to find the multiple sink the optimal solution is obtained in order to gain the locations for efficient use of energy and was proposed in [9] .To reduce the hop distance between the sink and source node of the network Particle Swarm Optimization was used in [10] and for multiple sink when came in scenario then in deployment multiple cluster were formed and cluster contain sink for energy consumption, along the energy efficient technique this method was used for the optimal deployment of the multiple sink in [11] and life balancing one.

Two key challenges i.e. energy consumption and sensor unreliability were presented by A. Thiagarajan, L. Ravindranath. For the consumption a scheme was developed, used to estimate the travel time i.e. VTrack system for the sensors data. A Hidden Markov Model (HMM) based map matching scheme and travel time estimation technique used by VTrack that incorporates space data to identify the most probable road segments driven by users and to attribute travel time to those segments [12].

3. PROPOSED METHOD FOR ANALYZING NETWORK LIFETIME IN WSN

In this paper we propose the concept of reducing the energy consumed by the nodes as the size of them are limited through the concept of Fermat point integrate with data aggregation protocol along with the forwarding scheme of multiple sink. Under this proposed method we consider the network comprise of multiple sink in the network with sensor node deployed randomly over a 2D plane with defined grid shape of the network. We compare the placement of nodes in the network for checking the consumption being analysis by then in order to get good energy efficient protocol for life time improvement.

Grid fashion with random nodes deployment and change in numbers of multiple sinks in way to get improvement. After the deployment of the nodes in grid we calculated theoretically above Fermat point in the network, if the point found is not the node then we consider the node near that is Fermat node for the source nodes. Thus, it is defines for the multiple source nodes of the network. Data is transmitted in two ways source to Fermat node and Fermat node to different defined sink. As the data pass on to the sink it will act as source for the rest and pass on in the same way until it reach the last sink defined. Data is transmitted either in single hop or in multiple hops. Source are selected either random or round robin fashion. According node ids and their deployment one after another selection is done in round robin mechanism. In random selection no proper mechanism is done as multiple selection of same node can also took place.
In greedy forwarding technique, a node forwards data to the neighbor who is closest to the destination. Compass routing selects the neighbor that makes minimum angle with the straight line joining destination node with the node currently holding data packet. In residual energy-based forwarding, the residual energy of a node is taken under consideration while selecting forwarding node. It may be mentioned here that the greedy forwarding, compass routing, and residual energy-based forwarding are all Fermat point-based. First, data is transferred from source to FN and then from FN to different sinks. Data aggregation is done at FN only. Greedy forwarding is done when there is looping in the network in order to transmit the data further to the nodes in network to reach to the sink or destination.
Algorithm:

1. Define shape and grid size.
2. Number of nodes and sinks.
3. Assign energy -> nodes.
4. Fermat point (found).
5. Source Node-> Fermat Node (data transfer).
6. Data aggregation on Fermat node.
7. Data forwarding : Fermat node-> sink
8. If looping occur

   Apply greedy algorithm.
9. Exit.

4. RESULT

The simulation is done on the Matlab assuming transmission to be done in various minutes or hours with comparison of square grid deployment of nodes in the network with different multiple sink (3, 4, and 5) in the network of variable length. We analysis the lifetime of the network by changing the area of the network with sink varying too and their effect is analysis. The consumption of energy can be seen reduced by the increase in number of sinks in the network. We assume the number of nodes for both the grid shape rectangle and square to be 100 and fixed the deployment to them are random and number of sinks vary then maximum energy consumption can be seen in network with three sink in the network of either shape of network. This analysis is done on the KPS routing protocol where Fermat node and data aggregation technique for multiple sink nodes in network design to reduce the consumption of energy in order to increase the network lifetime. We analysis the looping technique as forwarding of data is done to the neighbors as if one is consider to be the neighbor then that consider one is also the neighbor of it so of passing the data is near to it too again leads to formation of loop to avoid such greedy forwarding is done. And we can see the result of round taken for data transmission on changing the sink nodes in the network.

These parameters are defined in the protocol which remains fixed in the network. Change can be seen in the shape and size of the network and analysis is done through the changes while fixing some parameters.

Table 1: Parameters for analyzing lifetime

Parameters	Values
Number of nodes	100
Source selection	Random
Deployment pattern	Random
Transmission range	45

When we consider square geometry of 30*30 grid with 3 sink node coordinate deployed on (0, 0), (0,300) and (300,300) then the round taken is 273. And on considering 4 sink node deployed coordinates on (0, 0), (0,300), (300, 0), and (300,300) then round taken is 269. Similarly for 5 sink nodes deployed (0,0), (0,300), (300,0), (150,150), and (500,300) then round taken is near 239.

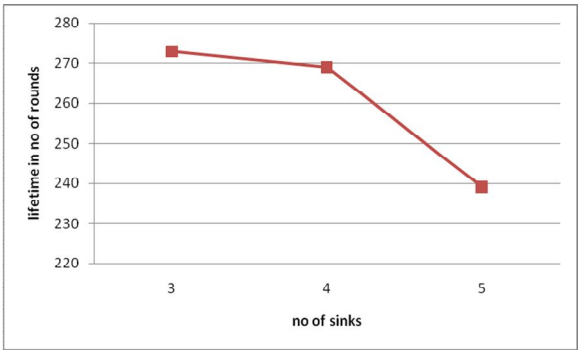

Figure 4: Effect on lifetime of nodes in number in rounds for varying sink

This graph depicts on considering the square shape geometry with changing the sink nodes in the network energy consumptions goes on decreasing linearly with increase in number of sink nodes in the network.

For different grid size example 300*300, 150*150 and 100*100 when analysis then for network consist of 3 sink node have maximum rounds and energy conservation for square shape geometry. As the graph too depict maximum lifetime for 5 sink network.

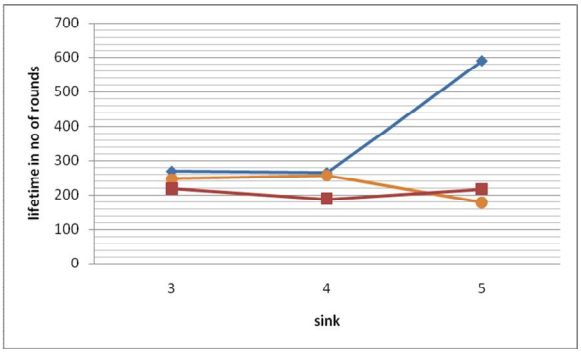

Figure 6: Sqaure shape grid with varing grid size effect of rounds of data transmission in network.

This graph depict that when size of grid varies the effect on network can be seen with increase in number of sink nodes too, maximum consumption on to the 3 sink network and goes on decresing with incresing number of sink in network.

For rectangular grid size 200 *400 when analysis is done with varying sink in the network of 3, 4, 5 sink nodes in the network.

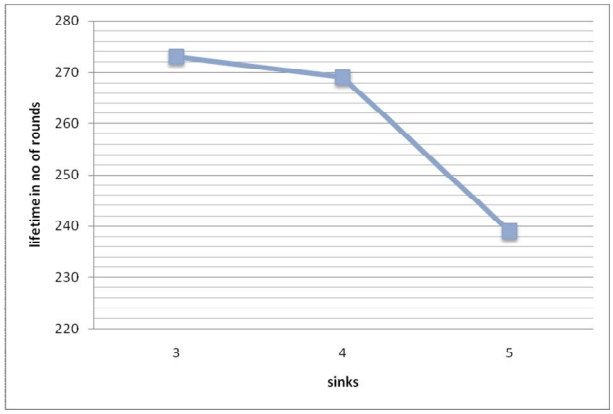

Figure 5: Rectangular shaped network with 3,4,5 sink v/s lifetime in no of round analysis

This graph shows the network with 3 sink nodes have maximum rounds taken for data transmission as the neighbours of them sends data to one other in more .

These result implies that with the change in the sink nodes maximum consumption of energy as number of rounds for data transmission in sink 3 containg node network can be observed to be more with change in shape and size of network. And consumption of energy can be occupied with increase the number of sink nodes in the network. As number of rounds remain less for sink 5 in network.

5. CONCLUSION:

This paper presents a framework for obtaining energy efficiently and improves the lifetime by increasing the sink nodes in the network. Analysis on network is done with change in number of nodes and shape (square and rectangular) and grid size then results are obtained. Data is collected i.e. aggregated on the Fermat node and is transmitted to the sink node. And if looping occurs among the nodes for data transmission then greedy forwarding techniques are used for data transmission which add on the energy consumption as compared with the forwarding techniques.

Finally, on comparing square and rectangular shape geometry with different grid size the maximum round for data transmission on 3 sink network is seen so we can conclude that the consumption is more on it as compared with network

consist of 5 sink nodes in network WSN. So on increasing the number of sink in network leads to increase in network lifetime with this analysis.

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