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Implementation for Network Sensor Deployment in Coverage Area Using Clustering Technique

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Abstract: ***A number of sensor nodes together form a Wireless Sensor Network. WSNs are used for a number of applications like monitoring of human body, under water surveillance, military purposes and traffic control etc. The consumption of the wireless sensor network (WSN) is increasing day by day as sensor nodes are becoming cheaper. Inefficient or manual placement of sensor nodes leads to the failure of sensor networks.WSN are special kinds of Ad hoc networks that became one of the most interesting areas for researchers to study. The most important property that affects these types of network is the limitation of the available resources, especially the energy. In this work the nodes are placed at a pre-determined optimized location, through which sensing range can be minimized. Sensing range minimization will lead to increased lifetime because of the less energy consumed during monitoring of targets.***

Keywords*:* WSN, Clustering, Network lifetime.

1.Introduction

Sensor node is a tiny autonomous device which is used for the monitoring, tracking and surveillance. A number of sensor nodes together form a wireless sensor network. WSNs are used for a number of applications like monitoring of human body, under water surveillance, military purposes and traffic control etc. Inefficient or manual placement of sensor nodes leads to the failure of sensor networks. This problem is converging day by day. Before this, work has been done by researchers on increasing lifetime and to provide maximum coverage. These all problems are related to the base of WSN i.e. Sensor Deployment. By placing the nodes at a pre-determined optimized location, sensing range can be minimized. Sensing range minimization will lead to increased lifetime because of the less energy consumed during monitoring of targets.

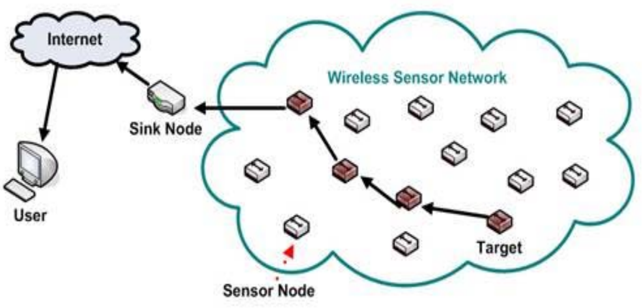

Figure 1: Wireless Sensor Network

Sensor networks are dense wireless networks of small, low-cost sensors, which collect and disseminate environmental data. Wireless sensor networks facilitate monitoring and controlling of physical environments from remote locations with better accuracy. These have applications in a variety of fields such as environmental monitoring, military purposes and gathering sensing information in inhospitable locations.

Sensor nodes have various energy and computational constraints because of their inexpensive nature and ad hoc method of deployment. Considerable research has been focused at overcoming these deficiencies through more energy efficient routing, localization algorithms and system design.

2.Clustering in Wireless Sensor Network

In clustering, the sensor nodes are partitioned into different clusters. Each cluster is managed by a node referred as Cluster Head (CH) and other nodes are referred as cluster nodes. Cluster nodes do not communicate directly with the sink node. They have to pass the collected data to the CH. CH will aggregate the data received from cluster nodes and transmits it to the base station. Thus minimizes the energy consumption and number of messages communicated to base station. Also number of active nodes in communication is reduced. Ultimate result of clustering the sensor nodes is prolonged network lifetime.

- **Sensor Node**: It is the core component of WSN. It has the capability of sensing, processing, routing, etc.
- **Cluster Head**: The Cluster head (CH) is considered as a leader for that specific cluster. And it is responsible for different activities carried out in the cluster, such as data aggregation, data transmission to base station, scheduling in the cluster, etc.
- **Base Station**: Base station is considered as a main data collection node for the entire sensor network. It is the bridge (via communication link) between the sensor network and the end user. Normally this node is considered as a node with no power constraints.
- **Cluster**: It is the organizational unit of the network, created to simplify the communication in the sensor network.

2.1. Euclidean Distance

When a network of sensors is represented in Euclidean space by a graph, there are two distances between any two nodes that may be consider. One of them is the Euclidean distance. The other is the distance between the two nodes in the graph, defined to be the number of edges on a shortest path between them. If a network of sensors is placed uniformly at random

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in a two-dimensional region and study two conditional distributions related to these distances. The first is the probability distribution of distances in the graph, conditioned on Euclidean distances; the other is the probability density function associated with Euclidean distances, conditioned on distances in the graph.

2.2 K-Means Clustering Algorithm

K-MEANS is the simplest algorithm used for clustering which is unsupervised clustering algorithm. This algorithm partitions the data set into k clusters using the cluster mean value so that the resulting clusters intra cluster similarity is high and inter cluster similarity is low. K-Means is iterative in nature. The steps for a general K-means clustering are:

1) Arbitrarily generate k points (cluster centers), k being the number of clusters desired.
2) Calculate the distance between each of the data points to each of the centers, and assign each point to the closest centre.
3) Calculate the new cluster centre by calculating the mean value of all data points in the respective cluster.
4) With the new centers, repeat step 2. If the assignment of cluster for the data points changes, repeat step 3 else stop the process.

Node clustering is the process of dividing nodes into classes or clusters so that items in the same class are as similar as possible, and items in different classes are as dissimilar as possible.

Depending on the nature of the data and the purpose for which clustering is being used, different measures of similarity may be used to place items into classes, where the similarity measure controls how the clusters are formed.

Some examples of measures that can be used as in clustering include distance, connectivity, and intensity. The K-means clustering approach is used to classify the data elements according to the distance between the centroid and the neighbor.

3.Design and Implementation

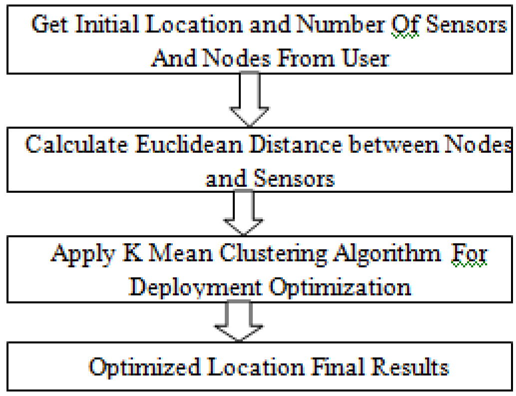
By placing the nodes at a pre-determined optimized location, sensing range can be minimized. Sensing range minimization will lead to increased lifetime because of the less energy consumed during monitoring of targets.
In this project there are some initial parameters from user in which the parameters are as

- Location points of nodes
- Number of sensors

So that the optimized location of sensor is found out on basis of k-mean clustering.
Process follow will be:

1. Get initial parameters of nodes and sensor.
2. Find Euclidean distance between nodes and sensor.
3. Do k-mean clustering.
4. And on basis of clustering find optimized location for sensor that is optimized location for sensor deployment.

3.1 Block Diagram



4.Results

4.1 K-mean Clustering

A WSN consists of spatially distributed autonomous sensors to monitor physical or environmental conditions and to cooperatively pass their data through the network to a Base Station. Clustering is a critical task in WSNs for energy efficiency and network stability. Clustering through Central Processing Unit in wireless sensor networks is well known and in use for a long time. [9] Presently clustering through distributed methods is being developed for dealing with the issues like network lifetime and energy. In this project, both centralized and distributed k-means clustering algorithm in network simulations is implemented. K-means is a prototype based algorithm that alternates between two major steps, assigning observations to clusters and computing cluster centers until a stopping criterion is satisfied. Simulation results are obtained and compared which show that distributed clustering is efficient than centralized clustering.

First-clustering Phase

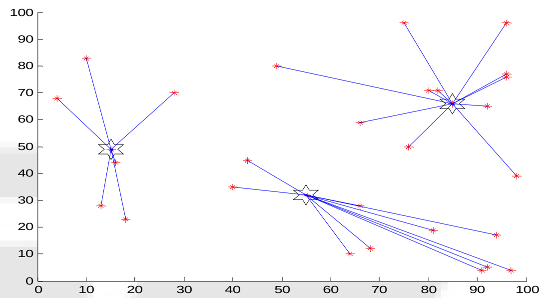


Figure 4.1: Initial Clustering

Reduced / second-clustering Phase

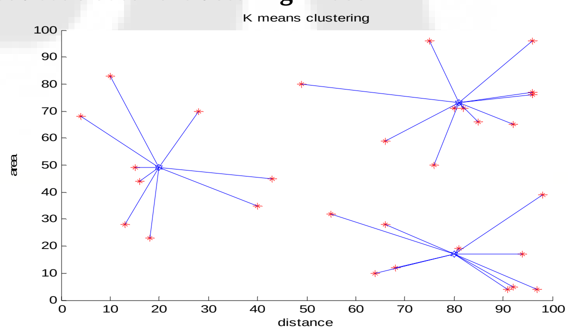


Figure 4.2: Final Clustering

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Clustering done initially is shown in figure 4.1 and the final clustering is shown in figure 4.2. Figure 4.2 shows the reduced and optimized clustering.

4.2 Power Received

Saving energy is a very critical issue in wireless sensor networks (WSNs) since sensor nodes are typically powered by batteries with a limited capacity. Since the radio is the main cause of power consumption in a sensor node, transmission/reception of data should be limited as much as possible [10]. Figure 4.3 shows a bar graph of the power received. In the initial clustering the power received is low, whereas the final clustering leads to a greater reception of power thus saving energy.

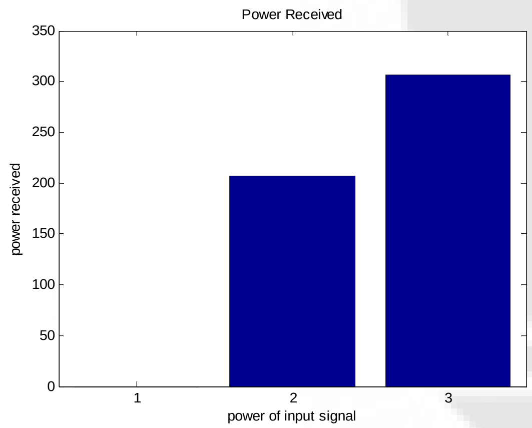

Figure 4.3: Power received

4.3 Pathloss

Path loss or path attenuation is the reduction in power density attenuation of an electromagnetic wave as it propagates through space. Path loss is a major component in the analysis and design of the link budget of a telecommunication system. This term is commonly used in wireless communications and signal propagation. Path loss may be due to many effects, such as free-space loss, refraction, diffraction, reflection, aperture-medium coupling loss, and absorption. Figure 4.4 shows the path loss of clustering done initially and finally. In initial clustering the path loss is more as compared to the final clustering.

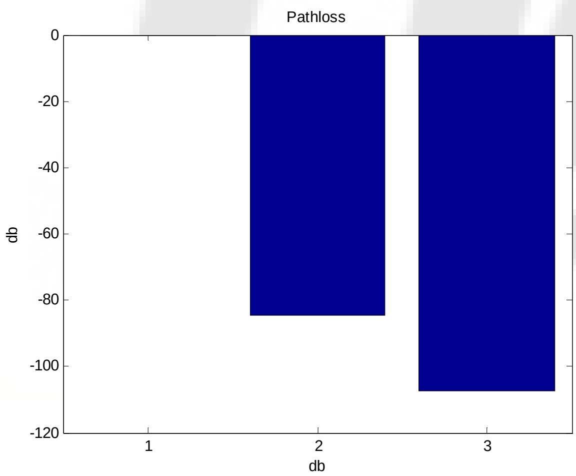

Figure 4.4: Path loss

5.Conclusion

Coverage in a WSN can be thought of as how well the wireless sensor network is able to monitor a particular field of interest. Ensuring sufficient coverage in a sensor network is essential to obtaining valid data. In this project it has been attempted to give a broad overview of the work that has been done to address the coverage problem in wireless sensor networks. The coverage problem can be approached in many different ways. The needs of a particular deployment will heavily influence the coverage scheme chosen. The issues faced when designing a coverage protocol include deterministic or random deployment, heterogeneous or homogeneous sensor nodes, and centralized or distributed algorithms. Much research focuses on a specific problem while others attempt to provide more general solutions that can be used for many deployment types. The research into the coverage problem is ongoing and new work is being published on an ongoing basis. However, there are still many fundamental problems that must be solved before wireless sensor networks can reach their potential. In the proposed method, we implemented clustering technique by placing the nodes at a predetermined location which minimizes the sensing range thus increasing the network lifetime.

6.Future Scope

Node clustering is a useful topology-management approach to reduce the communication overhead and exploit data aggregation in sensor networks. Sensor networks have a variety of applications. Examples include environmental monitoring – which involves monitoring air soil and water, condition based maintenance, habitat monitoring (determining the plant and animal species population and behavior), seismic detection, military surveillance, inventory tracking, smart spaces etc.

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