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COMMUNICATION OVERHEAD AND AVERAGE ENERGY CONSUMPTION USING DIFFERENT CLUSTERING TECHNIQUES IN WSN SYSTEM

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ABSTRACT

The wireless sensor networks are interesting network to study due to the fact that large number of applications are being developed using these networks system. A wireless sensor network of the type investigated here refers to a collection of sensors, and nodes that are linked by a medium which is wireless in nature system. The clustering is an efficient technique used to achieve the specific performance requirements of large scale wireless sensor networks. We have carried out the performance analysis of clusterbased wireless sensor networks for different communication patterns. In this project are using fuzzy clustering, k-mean and self-organizing map (SOM) based clustering method. It is observed that overhead in cluster based protocol is not much dependent upon update time. Simulation a result indicates that a cluster based protocol has low communication overheads compared with the velocity based protocol. In the simulation result we consider main approaches Clustering technique (SOM, Fuzzy, K-Means), differentdifferent numbers of node (50,100 and 150) with 5 cluster. The simulation performance analysis on the based comparison of communication overhead and average energy consumption. The result shown between communications overhead versus velocity (m/s) and percentage decay rate of energy for WSN versus Velocity in (m/s).

Key-Word: WSN, SOM, Fuzzy, K-Means, Sensors, Nodes.

INTRODUCTION

Wireless Sensor Network Architecture

A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are humidity, pressure, temperature, wind direction and speed, vibration intensity, illumination intensity, sound intensity, chemical concentrations, power-line voltage, pollutant levels and vital body functions.

A wireless sensor and actuator network (WSAN) is an ad hoc network deployed either inside the phenomenon to be observed or very close to it. In unlike some existing sensing techniques, the position of sensor network nodes not be engineered or predetermined. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities. Sensor node can be defined as a self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions, such as motion or pollutants, vibration, sound, temperature, pressure, and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analysis.

A. Cluster Head

Clustering is used in order to advance the scalability of network performance. Clustering is useful in several sensor network applications such as inter cluster communication, node localization and so on. Clustering algorithms have extensive applications in the precedent years and common clustering algorithms have been proposed for energy consumption in recent years in all of these algorithms, and nodes are structured as clusters, superior energy nodes are called as Cluster Head (CH) and other nodes are called as normal sensor nodes.

METHODOLOGY

TheSystem has been implemented in the MATLAB. The wireless sensor network is design with following specification in table 1.1. The method of design simulation has been given below:

Table 1.1: Specification Fuzzy, SOM and K-Means

S.NO	**SPECIFICATION**	**VALUE**		
		SOM	**FUZZY**	**K-MEANS**
1	NO. of Node and cluster	50,100,150		
2	Length of network area	1×1m		
3	Maximum range	500 m		
4	Noise power in dBm	50 dbm		
5	Transmitted power	1 Mw		
6	OPERATING FREQUENCY	2.4 GHZ		

IMPLEMENTATION FOR CLUSTERING

The cluster-heads are elected by the base station in each round by calculating the chance each node has to become the cluster-head by considering three fuzzy descriptors – node concentration, an energy level in each node and its centrality with respect to the entire cluster. Moreover, base stations are many times more powerful han the sensor nodes, power and storage, having sufficient memory. A central control algorithm in the base station will produce better cluster-heads since the base station has the global knowledge about the network. There are approach energy is spent to transmit the location information of all the nodes to the base station (possibly using a GPS receiver). For cluster-head collects n number of k bit messages from n nodes that joins it and compresses it to c*n k bit messages with c ≤ 1 as the compression coefficient. The operation of this fuzzy cluster-head election scheme is divided into two rounds each consisting of a setup and steady state phase similar to LEACH. The model of fuzzy logic control consists of a fusilier, fuzzy inference engine, fuzzy rules and a de fusilier. We have used the most commonly used fuzzy inference technique called Mamdani Method due to its simplicity. They have four steps follow.

- Fuzzification of the input variables energy, concentration and centrality - taking the crisp inputs from each of these and determining the degree to which these inputs belong to each of the appropriate fuzzy sets.
- Rule evaluation - taking the fuzzifier inputs, or applying them to the antecedents of the fuzzy rules.
- Aggregation of the rule outputs - the process of unification of the outputs of all rules.
- Defuzzification the input for the defuzzification process is the aggregate output fuzzy set chance and the output is a single crisp number. During defuzzification, it finds the point where a vertical line would slice the aggregate set chance into two equal masses. In practice, the COG (Center of Gravity) is calculated and estimated over a sample of points on the aggregate output membership function, are using the following formula:

$$COG = (\sum \mu_A(x) * x) / \sum \mu_A(x) \quad (1)$$

Where, is the membership function of set Expert knowledge is represented based on the following three descriptors:

- **Node Energy** – the energy level of available in each node, an designated by the fuzzy variable energy,
- **Node Concentration** – the number of nodes present in the vicinity, or designated by the fuzzy variable concentration,
- **Node Centrality** - a value which classifies the nodes based on how central the node is to the cluster, in the designated by the fuzzy variable centrality. The base station selects each node and calculates the sum of the squared distances of other nodes from the selected node. They have transmission energy is proportional to d2 (2) data, the lower the value of the centrality, the lower the amount of energy required by the other nodes to transmit the data through that node as cluster-head.

A. Means Clustering

k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. In the procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed apriori. There are main idea is to define k centres, one for each cluster. These centres should be placed in a cunning way because of different location causes different result. So results, the better choice is to place them as much as possible far away from each other. For the next step is to take each point belonging to a given data set and associate it to the nearest centre. When no point is pending, the first step is completed and an early group age is done. After we have these k new cancroids, a new binding has to be done between the same data set points and the nearest new centre. A loop has been generated. As a result of this loop we may notice that the k canters change their location step by step until no more changes are done or in

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other words canters do not move any more. The finally, this algorithm aims at minimizing an objective function knows as squared error function given by:

$$J(V) = \sum_{i-1}^{c} \sum_{j-1}^{c_i} (\|x_i - v_j\|)^2 \qquad (2)$$

Where:

'$||xi - vj||$'is the Euclidean distance between x_i and v_j.

'ci'is the number of data points in i^{th} cluster.

'c' symbol is the number of cluster centers.

Algorithmic steps for K-Means clustering

Let as $X = \{x1, x2, x3, \ldots \ldots.., xn\}$ be the set of data points and
$V = \{v1, v2, \ldots \ldots., vc\}$ *be*the set of centers.

1) Randomly select 'c' cluster centers.
2) The Calculate distance between each data point and cluster centers.
3) The data point to the cluster center whose distance from the cluster center is minimum of all the cluster centres.
4) The recalculate in new cluster center using:

$$v_i = \left(1/c\right) \sum_{j-1}^{c_i} x_i \qquad (3)$$

Where, 'ci' represents the number of data points in i^{th} cluster.

A.1 Cluster based approach for 5 access points of K-means technique different-different Nodes

k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. We consider 5 access points of K-means technique for 50, 100 and 150 Nodes as shown in figure 1, 2, and 3 respectively.

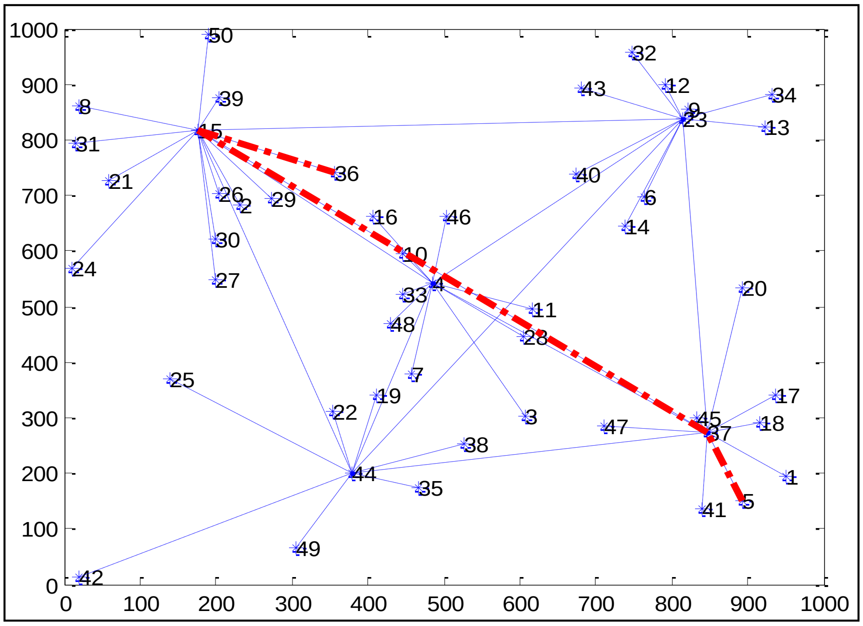

Fig: 1Performance of K-means clustering for 50 Nodes

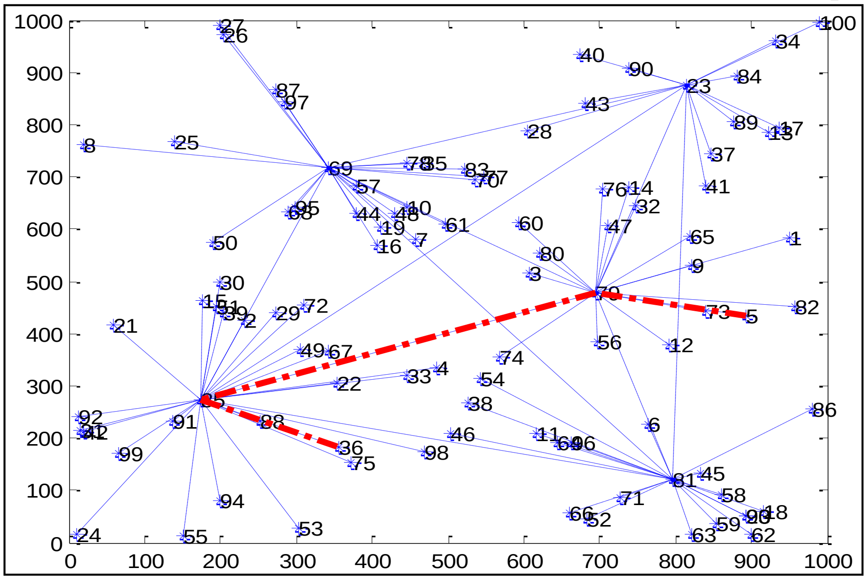

Fig: 2Performance of K-means clustering for 100 Nodes

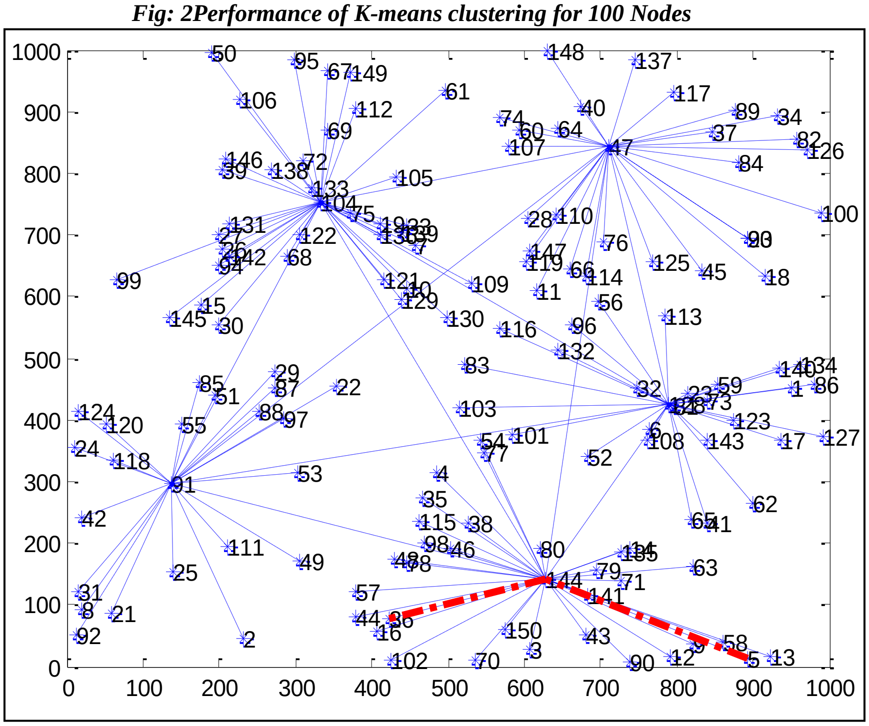

Fig: 3Performance of K-means clustering for 150 Nodes

A.2 Fuzzy C-Means Clustering

This algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and the data point. For more the data is near to the cluster center more is its membership towards the particular cluster center. In clearly, summation of membership of each data point should be equal to one. There are after each iteration membership and cluster centers are updated according to the formula:

$$\mu ij = \frac{1}{\sum_{k=1}^{c}\left(\frac{dij}{dik}\right)^{(2/m-1)}} \quad (4)$$

$$v_j = \left(\sum_{i-1}^{n}\left(u_{ij}\right)^m x_i\right)/\left(\sum_{i-1}^{n}\left(u_{ij}\right)^m\right), \quad \forall j = 1,2, \dots \dots \dots c \quad (5)$$

Where: *'n'* is the number of data point, 'vj' represent the j^{th} cluster centre, 'm' is the fuzziness index m € [1,∞], 'c' represent the number of cluster centre, 'µij' represent the membership of i^{th} data to j^{th} cluster centre, *'dij'* represent the Euclidean distance between i^{th} data and j^{th}cluster centre. The main objective of fuzzy c-means algorithm is to minimize:

$$J(U,V) = \sum_{i-1}^{n} \sum_{j-1}^{c} (u_{ij})^{m} \|x_i - v_j\|^2 \quad (6)$$

Where:$'||xi - vj||'$ is the Euclidean distance between i^{th} data and j^{th}cluster centre.

Algorithmic steps for Fuzzy c-means clustering:

Let X = {x_1, x_2, x_3 ..., x_n} be the set of data points and V = {v_1, v_2, v_3 ..., v_c} be the set of centers.

1) Randomly select *'c'* cluster centers.
2) Calculate the fuzzy membership $'\mu_{ij}'$ using:

$$\mu_{ij} = 1/\sum_{k-1}^{c} (d_{ij}/d_{ik})^{(2lm-1)} \quad (7)$$

3) Compute the fuzzy centers $'v_j'$ using:
4) Repeat step 2) and 3) until the minimum *'J'* value is achieved or $||U(k+1) - U(k)|| < \beta$.

Where: 'k' is the iteration step, 'β' is the termination creation between [0,1], $'U = (\mu_{ij})_{n*c}'$ is the fuzzy membership matrix, *'J'* is the objective function.

Cluster based approach for 5 access points of Fuzzy technique for different Nodes

We consider 5 access points of Fuzzy technique for 50, 100 and 150 Nodes as shown in figure 4, 5, and 6 respectively.

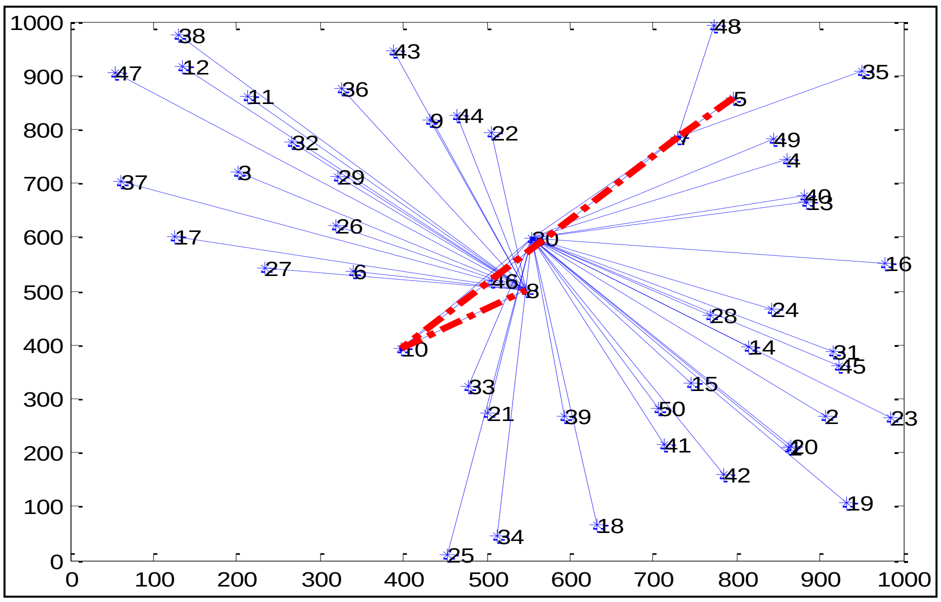

Fig: 5Performance of fuzzy clusteringfor 50 Nodes

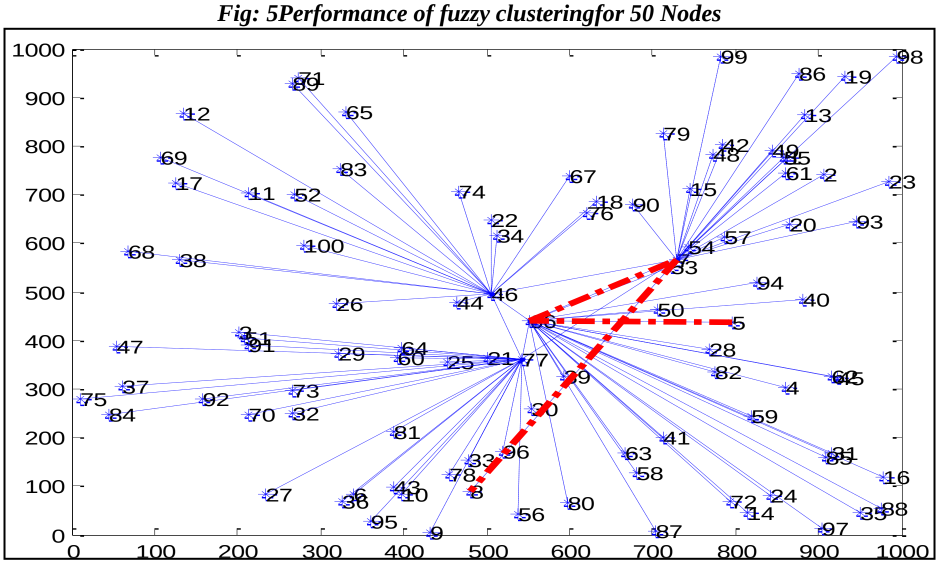

Fig: 6Performance of fuzzy clusteringfor 100 Nodes

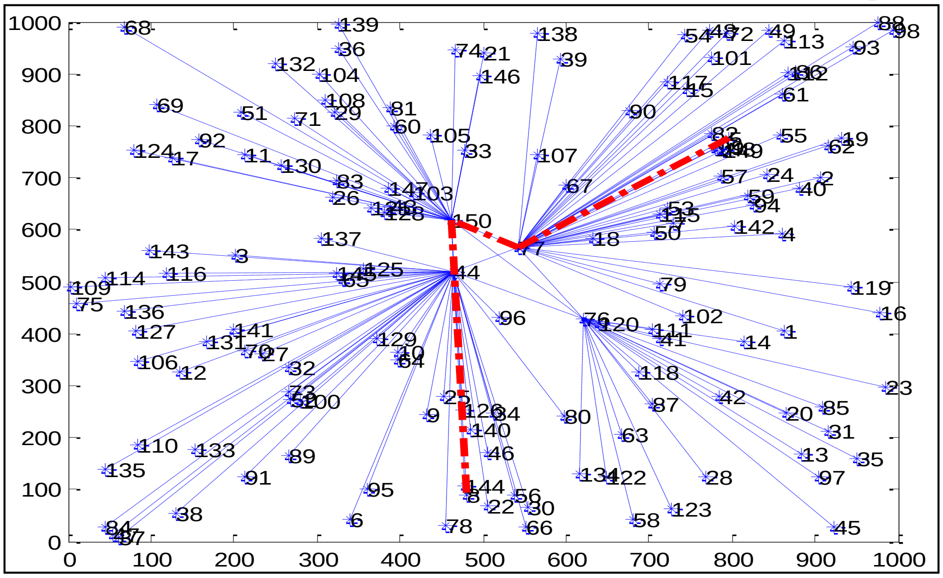

Fig: 7Performance of fuzzy clusteringfor 150 Nodes

A.3 SOM based clustering

The self-organizing map (SOM) is an important tool in exploratory phase of data analysis and mining. It projects input space on prototypes of a low-dimensional regular grid that can be effectively utilized to visualize and explore properties of the data. When the number of SOM units is large, to facilitate quantitative analysis of the map and the data, similar units need to be grouped, i.e., clustered.

So in data analysis, unsupervised methods are very attractive and in particular the Kohonen algorithm is nowadays widely used in this framework. It achieves both tasks of "projection" and classification.

4.5.3.1 Cluster based approach for 5 access points of SOM technique for different Nodes

Let us recall the definition of this algorithm, also called SOM (Self-Organizing Map). In its genuine form, it processes quantitative real-valued data, in which each observation is described by a real vector. For example the quantitative variables can be ratios, quantities, and measures, indices, coded by real numbers. For the moment, we do not consider the qualitative variables which can be present in the database. We consider 5 access points of SOM technique for 50, 100 and 150 Nodes as shown in figure 7, 8, and 9 respectively.

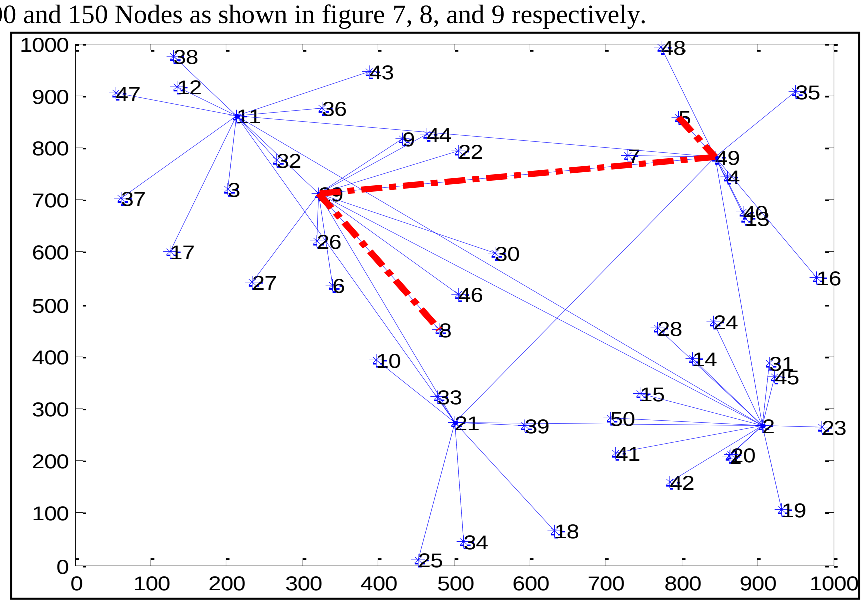

Fig: 7Performance of SOM clusteringfor 50 Nodes

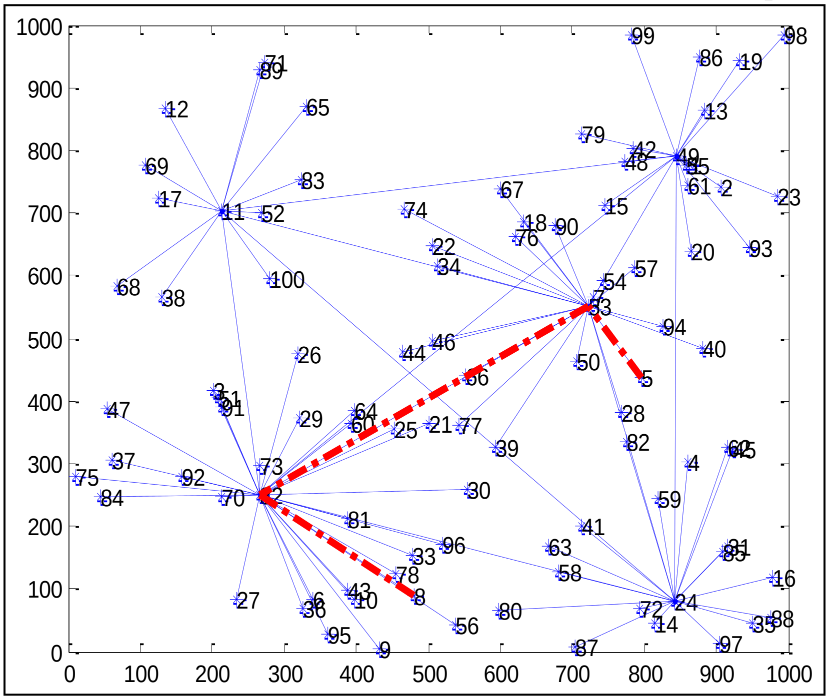

Fig: 8Performance of SOM clusteringfor 100 Nodes

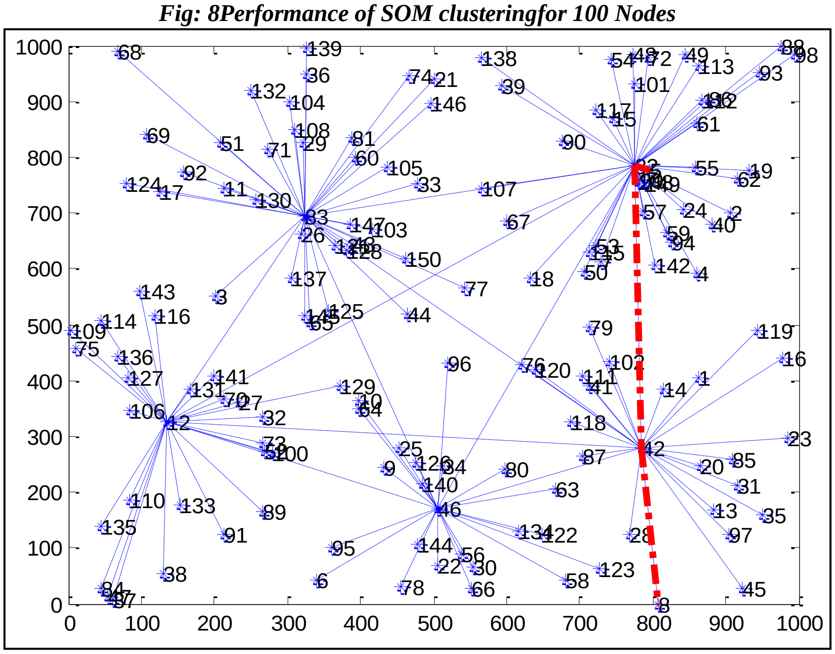

Fig: 9Performance of SOM clusteringfor 150 Nodes

In agglomerative clustering, the SOM neighborhood relation can be used to constrain the possible merges in the construction of the dendrogram. In addition, knowledge of interpolating units can be utilized both in agglomerative and portative clustering by excluding them from the analysis. If this is used together with the neighborhood constraint in agglomerative clustering, the interpolative units form borders on the map that the construction of the dendrogram must obey. It may even be that the interpolating units completely separate some areas from the rest of the map.

CONCLUSION

The life of wireless network is strongly depends on the energy consumption of network per unit time. The energy consumption reduction has been taken as a objective in this project. The clustering based network architecture has

been proposed in this project to reduce the communication overhead which in turn reduces the energy consumption. The various clustering techniques are available for locating the access point for WSN. The K-means, Fuzzy C-mean and self organizing map (SOM) based techniques are used in this project. The optimum location of AP is important due to communication overhead depends on the moving distance between sink location and AP.
The sink velocity from 50 m/s to 300 m/s has been taken into the account for finding the energy consumption and a comparative analysis is presented in the result section of the thesis. The performance of wireless sensor networks system for Self organizing map has performed better than other two methods. It is also observed that overhead pattern in cluster based protocol is not much dependent upon update time.

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