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PERFORMANCE ANALYSIS OF CLUSTER FORMATION IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless Sensor Network plays an extremely significant role in usual lives. Wireless Networks in provisions of constraints of their resources. The energy consumption is the principal concern in WSN. It system is built on an IEEE 802.15.4 wireless mesh network. Wireless Sensor Networking is a network of wireless sensor nodes deployed in an area. The wireless sensor network consists of the sensor nodes. The idea of development of wireless sensor networks was initially motivated by military applications. A WSN provides a reliable, low maintenance, low power method for making measurements in applications where cabled sensors are impractical or otherwise undesirable. A wireless sensor network (WSN) is a wireless network using sensors to cooperatively monitor physical or environmental conditions such as humidity, pressure, temperature, sound, vibration. The reduction of energy overhead is a major challenge in wireless sensor networks. Simulation results are obtained and compared which show that distributed clustering is efficient than centralized clustering. In this paper Comparison of Communication overhead for 50 nodes and 100 nodes of three clustering technique SOM, K-Means and Fuzzy clustering and result analysis in between Communication overhead versus velocity in m/s.

Keyword: **- Communication overhead, Energy Optimization, Wireless Sensor Network, Subtractive clustering and Fuzzy clustering, SOM, K-mean**

I. INTRODUCTION

A wireless sensor network (WSN) in its simplest form can be defined as a network of (possibly low-size and less complex) devices which are denoted as nodes that can sense the environment and communicate the information gathered from the monitored field through wireless channel or link. In the data is forwarded, possibly via multiple hops relaying, in sink network that can use it locally, or connected to other networks. The idea of development of wireless sensor networks was initially motivated by military applications. Wireless sensor network provides a reliable, low power method for making measurements in applications where cabled sensors are impractical or otherwise undesirable, low maintenance. In the nodes are connected in senor, wireless sensor network (WSN) is a large network of resource-constrained sensor nodes with multiple preset functions used, sensing and processing, to fulfill different applications. 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. Wireless Sensor Networks are wireless networks that usually consist of a great number of far distributed devices that are equipped with sensors (instruments that measure quantities in our environment) to monitor physical or environmental phenomenon's. These devices work autonomous and are logically linked by self-organizing means. Some of the challenges for these systems are:

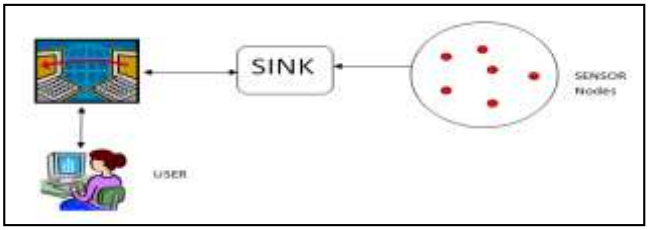

Fig: 1. Wireless sensor Network (WSN)

A. **Node size:** Miniaturization is the keyword in many studies about WSNs. Developing smaller nodes, with the same or even more efficiency than their bigger brothers is still a challenge, even if present sensor nodes, are hardly as big as a coin.

B. **Mobility:** Many applications urge the factor mobility into WSN challenges. For example, commercial applications, like vehicle tracking, need networks that are able to constantly change its routing paths and infrastructure. • Privacy and Security: Unlike wired channels, wireless channels are accessible to both, legitimate and illegitimate users. Therefore, several methods, like encoding the traffic, have to be discussed.

C. **Reliability:** WSNs are wireless networks and are therefore vulnerable to problems like packet loss. Nevertheless, they are used in areas such as chemical attack detection, in which these problems could easily lead to serious catastrophes.

D. **Power Consumption:** The nodes of Wireless Sensor Networks are usually battery powered because of their size. This limits the lifetime of a sensor node and raises the topic of energy-efficiency in all aspects.

II. WIRELESS SENSOR NETWORK

Wireless sensor networks have gained considerable popularity due to their flexibility in solving problems in different application domains and have the potential to change our lives in many different ways. WSNs have been successfully applied in various application domains. **Military applications:** Wireless sensor networks be likely an integral part of military command, control, communications, computing, intelligence, battlefield surveillance, reconnaissance and targeting systems. **Area monitoring:** In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored. When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action. **Transportation:** Real-time traffic information is being collected by WSNs to later feed transportation models and alert drivers of congestion and traffic problems. **Health applications:** Some of the health applications for sensor networks are supporting interfaces for the disabled, integrated patient monitoring, diagnostics, and drug administration in hospitals, tele-monitoring of human physiological data, and tracking & monitoring doctors or patients inside a hospital. **Environmental sensing:** The term Environmental Sensor Networks has developed to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc.

III. SIMULATION OF SENSOR CLUSTERS

Two well-known clustering algorithms are used in association with a visualization interface to simulate the possible cluster network with optimized energy consumption. Clustering algorithms Subtractive clustering assumes each node as a potential cluster head and calculate the measure of' the likelihood that each node defines the cluster head, based on the density of surrounding nodes.

1. The algorithm has the following features: Selects the node with the highest potential to be the first cluster head.
2. Removes all nodes near to the fust cluster head, in order to determine the next node cluster and its head location.
3. Iterates this process until the entire nodes are within radii of a cluster.

Fuzzy C-mean (FCM) algorithm was introduced by Bezdek. The FCM based algorithm is a data clustering technique wherein each data point belongs to a cluster to some degree that is specified by a membership grade.

K- Means: - Clustering K-means was first used by MacQueen in 1967 is one of the simplest clustering method comes under unsupervised learning algorithms used to solve the well known clustering problem. It follows a simple and easy way to classify a given data set through a certain number of clusters (i.e. k clusters) fixed a priori. K- Means clustering comes under the category of partitioning method in which a partition of a database D of n objects is done into a set of k clusters. Given a k, the main task is of finding a partition of k clusters that optimizes the chosen partitioning criterion. That's why we have preferred k-means clustering for this work.

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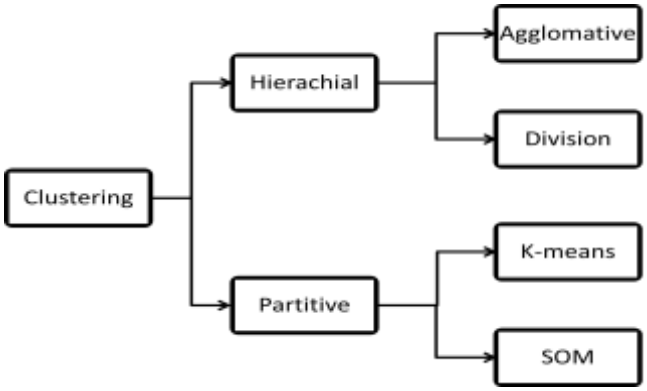

Fig. 2 Steps to of Cluster Formation

IV. CLUSTERING IN WSN

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 cluster head. Cluster head will aggregate the data, received from cluster nodes and transmits it to the base station.

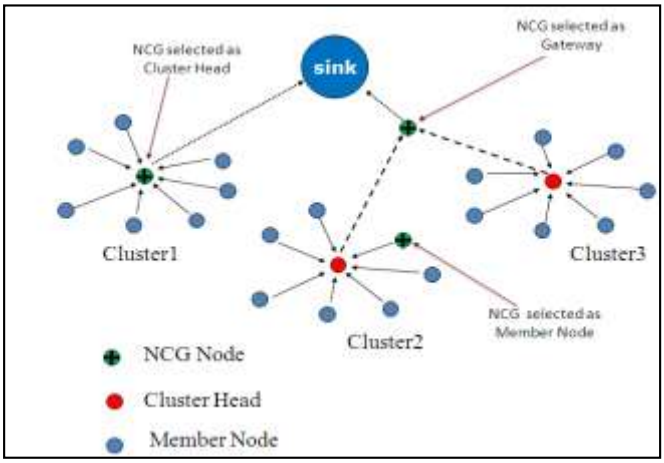

Fig. 3 Clustered Sensor Network

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 wireless sensor network. 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.

V. SIMULATION RESULTS

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We show that our protocol can provide secure cluster formation without sacrificing the performance of the clusters. We use the following metrics to evaluate the cluster characteristics: average cluster size, maximum size of clusters, variance of the cluster size, and number of single-node clusters. The average cluster size depends on the density of the networks and the transmission range of the sensor nodes. The average cluster size should not be too small. In sensor networks, it is not desirable to include too many nodes in a large cluster due to the increasing message collisions and transmission delay in a large cluster.

Table 1: The following parameters has been taken for simulation

S. No.	Parameter	Value
1	No. of node	50,100
2	No. of cluster	5
3.	Clustering technique	SOM, FUZZY, K-MEANS
4.	Update time	10 s
5.	Update distance	50 m
6.	Sink velocity	50-300 m/s
7.	Network length	1000 x 1000 m^2

A. Comparison of Communication overhead for 50 nodes of three clustering technique:

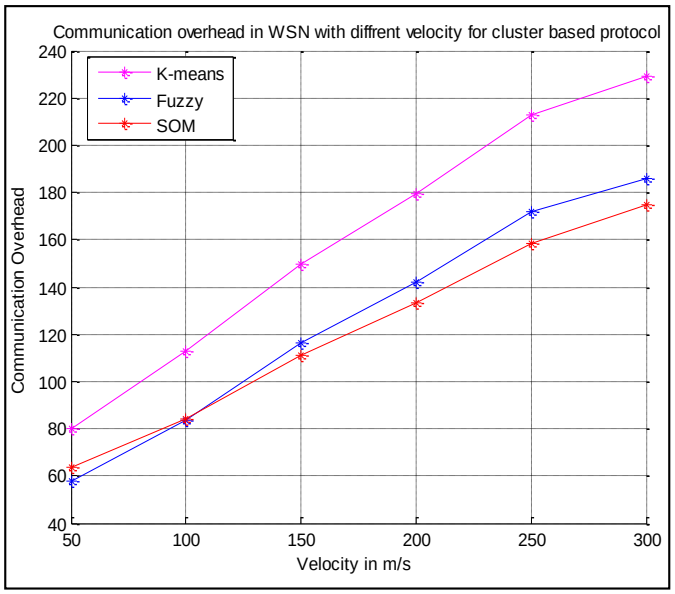

Fig. 4 Communication overhead in WSN with velocity

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B. Comparison of communication overhead for 100 nodes of three clustering technique

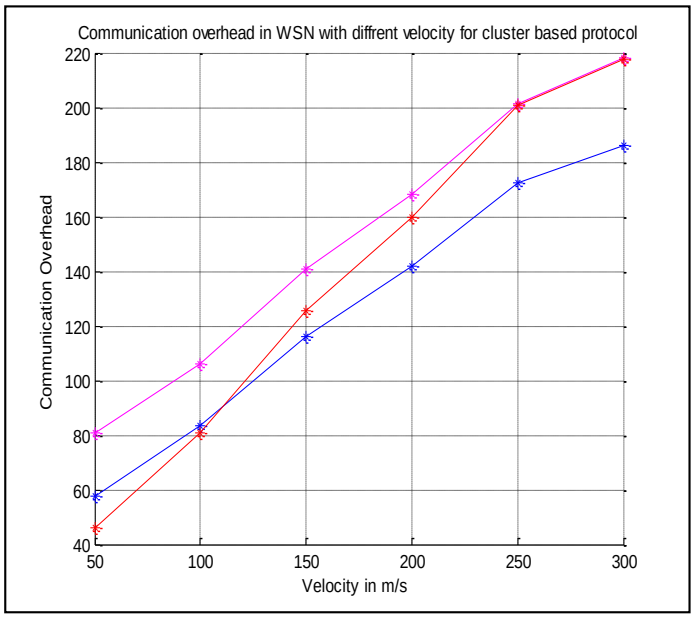

Fig: 5 Communication overhead in WSN with velocity

VI. CONCLUSION

Wireless networking has witnessed a strong interest in the recent past due to the applications in mobile and personal communications. Wireless network architectures can be categorized into Infrastructure wireless network architectures and ad hoc wireless network architectures. It is clear that cluster formation is dependent on the distribution of sensors and the placement of the base station in addition to the processor dependent parameters. If the base station is very close to the sensor field, the energy minimization component & encourages the formation of more clusters than that if the base station is far away from the sensor field. Obviously, if the number of bits per packet increases the energy loss is higher, but it is unlikely to influence the cluster formation process. It can be generally concluded that Fuzzy-C-mean algorithm provide the better solution. 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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