Evaluate and Improve Fuzzy Clustering to Increase Lifetime of WSN

[1]Sonia Saini, [2]Anurag Rana
[1]Research Scholar, Department of Computer Science
[2]Head of Department of Computer Science
Arni University, Distt. Indora, Kadhgarh, Punjab

Abstract-The wireless sensor networks is the decentralized type of network in which sensor nodes sense the information and pass information to base station. The size of the sensor node is very small due to which battery power of the sensor node is very limited. The various clustering techniques has been proposed in the recent times which increase network lifetime and reduce energy consumption of the sensor nodes. In this paper, various clustering techniques has been reviewed and discussed in terms of various parameters.

Keywords-WSN, Fuzzy Clustering, Energy Consumption.

I. INTRODUCTION

A WSN typically has minimum infrastructure. It consists of several sensor nodes (few tens to thousands) working together to monitor an area to acquire data in regards to the environment. There are two kinds of WSNs: structured a dense structured. An unstructured WSN is one which has a dense assortment of sensor nodes. Sensor nodes may be deployed in an ad hoc manner into the field. Once deployed, the network is left unattended to execute monitoring and reporting functions. In a structured WSN, all or a number of the sensor nodes are deployed in a preplanned manner. The advantage of a structured network is that fewer nodes could be deployed with lower network maintenance and management cost. WSN has its own design and resource constraints [1]. Resource constraints incorporate a limited level of energy, short communication range, low bandwidth, and limited processing and storage in each node. Design constraints are application dependent and are on the basis of the monitored environment. The surroundings plays a vital role in determining how big the network, the deployment scheme, and the network topology. How big the network varies with the monitored environment. For indoor environments, fewer nodes are needed to form a network in a limited space whereas outdoor environments may require more nodes to cover a bigger area. An offer hoc deployment is preferred over pre-planned deployment when the surroundings is. In accessible by humans or once the network consists of hundreds to tens of thousands of nodes [2]. Obstructions in the surroundings also can limit communication between nodes, which in turn affects the network connectivity (or topology).

Challenges in WSN:

- Security
- Routing
- Energy
- Qos

A. Security:

The requirement of security not only affects the operation of the network, but also is highly important in maintaining the availability of the whole network .It is necessary to know and understand these security requirements first before implementing security scheme for WSN.WSN should take the following major security requirements which are basic requirements for any network into consideration of secure mechanism

- Data Integrity
- Data Confidentiality
- Data Availability
- Data Authentication
- Data Freshness

B. Routing in WSN:

In general, routing in WSNs can be divided into °at-based routing, hierarchical-based routing, and location-based routing depending on the network structure. In location-based routing, all nodes are typically assigned equal roles or functionality. In hierarchical-based routing, however, nodes will play different roles in the network. In location-based routing, sensor nodes' positions are exploited to route data in the network [3]. A routing protocol is considered adaptive if certain system parameters can be controlled in order to adapt to the current network conditions and available energy levels. Furthermore, these protocols can be classified into multipath-based, query-based, negotiation-based, QoS-based, or coherent-based routing techniques depending on the protocol operation. In addition to the above, routing protocols can be classified into three categories, namely, proactive, reactive, and hybrid protocols depending on how the source finds a route to the destination. In proactive protocols, all routes are computed before they are really needed, while in reactive protocols, routes are computed on demand. Hybrid protocols use a combination of these two ideas. When sensor nodes are static, it is preferable to have table driven routing protocols rather than using reactive protocols [4].

A significant amount of energy is used in route discovery and setup of reactive protocols. Another class of routing protocols is called the cooperative routing protocols. In cooperative routing, nodes send data to a central node where data can be aggregated and may be subject to further processing, hence reducing route cost in terms of energy use. Many other protocols rely on timing and position information

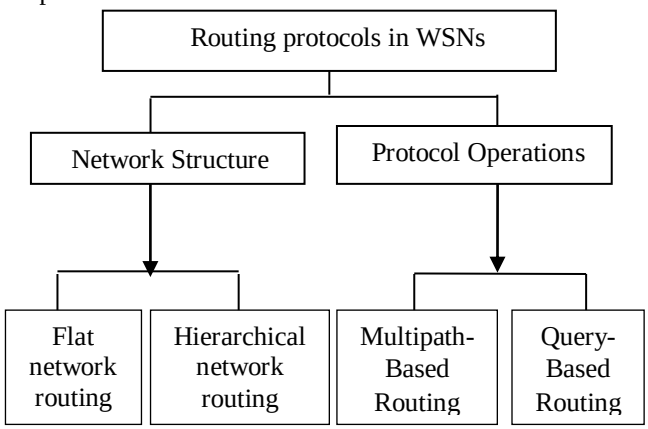

Fig. 1: Routing protocoles in wsn

C. Flat network routing: In this type of protocols, every node plays the same role and these nodes collaborate among themselves to perform the sensing task [5]. BS sends queries to particular region and waits for the replies containing information of surroundings around the sensors nodes in selected region.

- Hierarchical network routing

Hierarchical routing is also known as clustering routing. This type of routing originally discovered in wire line networks. Clustering routing techniques provide the scalability and efficient communication. In these routing methods, higher energy nodes perform the task of processing and transmission of data and low energy nodes perform the sensing in the proximity of the target [6].

- Multipath routing protocols:

Those routing protocols are explained in this subsection that uses multiple paths to enhance network performance rather than a single path in order. By diverting path from primary path to the other path fault tolerance can be reduced. By maintain path between source and destination traffic management and energy consumption also increases.

- Negotiation-based routing:

High-level data descriptors are used by this protocol to abolish redundant data transmissions through negotiation. According to the availability of resources communication decisions are taken by the protocols [7]. The motivation is that the use of flooding to disseminate data will produce implosion and overlap between the sent data, so nodes will receive duplicate copies of the same data. This operation consumes more energy and processing by sending the same data by different sensors

D. *QOS:*

QoS-based routing protocols, the network has to balance between energy consumption and data quality. In particular, the network has to satisfy certain QoS metrics, e.g., delay, energy, bandwidth, etc. when delivering data to the BS. Sequential Assignment Routing (SAR) proposed is one of the first routing protocols for WSNs that introduces the notion of QoS in the routing decisions. Routing decision in SAR is dependent on three factors [8]: energy resources, QoS on each path, and the priority level of each packet. To avoid single route failure, a multi-path approach is used and localized path restoration schemes are used.

E. *Energy:*

In past years, WSN networks have gained increasing attention from both the research community and actual users. As sensor nodes are generally battery-powered devices the critical aspects to face concern how to reduce the energy consumption of nodes, so that the network lifetime can be extended to reasonable time.

- Energy issues elaborate:

In the wireless sensor networks the primary issue is constrained battery life utilized by sensor nodes. The size of the sensor nodes is little so constraints are there like battery size, processors, stockpiling for data, these all are little as sensor nodes. So the fundamental spotlight on upgrading energy consumption in wireless sensor networks [9]. In WSN a considerable measure of detected data and routing information must be sent which regularly have some time constraints so that the information can be used before any incident happens, e.g. industrial monitoring, hardware monitoring, and so on.In WSN the energy power consumption is much higher in data communication than interior preparing. So energy conservation in WSN is should be addressed.

II. TECHNIQUES TO CO-UP WITH ENERGY

CLUSTRING

- Leach heed
- Fuzzy leach

Clustering: Clustering algorithms for wireless sensor networks can be divided into two main categories depending on cluster formation criteria and parameters used for cluster head election.

Table 1 Clustering algorithms

Probabilistic (random or hybrid) clustering algorithms	Non probabilistic clustering algorithms
Low Energy Adaptive Clustering Hierarchy (LEACH),Energy-Efficient Hierarchical Clustering(EEHC), Hybrid Energy-Efficient Distributed Clustering(HEED), etc.	Node Proximity and Graph-Based Clustering Protocols, Weight-Based Clustering Protocols, Biologically Inspired Clustering Approaches.

Clustering in WSNs involves grouping nodes into clusters and electing a cluster head such that [10]:

- The members of a cluster can communicate with their cluster head (CH) directly.
- A cluster head can forward the aggregated data to the central base station through other CHs.
- There are many techniques that are used in clustering these are LEACH, and many more improved forms of LEACH like E- LEACH, LEACH-SM, multi-hop-LEACH, ENCM and so on. LEACH protocol contains two phases:

Cluster set up phase in this stage the every node portrays regardless of whether to wind up a cluster head for current round. Every one of the nodes pick a random number 0 or 1 for made a decision. A threshold worth is setup, if the quantity of the node is not as much as threshold quality, then the node turns into a cluster head for current round.

Steady phase: The network will enter the steady stage when the cluster head dole out time slots to its individuals for utilizing TDMA mode. The steady stage is isolated into frame, where nodes send their data to the cluster head at most once per frame amid their apportioned transmission slot.

- The election of cluster head node in LEACH has some deficiencies such as:
- Some very big clusters and very small clusters may exist in the network at the same time.
- Unreasonable cluster head selection while the nodes have different energy.
- Cluster member nodes deplete energy after cluster head was dead.
- The algorithm does not take into account the location of nodes.

Ignores residual energy, geographic location and other information, which may easily lead to cluster head node will rapidly fail.

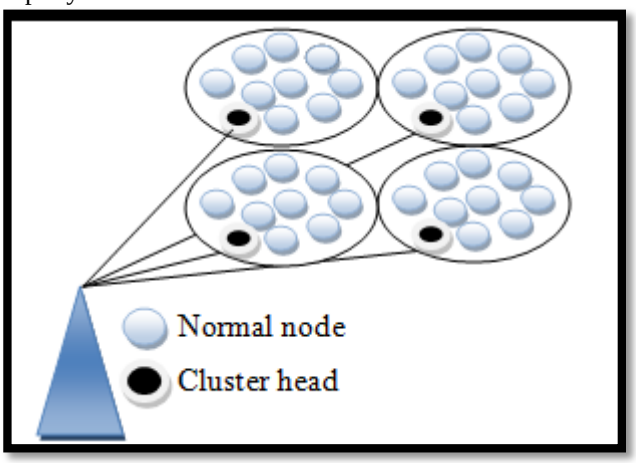

Fig. 2: (a) Single Hop Clustering

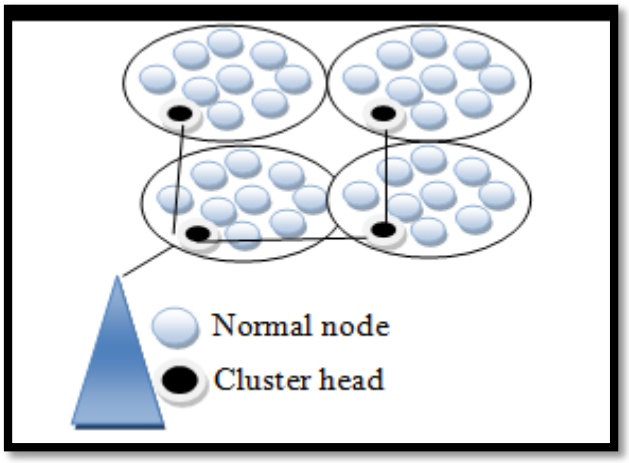

Fig 2 (b) Multi Hop

The clustering is as shown in above Fig. 2 (a) and Fig. 2 (b). Fig. 2 (a) shows that single hop with clustering and Fig. 2 (b) multi hop with clustering. In the above Fig. 2 (a) and Fig. 2 (b) the LEACH is divided into three clusters [11]. Black node is the cluster head which represent the cluster. All the white nodes are the members of the cluster these are not cluster head. In a cluster the cluster head is changed randomly by any cluster protocol. To changing the cluster head between each cluster nodes is to distribute the network load. In this way the performance of the entire network is improved and can be achieved lower energy consumption.

CLUSTERING

A. Fuzzy clustering:

Fuzzy clustering is a kind of soft clustering method and primarily predicated on concept of segmenting data by utilizing membership examples of cases which are computed for every cluster. However, most of the current fuzzy clustering modules packaged in both open source and commercial products have not enough enabling users to explore fuzzy clusters deeply and visually when it comes to investigation of different relations among clusters. Furthermore, without a decision maker or an expert, it's hard to decide the number of clusters in fuzzy clustering studies. Fuzzy clustering is an effective clustering approach which associates a data point with multiple clusters. Standard fuzzy clustering models like fuzzy c-means derive from minimizing the sum total cluster variation, which will be defined because the sum of the distances between the data points and their corresponding cluster centers weighted by the membership degrees. In this paper, we propose a fuzzy mini max clustering model by minimizing the utmost value of the pair of weighted cluster variations in such a way they satisfy a prior distribution.

B. Leach:

Leach is just a distributed algorithm which promotes local decisions to choose CHs. It selects CHs predicated on

probability model and then rotates CHs. This model is employed to be able to balance energy use of the nodes through the network lifetime; otherwise selected CHs would consume more energy when com-pared to member nodes [12]. In LEACH, CHs perform data compression before transmitting data to the sink. However, LEACH is not an efficient algorithm with regards to the network lifetime since it does not think about the distribution of sensor nodes and the remaining energy on each node. LEACH is also uses CDMA so that each cluster uses different set of CDMA codes to minimize interference between clusters.

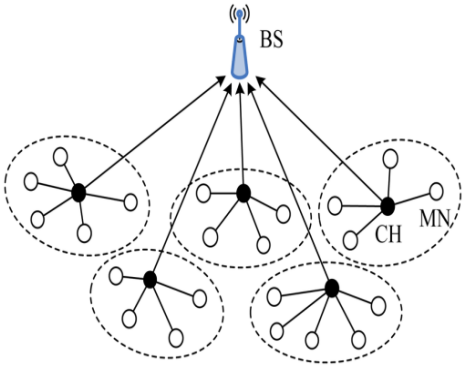

Fig 3: Leach clustering base station

C. Heed:

HEED protocol is made for multi-hop networks and node-equality is the principal assumption. Two-phase parameter check is performed to choose CHs. In the very first phase, remaining energy of a node is useful for the probabilistic selection of the CHs. If a tie occurs in the very first phase, second-phase parameters such as node degree, distance to neighbors, and intra-cluster energy consumption are applied to break the tie in the selection process. However, HEED algorithm is suffering from the hotspots problem and causes unbalanced energy consumption due to the tendency to generate a lot more than expected number of clusters

D. Fuzzy leach:

Fuzzy leach (low energy adaptive clustering hierarchy (LEACH) is a TDMA based MAC protocol which is integrated with clustering and a simple routing protocol in WSN the goal of fuzzy leach is to lower the energy consumption required to create and maintain cluster in order to improve the life time of a wireless sensor network [12]. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm to each round to determine whether it will become a cluster head in this round.

AUTHOR	YEAR	DISCRIPTION	OUTPUT
[1] Yuan, Jinhui, and Hong Chen	2004	In this the technique used is Multilevel network clustering. The main feature of this technique isenergy efficient for immobile nodes in Wireless Sensor Network.	From this paper, the limitation is The effect of energy efficiency in multiple sink being ignored.
[2]Yuan, Jinhui, and Hong Chen	2005	The authors proposed an optimized clustering technique based on spatial-correlation in wireless sensor networks (WSN). It combines the advantages of clustering technique with spatial correlation. It includes four parts: clusters construction, cluster-head election, clustering routing and clusters maintenance.	Simulation results show that the approach is energy efficient and has lower average relative error than other approaches.
[3]K. N., and BP Vijaya Kumar	2006	In this method, proposed a method for clustering and their analysis to study the cluster formation, their behavior with respect to the system parameters and applications requirement. They had used Nero-Fuzzy technique to obtain Dynamic clustering.	The simulations are carried out to evaluate the performance of the proposed method with respect to different parameters of sensor node and applications requirement.
[4] Hongmei Deng, Wei Li and Dharma P.Agarwal,	2007	In this paper, they proposed the method for detecting the single black hole node. In this proposed method, each intermediate node send backs the next hop information when it sends back an RREP message.	One limitation of the proposed method is that it works based on an assumption that malicious nodes do not work as a groupwhich is an unreal situation.
[5] Goli, Sepideh et al	2005	In this paper, addressed clustering as an efficient way for routing.. In this paper, an Efficient Distributed Cluster-head Election technique for Load balancing (EDCEL) is proposed.	Simulation results show the effectiveness of this approach in terms of balancing intra-cluster energy dissipation and lifetime longevity.

[6] Asis kumar and Suchismita Chinara.	2008	In this paper, data transmission technique for Clustered wireless sensor network (CWSN). The proposed scheme starts by assigning the identity, shared secret key and an encryption key to the sensor nodes by the base station (BS).	The secured communicating protocol described in this paper guarantees that, when two sensor nodes are in communication, they must have gone through prior authentication and key pre-distribution process.
[7] EbinDeniRaj	2009	In this paper they talked about the cluster head Gateway Switch Routing protocol (CGSR) utilizes a hierarchical network topology. In this they compose every one of the nodes into cluster and every one of the nodes ought to trust on a cluster head which is chosen by any selection calculation. Algorithms based on load balancing reduce communication cost to a great degree.	They examined on algorithms which concentrate on a Density and Distance based Cluster Head, An Energy Efficient Algorithm for Cluster-Head Selection in WSNs, Consumed Energy as a Factor for Cluster Head.
[8] Limin Meng, et.al	2010	In this paper discussed that in wireless sensor networks one of the most important factor is energy. Clustering algorithms are used to obtain long lifetime. WSN should meet various requirements for quality of service (Qos).	As a result They compared their work with some typical route algorithms that showed algorithm is robust and effective
[9]Arun K. Somani, et al	2011	In this paper, talked about a distributed, light weight, scalable clustering calculation for clustering in wireless sensor networks. The environment where the sensors are sent randomly here clustering algorithms are exceptionally appropriate.	Results demonstrate that not very many nodes (less than 5%) are not ready to join a cluster or remain orphan, numerous are secluded because of random deployment and communication range limitation.
[10] Wang, Sheng-Shih et al	2012	In this paper they uses ELECT technique with the help of that remaining energy in packet delivery ratio and energy consumption	As a result, the multi-objective fuzzy clustering algorithm has the ability to address both hotspot and energy hole problem in station and evolving network.

III. CONCLUSION :

In this paper, it is been concluded that wireless sensor networks is the decentralized type of network which sense environmental information and pass sensed information to base station. The clustering is the efficient technique which reduce energy consumption of the network. In this paper, it is been analyzed that fuzzy logic based clustering techniques are most energy efficient techniques for wireless sensor networks

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