# Classification of Unequal Clustering Routing Algorithms in Wireless Sensor Networks

Ali Abdul-hussian Hassan[1 2], Wahidah Md Shah[1], Mohd Fairuz Iskandar[1], Mohammed Nasser Al-Mhiqani[1], Zaidoon Kamil Naseer[1]

[1]Faculty of Information and Communications Technology,Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
[2] College of Education for Pure Sciences, University of Kerbala, Kerbala, Iraq.

*Corresponding e-mail: altaeeali800@yahoo.com

**Keywords**: Wireless Sensor Network; Unequal clustering features; Unequal cluster algorithms.

**ABSTRACT** – Clustering is the most popular energy efficient technique in WSNs. It has classified into two categories; equal cluster size and unequal cluster size. In unequal approach, the size of the clusters are modifying proportionally according to some parameters such as its distance from the base station. In this paper, we classified unequal cluster algorithms in terms of nature of algorithm that used in the clustering. The main purpose of this work is to discuss the characteristics of protocols according to the clustering algorithms types.

## 1. INTRODUCTION

Wireless Sensor Networks (WSNs) employing around thousand distributed sensor nodes in the monitoring area to observe the changes that happen in the applications [1][2]. Because of the energy constrained for sensor nodes, the enhancement of energy efficiency for sensor networks is very important issue. To combat such problem, wireless sensor nodes are grouped into clusters, and in each cluster, at least there is one node act as a cluster head, gathering the sensing data from its cluster member and forwarding to sink or base station.

Clustering in WSNs is categorized into two types: equal and unequal clustering size. According to Dhanpal et al. 2015 [3], equal sized clustering approach has introduced uneven energy consumption. Along with this uneven energy dissipation is occur in data routing approaches; single hop and multi hop. So, a single hop routing when used, cluster heads positioned far from the sink, it need to consume energy than more others that locate close to sink, because the long distance of data dissemination and this leads to early death for these cluster heads. In contrast, in a multi hop routing approaches, cluster heads existed close to the sink will die early when compared with the others, because they are burden with heavy data traffic and this causes a problem known as "hot-spot".

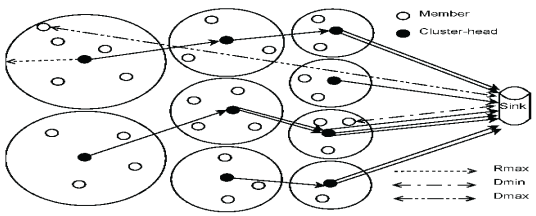


Fig. 1. Architecture of unequal clustering[4]

The structural design of unequal cluster size within WSNs is shown in Figure 1. Unequal clustering minimize the size of the clusters that closer to BS, and when the distance to BS is increasing, the size of clusters increases too. The size of the cluster is immediately relative to the distance between CHs and BS.

Significantly, the hot spot problem reduces the network lifetime and minimizes the sensing coverage, so that typically cased partition in network. That is why, an unequal clustering size approaches has been established as a solution.

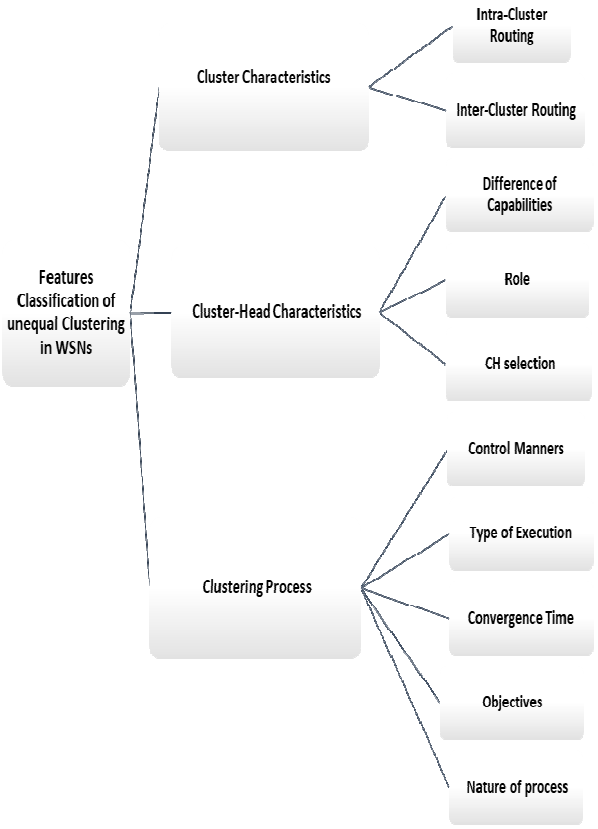


Fig.2. Features Classification of unequal Clustering in WSNs

## 2. CLASSIFICATION OF UNEQUAL CLUSTERING FEATURES IN WSNS

The clustering attributes for unequal cluster size, can be classified into three categories which are: characteristics of the cluster, characteristics of cluster head and the process of clustering algorithm**,** as shown in the figure 2. In this part, we talk about the details of clustering features in WSNs, to suggest a more comprehensive and fine-grained taxonomy compared to previous work.

## 3. CLASSIFICATION OF UNEQUAL CLUSTERING ALGORITHM IN WSNs

Generally, WSN is built of large number of sensor nodes ranging from hundreds to thousands. Unequal clustering is an effective way of organizing a huge number of nodes uniformly distributing the load and eliminating hot spot problem. In this section, an extensive literature survey of published unequal clustering algorithms is presented. These algorithms are classified in five ways: Probabilistic, Fuzzy based, heuristic based, Weight based and Compound unequal clustering algorithm. Figure 2 illustrates some algorithms that is found in the literature.

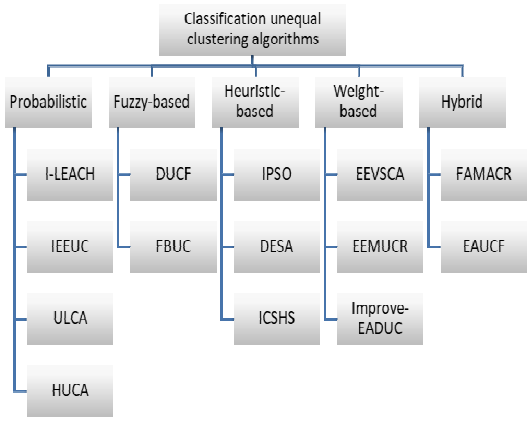


Fig. 2. Classification unequal clustering algorithms

## 4. RESULTS AND DISCUSSION

We summarized the differences and categories of the Unequal Clustering routing protocols in WSNs depend on a set of clustering features. In addition, we compared the various unequal clustering routing algorithms in WSNs based on a few important metrics.

Firstly, different algorithms are evaluated according to cluster characteristic that consist: cluster characteristic in terms variability in number of clusters members, Inter-cluster routing and Intra-cluster communication. In addition, these algorithms compared according to clustering process. The approach of clustering can be classified to five categories: Probabilistic, fuzzy, heuristic, weight and hybrid type.

We also compare the different clustering routing in WSNs based on a few important metrics such as (BS location, Nodes numbers and number of utilized Scenarios, Node Deployment in fields and the protocols that compare to).

From the comparison, most of the algorithms utilized distance to the base station as an important parameter for constructing the cluster and cluster head selection. This approach however caused the irregular shape for cluster because it is pulling the cluster shape toward BS, which lead to increase the energy consumed in intra-cluster communication. It is clear when some algorithms utilized various locations for BS.

## 5. CONCLUSIONS

Clustering in WSNs is considering the best choice for saving the energy but still suffers from some drawbacks like hot spot problem. One of more solution that used to overcome this challenge is Unequal Clustering approach, which consistently balance the energy consumptions among all sensor nodes, and seek to overcome the hot spot problem. In this manuscript, an Unequal Clustering approach is classified into five categories: Probabilistic, fuzzy, heuristic, weight and hybrid. These protocols are clarified with their characteristics, classification, clustering features, and nature of algorithm that used in the clustering. The probabilistic category is more simple than others categories and it very suitable for large scale of networks. Weight and Fuzzy can be utilize for robust and reliable applications. In order to getting optimal solution for specific environment, heuristic category is the better choice.

## ACKNOWLEDGMENT

This work is fully supported by Universiti Teknikal Malaysia Melaka-Zamalah Scheme. So, the authors would like to thank Zamalah Scheme for providing the facilities and financial support for this research.

## REFERENCES

[1] F. Kiani and A. Seyyedabbasi, 'Wireless Sensor Network and Internet of Things in Precision Agriculture', International Journal of Advanced Computer Science and Applications, vol. 9, no. 6, pp. 99–103, 2018.

[2] O. Younis and S. Fahmy, 'HEED : A Hybrid , Energy-Efficient , Distributed Clustering Approach for Ad-hoc Sensor Networks', vol. 238294, pp. 1–36.

[3] D. K. Dhanpal, A. Joseph, and A. Panicker, 'An Energy Efficient Unequal Cluster Based Routing Protocol For WSN With Non-Uniform Node Distribution', vol. 4, no. 5, 2015.

[4] L. Z. Said Talbi, 'Enhanced Unequal Clustering Algorithm for Wireless Sensor Networks', International Conference of Computer Systems and Applications (AICCSA), 2015.