Clustering Management Technique of Hot Spot Area Based on Distance Weight in WSNs

Almutairi Fahad Muaybid A*, ChoonSung Nam**, DongRyeol Shin*
*Sungkyunkwan University, Korea, **Yonsei University, Korea, *Sungkyunkwan University, Korea
E-mail : fahad-1987@hotmail.com, namgun99@gmail.com, drshin@skku.edu

1. Introduction

Because of recent technical improvement in wireless networks, nodes can sense adjacent area, local processing and wireless communication. We call the network which use the device with small size, low price and low power wireless sensor networks (WSNs) [1]. WSNs are composed of many sensor nodes for monitoring or collecting data from specific area of network. The scattered sensor nodes detect environmental phenomena and generate sensing data of environment like temperature, humidity, sound and so on. These created sensing data are sent to the base station (BS) and sink node over the wireless networks which support interface, like Internet and satellite, to end users[2].

In WSNs, data transmission of sensor nodes is multi-hop manner because of limited transmission range. Sensor nodes can connect external networks through sink node or BS. That means that nodes near BS always relays sensing data from other nodes. This area is called Hop Spot Area and the nodes in hot spot are Hot Spot Nodes(HSNs). HSNs usually consume more energy for this. Thus, this paper proposes to prevent HSNs' death early by finding energy consumption relationship between location and role of nodes.

2. Related works

WSNs have to use the routing algorithm considering low-power operation because they have limited features of sensor nodes[3-5]. WSNs' routing technique can be divided into two mechanism, flat-routing and hierarchical-routing. Flat-routing technique regards the whole network as one region, enabling all nodes to participate in just one region. On the other hands, hierarchical-routing technique is based on local cluster routing. Adjacent sensor nodes can monitor similar or same data. Sensor nodes can consume more energy to process duplicate sensing data. So, clustering that prevents duplicate data delivery is more good technique than the flat-routing.

A process of clustering is as follows. First, the sink node selects cluster heads(CHs) among scattered nodes in WSNs. Elected cluster heads form a local cluster by formation messages. Member nodes(MNs) in a local cluster send own sensing data to a CH in a local cluster. CHs collect sensing data from member nodes for data-aggregation which prevents duplicate or similar data transmission.

The basic clustering techniques is lower energy adaptive clustering hierarchy (LEACH) protocol[6]. In LEACH, communication method is based on one-hop communication. It is not real communication range. So, Xiangning and Yulin[6] proposed m-LEACH (multi-hop based LEACH) to consume low energy and maintain clusters with the view of improving WSN lifetime. It present two important ideas of improving LEACH protocol. The first idea focuses on the selection criterion of cluster head node. Usually, LEACH protocol uses random selection of cluster head during each round. This means that some nodes may exhaust energy too fast because of multiple selections. The proposed protocol creates nodes with enhanced residual energy and thus increased likelihood of preventing network death [7]. The second idea emphasizes on the multi-hop communication of cluster heads. Usually, LEACH protocol involves direct communication between cluster heads communicate and sink. In addition, the protocol involves greater consumption of energy between sink and cluster head than among the cluster heads. This means that the cluster head exhausts energy soon. The multi-hop communication approach can help prevent quick network death and thus serve to prolong its lifetime by way of energy consumption balancing.

Base-Station Controlled Dynamic Clustering Protocol (BCDCP) [8] is a centralized routing protocol, which a scheme that aims to improve network lifetime by evenly distributing energy dissipation among sensor nodes. According to BCDCP, minimizing energy consumption is very important issue in sensor network design. This feature is especially important because the sensor nodes consist of small and irreplaceable batteries with limited power in harsh environment. Therefore, it indicates the value of energy efficiency if one is to maximize network life. The BCDCP scheme uses this base station to manage coordinated sensing tasks that are performed by the senor nodes. Therefore, the proposed BCDCP features two key elements: base station and sensor nodes. The approach involves arranging the sensor nodes to operate in both the cluster head mode where node gathers data within its cluster nodes and performs data fusion to the base station, and the sensing mode where the nodes sense and transmit sensed data to the cluster head.

ACT[9] is a cluster-based routing protocol to arrange cluster sizes and transmission ranges for wireless sensor networks. The goal of ACT is to set up smaller cluster near the base station(BS). This is the case given that CHs closer to the BS should transmit more relay data to BS. In particular, the proposed ACT model allows equal energy consumption in all the CH such that CH near the BS which does not drain their power faster. The approach key point is to separate the network topology with the view of prolonging its lifetime.

We can know that energy consumption of nodes depends on CH and cluster size through these clustering algorithms and location of sensor nodes affects to increase relay data packet. Thus, clustering algorithm should be adopt to balance energy consumption between HSNs and other nodes considering these features.

3. Clustering management technique of hot spot area based on distance weight

The proposed clustering management technique focuses the number of data which is dependent on location of sensor nodes. That means that location of nodes affect the number of data. The number of relay data can increase if distance between sink node and sensed node is far. The relay data can occur two cases, Inter-cluster and Intra-cluster. In inter-cluster, CHs have to send collected sensed data to a sink. In this time, to send it to a sink, nodes on a path to sink process relay of data. In intra-cluster, member nodes(MNs) transmit sensing data to own CH. So, member nodes have a role to relay data from neighbor nodes. These relay data affect energy of HSNs. So, we will find how to affect these relay data into HSNs. The proposed modeling is as following.

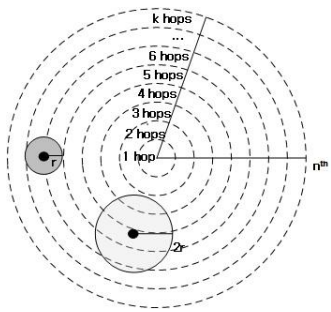

Figure 1. Clustering modeling for hot spot area

In figure 1, dotted line shows distance weight to a sink node. The two rings describe local clusters depend on cluster size. ‘r’ is transmission range. We can find relationship between HSNs energy consumption and location of node or cluster size. Generally, if cluster size is bigger, CHs and MNs consumes more energy because CHs have to collect more MNs’ data and MNs should relay more data. Thus, we can find that nodes in hot spot area, HSNs, need not to be elected as CH. On the other hands, if cluster size is smaller, the number of CHs is increased. That means that relay data which HSNs process would be increased. And HSNs consumes more energy. So, we should find proper clustering technique through tradeoff between cluster size and location.

4. Conclusion

To set up local clusters in WSNs, it should consider energy consumption near sink node or BS. To achieve this, we have to find factors which location of sensor nodes can affect energy consumption like distance weight. Thus, this paper found two factors to affect energy consumption of nodes. One thing is local cluster size. Another thing is location of CHs in WSNs. Through them, we proposed novel clustering management technique which can balance between HSNs and others.

5. Reference

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