



Energy Efficient Protocol for Cluster Head Selection in Multitier WSN

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Abstract- *Wireless sensor network and its applications are interesting research that have been focused recently. Battery consumption of sensor nodes is the main problem in the family of wireless sensor that should be solved. So, to increase the scalability of the network, and to reduce the energy usage for overall sensor operations, clustering techniques and data aggregation are the main focus in this paper. The multi tier techniques has been designed precisely and the selection of the cluster head using Fuzzy Logic based on the three selected parameters are well used along with its limited resources of wireless sensor network. In this study, the main primary and secondary cluster head are the important entities of the algorithm for receiving and transmitting data to the base station. The contribution of this paper is mainly on the selection of a secondary cluster head and the routing protocol which the data transmission will involved the nearest cluster head for both tier one and tier two. Due to multi tier clustering in sensor network, the operations of the sensor network will eventually increase the lifetime of the network compared to LEACH and SEP protocols.*

Index Terms- *Wireless sensor network, leach, primary cluster head, secondary cluster head, multi tier, energy efficiency.*

I. INTRODUCTION

A wireless network is any type of computer network that uses wireless data connections for connecting network nodes. Wireless networking is a method by which homes, telecommunications networks and enterprise (business) installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations.^[1] Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure.^[2] Examples of wireless networks include cell phone networks, Wi-Fi local networks and terrestrial microwave networks.

II. TYPES OF WIRELESS NETWORKS

Wireless PAN: Wireless personal area networks (WPANs) interconnect devices within a relatively small area, that is generally within a person's reach.^[3] For example, both Bluetooth radio and invisible infrared light provides a WPAN for interconnecting a headset to a laptop. ZigBee also supports WPAN applications.^[4] Wi-Fi PANs are becoming commonplace (2010) as equipment designers start to integrate Wi-Fi into a variety of consumer electronic devices. Intel "My WiFi" and Windows 7 "virtual Wi-Fi" capabilities have made Wi-Fi PANs simpler and easier to set up and configure.^[5]

Wireless LAN: Wireless LANs are often used for connecting to local resources and to the Internet A wireless local area network (WLAN) links two or more devices over a short distance using a wireless distribution method, usually providing a connection through an access point for Internet access. The use of spread-spectrum or OFDM technologies may allow users to move around within a local coverage area, and still remain connected to the network.

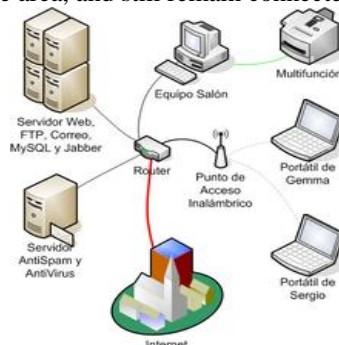


Fig.1. Wireless LAN

Products using the IEEE 802.11 WLAN standards are marketed under the Wi-Fi brand name. Fixed wireless technology implements point-to-point links between computers or networks at two distant locations, often using dedicated microwave or modulated laser light beams over line of sight paths. It is often used in cities to connect networks in two or more buildings without installing a wired link.

Wireless mesh network: A wireless mesh network is a wireless network made up of radio nodes organized in a mesh topology. Each node forwards messages on behalf of the other nodes. Mesh networks can "self heal", automatically re-routing around a node that has lost power.

Wireless MAN: Wireless metropolitan area networks are a type of wireless network that connects several wireless LANs.

- WiMAX is a type of Wireless MAN and is described by the IEEE 802.16 standard.[6]

Wireless WAN: Wireless wide area networks are wireless networks that typically cover large areas, such as between neighboring towns and cities, or city and suburb. These networks can be used to connect branch offices of business or as a public internet access system. The wireless connections between access points are usually point to point microwave links using parabolic dishes on the 2.4 GHz band, rather than omnidirectional antennas used with smaller networks. A typical system contains base station gateways, access points and wireless bridging relays. Other configurations are mesh systems where each access point acts as a relay also. When combined with renewable energy systems such as photovoltaic solar panels or wind systems they can stand alone systems.[5]

A sensor network is an integrated circuit of sensor, embedded compute, modern network, wireless communication and distributed information process. Wireless sensor network is a new information acquiring and processing technology which yields by the recent advances in miniaturization and low power design that led to the development of small-sized battery functioned sensors that are capable of detecting ambient conditions such as temperature and sound [2]. Sensor networks are widely used in variety of applications such as civil as well as military applications because of its miniaturization in size, low cost and large lifetime. In order to keep the cost and size of these sensors small, they are equipped with small batteries that can store at most 1 Joule. A sensor in such a network can therefore communicate directly only with other sensors that are within a small distance [1]. In order to communicate for a very long distance they must create an organization structure amongst these nodes. Since the fundamental advantage of wireless sensor networks is the ability to deploy them in an ad hoc manner, as it is not feasible to organize these nodes into groups pre-deployment. For this reason, there has been a large amount of research into ways of creating these organizational structures [2].

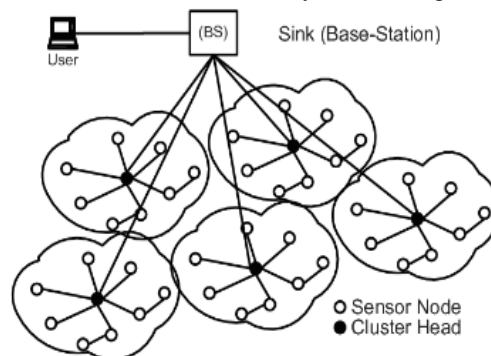


Fig. 2 General Architecture of sensor network

Figure.1.2 shows the general architecture of sensor network. The basic parameters of the sensor networks are Sensor Node, Cluster, Cluster head, Base Station and user, in the hierarchical architecture of the group the base station is at the upper level which provides communication link between the user and the clusters. The data in the sensor network are gathered for providing the answers for the queries raised by the user [1]. An essential part of developing WSNs is being energy aware by reducing the power consumption because of the power limitation. There are many possible solutions in order to reduce the power consumption of the wireless sensor nodes such as enhance the storage systems energy density, improve a technique to distribute the power among the nodes, and produce a mechanism to make the nodes scavenge their own power [6]. The clustering algorithms play an important role in not just organizing the network but also control the performance of the network organization. There are several key limitations in wireless sensor networks, that clustering schemes must consider are Energy, Lifetime of Network, Application, Accuracy, Receiver Sensitivity, Type of transmitting signal, Distance, response time, cluster stability, cluster overlapping, location awareness, QoS support and node mobility.[1]

Wireless sensor network, (WSN) are tiny devices that are contain thousand or extra sensor nodes which are distributed in the area of sensor environments [1]. There are many ways to distribute the sensor nodes in its field such as using manually or by randomly. The main purposes of the deployment is to monitor certain phenomena of interest such as military surveillance, landslide detection, physical environment, health field and so on [2]. The main problem in wireless sensor network is it on battery consumption. The sensor node battery cannot be recharge after certain period of time where there is no power supply to recharge the battery once it is depleted [3]. So, to harmonize and maximize the lifetime of the sensor networks is an important challenge in order to achieve the energy efficiency of sensor nodes. Clustering is one of the effective methods that use data aggregation to reduce the energy usage in WSN [4-6]. In clustering, there are a

cluster head at each of the clusters that has been identified. The cluster head acts as an intermediary between the sensor nodes and it irresponsible to send the data it receives from the other sensor nodes to the base station. This communication reduces the energy consumption of sensor nodes because the data is not directly send to the base station [7]. Thus, clustering is helpful in minimizing the usage of sensor node energy. LEACH is one of the established clustering based routing protocol in WSN [8]. The selection of cluster head in Leaches done randomly and the data that transmit between the cluster head and the base station is done directly which tend to exhaust the sensor battery quickly. A new cluster head algorithm known as Multitier Algorithm Protocol (MAP). The cluster head selection algorithm in MAP is done on the second level of multitier network. Additionally, data transmitting between the cluster head and the base station is using multi hop communications. These transmission will passed through two cluster heads at each tier called primary and secondary cluster head before it reach to the base station.

There have been many approaches being implemented such as Low Energy Adaptive Clustering Hierarchy (LEACH) [2], Power Efficient Gathering in Sensor Information Systems (PEGASIS) [6], Stable Election Protocol (SEP) [1], A Hybrid Energy-Efficient Distributed Clustering Approach for Ad-Hoc Sensor Network (HEED) [11], and An Energy Aware Fuzzy Unequal Clustering Algorithm For Wireless Sensor Network [2]. Due to that, LEACH was the first algorithm that studied clustering routing protocol which is adaptable for a huge network and can drastically prolonging the lifetime of the sensor network.

In LEACH, during the startup phase, each of the sensor nodes will become a cluster head (CH) with fixed probability. The next rounds in LEACH only start after the election period is elapsed. At this stage, all other members nodes in the cluster decide whether it can becomes a CH. The previous cluster head or other sensor nodes that have not become a cluster head will join the cluster which is the nearest to the CH and this CH used more energy rather than the non CH. All communication from the sensor node to the base station will go through the cluster head for each of the cluster. The cluster head will aggregate the data and then send the data to the base station. There are maximum number of data packets that can be carried out by CH from each of the sensor nodes [3] and this might make CH reaching its capacity to handle the data. Therefore, CH normally die on early phase [4]. So, the effective techniques should be considered to prolong the lifetime of the sensor node and the network lifetime.

III. LITERATURE SURVEY

In this paper have studied the different papers to review my research topic. I have studied different authors papers .each have followed the different techniques and methods.

Sofiah.W.I., et.al (2014) have studied Wireless sensor network and its applications are interesting research that have been focused recently. Battery consumption of sensor nodes is the main problem in the family of wireless sensor that should be solved. So, to increase the scalability of the network, and to reduce the energy usage for overall sensor operations, clustering techniques and data aggregation are the main focus. The multi tier techniques has been designed precisely and the selection of the cluster head using Fuzzy Logic based on the three selected parameters are well used along with its limited resources of wireless sensor network. In this study, the main primary and secondary cluster head are the important entities of the algorithm for receiving and transmitting data to the base station. The contribution of is mainly on the selection of a secondary cluster head and the routing protocol which the data transmission will involved the nearest cluster head for both tier one and tier two. Due to multi tier clustering in sensor network, the operations of the sensor network will eventually increase the lifetime of the network compared to LEACH and SEP protocols.[1]

Grover.A., et.al (2014) have studied energy models to cluster based energy efficient routing in Wireless sensor networks (WSNs). In wireless sensor networks, nodes execute on confined force batteries that brings about reducing its lifetime, henceforth WSNs are viewed as a force devouring plans. As the wireless sensor nodes are greatly energy based, the energy efficient routing protocols are necessary with the aim of balancing and reducing energy consumption over the whole network. Subsequently, several specialists have proposed distinct routing protocols for sensor networks, especially routing protocols depending on clustering scheme to minimize the energy utilization in wireless sensor network. This is on the account of the utilization of cluster based routing that has various benefits like to minimize control messages, re-usability of bandwidth and diminishing the energy consumption by aggregating data at intermediate sensors. his article presents a multi-tier multi-hop clustering scheme to reduce the energy consumption of wireless sensor network in which, multipath-AODV routing protocol is used to route the data from source to destination. In the demonstration of simulation results, as compare to LEACH the proposed algorithm provides higher performance and longer network lifetime.[2]

Tripathi.A., et.al (2014)“ have studied Wireless sensor networks (WSNs) consist of sensor nodes. These networks have huge application in habitat monitoring, disaster management, security and military, etc. Wireless sensor nodes are very small in size and have limited processing capability and very low battery power. This restriction of low battery power makes the sensor network prone to failure. Data aggregation is a very crucial technique in WSNs. Data aggregation helps in reducing the energy consumption by eliminating redundancy. This work focuses on summarizing various approaches used for the purpose of data aggregation and its various energy-efficient uses in WSN.[3]

M.Sheik Dawood[2012] have studied Use of wireless sensor networks has increased to monitor the disaster management, surveillance and industrial automation. For such applications the sensors have to be grouped together to deploy in large numbers and to operate autonomously in the network. Several researchers have provided different cluster based routing protocol for sensor networks to enhance power control and node lifetime improvement. Wireless sensor network (WSN) require a various power management protocols to reduce the energy consumption. Different cluster-

based schemes are discussed as a solution for this problem. In this analysis of the present-day classification and general grouping of published clustering schemes. The surveys different clustering algorithms for WSNs; give emphasis to their purposes, characteristics, importance, complexity, etc. We also analyse these clustering algorithms based on metrics such as energy efficiency, cluster stability, location awareness, node mobility and QoS support.[4]

IV. PROBLEM DEFINITION & OBJECTIVE

Problem Definition

The following problems are found:

- The main problem in wireless sensor network is the battery consumption. The sensor node battery cannot be recharged once it is depleted and there is no power supply.
- The existing protocols are not applicable to those WSNs that are deployed in large regions because it uses single hop routing where each sensor node can communicate directly to the cluster head and the base station. So, it causes problems of energy imbalanced.
- The problem of unbalanced energy dissipation in cluster based WSNs is investigated. Another problem is cluster-based and homogeneous WSNs in which cluster heads transmit data to base station by one -hop communication.
- There is problem to selection of next cluster head after the first cluster head is dead. The selection of the next cluster head will probably change all the nodes members in the cluster and the energy of the data transmission will be captured at this stage.

Comparison Table

Name of Author	Protocol Used	Result
Amit Grover	multipath-AODV routing protocol	It provides higher performance and longer network lifetime as compare to LEACH.
M.Sheik Dawood	clustering algorithms	The parameters which are mostly included energy efficiency, cluster stability, location awareness, node mobility and QoS support.
Wan Isni Sofiah Wan Din	Fuzzy Logic	It Compared to LEACH and SEP protocols, the iteration is up to 5000 and all the sensor nodes dead.

V. CONCLUSION

Clustering is one of important method to be applied in order to prolong the network lifetime of wireless sensor network. The selections of cluster head also are important parts to be considered so that the lifetime of sensor nodes remains longer than usual. In this review paper different researcher studied the different protocol to maintain the energy. In the future work energy is maintained with the dead nodes and it is compared with other protocols.

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