Heterogeneous Wireless Sensor Networks Clustering And Energy Efficient Routing Optimization Algorithm

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Abstract- *Modern monitoring technology is the Wireless Sensor Network (WSN). There's a direct link between life span and performance. The network energy loss can be reduced by an efficient and reasonable clustering and routing algorithm, which is of great importance for extending network life. The traditional WSN protocol was hard to meet today's society's needs. This paper focuses on the advantages and disadvantages of the traditional WSN protocol and proposes relevant improvements to optimize and extend the traditional WSN protocol's lifetime.*

Keywords- Wireless sensor network; Clustering; Data heterogeneity; routing algorithm

I. THEORETICAL UNDERSTANDING

QOS refers to quality as perceived by the user. In the networking community, QOS is interpreted as a service quality measure that the network offers to the end user or application. In traditional data network, QOS defines parameters like packet loss, delay, jitter, bandwidth, etc. However, the QOS requirement in WSN such as data accuracy, aggregation delay, fault tolerance and network lifetime etc. are application-specific and differ from traditional end-to-end QOS requirements due to the difference in application domains and network properties. While some QOS solutions (such as Intserv, Diffservetc) are developed for traditional networks, these cannot be easily ported inWSN's.

Many cheaper miniature sensor nodes are assembled and placed within the range to use, and a wireless communication connection forms a self-organizing network system, a wireless sensor network. This network's main function is to help perceive, collect, process and transmit objects and information within the network. Though a miniature sensor node, it needs four modules internally: sensor, transformer, wireless communication, and energy supply. Energy supply sensor is a very important module providing all the sensor node energy. The micro-battery provides the sensor's energy, but its energy is limited. How to improve battery use is the key to the wireless sensor network's lifetime, and is also the focus of research at thisstage.

A cluster is a collection of associated nodes. Cluster head and several cluster units are combined into a cluster. The network is usually called clustering and routing algorithms. The clustered structure has advantages over ordinary structures. It is expressed mainly in: (1) during theprocessing of data. Data fusion requires the completion of a cluster head node that can effectively reduce the amount of data processing; (2) the use of distributed algorithms in a clustered structure is very important for large-scale network processing; to achieve long-distance routing and forwarding that can efficiently improve network service life, only cluster head nodes must be connected to the network. (4) Clustered structure is more convenient. You can adjust the movement and increase or decrease sensor nodes as required without affecting their performance.

II. INTRODUCTION

Wireless Sensor Network was an important technology for science and technology development (WSN). According to relevant research, WSN has good development prospects that would undermine knowledge and change people's way of life in the coming years. WSN has been widely used in various industries, comprising three main elements, namely sensors, sensors and observers. It promotes communication between people and between people and nature and greatly improves cognitive capacity [1-3]. Currently, WSN development's main barrier is network life. Therefore, reducing network energy consumption and extending network life is a major problem tosolve.

III. RESEARCH CONSEQUENCE OFWSN

WSN developed rapidly in recent years. The 1970s saw most basic sensors appear, but their functions are unique, and can only be used for point-to-point transmission. Computer and communication capabilities are unavailable. In this field, network and sensors are combined to form a wireless sensor network through deepening research by people. WSN has the following characteristics to traditional sensors [4]: (1) WSN considers data a relatively high redundancy centre. The randomness of sensor network nodes

is high, and information such as node number is not directly related to other information. If stored uniformly, much space is needed. WSN can directly link node information to other information and address the connection between communication and task user demand and supply. The sensor node is a data-centered network. Cluster heads are often set at high density locations to avoid problems in the data collection process, resulting in high resemblance in the information collection process between adjacent nodes and high redundancies [5~6]. (2) Wireless network resources are limited. One of the most important factors making an endless sensor network widely applicable is its small size, light weight, and low price that satisfies the needs of the public. The sensor node has no strong hardware resources, storage space is relatively small, and data processing capacity is poor. Often, WSN uses small batteries to supply power during operation to reduce control costs and improve monitoring quality. This form of power supply limits energy to some degree, so WSN can only operate for a limited time. Reducing WSN energy loss during operation may extend network survival time. (3) The random distribution features of self-organizing network nodes allow nodes to form clusters in line with the lower-consumption principle that would save network facilities [7]. WSN has been implemented in a number of key areas, including military and defense, environmental monitoring, medical, rescue and disaster relief areas [8].

IV. ANALYSIS AND ROUTING ALGORITHMS INWSN

Multi-path multi-speedprotocol:

This protocol is SPEED extension providing multi-path, multi-speed packets across the network. We are proposing a novel energy-efficient approach for QOS supplying WSNs, which can overcome disadvantages of existing protocols. Proposed protocol performance will be evaluated and compared with existing protocols using NS2 simulator.

After research, the wireless communication module in the sensor node consumes significantly the same energy during idle time and in the transmission and receiving state in the sensor network, meaning that energy demand can be effectively reduced only if the node in the wireless communication module is closed. It consists of cluster head nodes and common nodes. The cluster head nodes work mostly, and the usual nodes are closed. Depending on cluster head nodes, they can connect to a linked network to complete data reception and transmission. This not only ensures normal data transfer, but also reduces energy consumption. Based on this principle, this paper optimises the clustering and routing algorithms of data-heterogeneous wireless sensor networks.

The main idea of Layer Clustering Protocol (LEACH) is to create cluster head nodes with a cyclic method. Therefore, LEACH can distribute the energy of the entire network to each node in a complex and uniform way that can reduce energy consumption and extend WSN's life cycle. It has these features [9]: (1) Cluster head is selected adaptably and randomly. The likelihood of each node becoming a network cluster head is the same. After the network runs for a certain time, each node can be come cluster head so that energy loss is evenly distributed to each node. (2) The cluster head collects information from rough internal nodes and performs data fusion processing that significantly reduces the transmission of information between clusters and significantly reduces energy consumption to improve network life. (3) Nodes do not need to store large amounts of routing information, effectively preventing conflict between information and collision. If nodes are not in their own TDMA timepiece, they sleep to save more network energy.

N nodes are deployed in the detection area, and the probability formula of each node becomes as follows:

$$P_i = P_{opt}(1+a_i) * E_r(i) / \overline{E}(r) \quad (1)$$

In the formula, $\overline{E}(r)$ is the average energy of all nodes in each round, $E(r) = Etotal(1-r / rmax) / N$

And Etotal is the overall power of multi-energy heterogeneous sensor network, r is the number of cycles selected, and rmax is the maximum number of cycles.

LEACH cycles by cycle, and each cycle requires a round. Each round includes two cluster head formation and data transmission stages. Due to cycle characteristics, cluster head nodes are generated randomly during the actual application process. This random generation causes the following problems: (1) There is no guarantee of uniform cluster head-stage distribution and no guarantee of cluster head-size reasonability. Too many head nodes in one section often exist, and relatively few head nodes in other sections. When there are too many cluster head nodes in a given part, energy is consumed unreasonably, eventually affecting service life of the network. If the head node is relatively small, this node energy is not sufficient to complete data transmission, and issues like intermittent network connectivity [7-8] will arise. (2) The cluster head node follows the basic cost principle in the LEACH algorithm which cannot guarantee the load balance of the cluster as the faster distance is the faster energy consumption of the base station cluster head. If the cluster head energy distribution is uneven, the system's

balance status will be broken, increasing network power consumption and reducing network life[10].

V. OPTIMIZATION AND ROUTING ALGORITHM INWSN

The LEACH-based subtractive clustering routing algorithm of WSN is improved and is still performed in round robin fashion. Unlike LEACH, WSN's clustering routing algorithm is divided into initialization and stabilisation, where initialization is a significant stage of cluster heading and cluster formation. Once head and cluster are formed, the entire system enters the stable work phase.

Cluster head nodes' data transmission phase. The actual working principle resembles LEACH[11]. Data have a clustering algorithm that can cluster common things into one category by analysis and calculation. This algorithm has good application value in static data analysis and is widely used in several fields. It can be applied better in WSN head calculation, cluster calculation and data transmission. A multitude of different types can be divided into the clustering algorithm, with hierarchical clustering, classification, density clustering, grid clustering and other clustering being common. The so-called hierarchical clustering processes the data and divides it into several tree diagrams. The tree diagram may be divided into two types of hierarchical clustering, bottom-up and top-down, according to processing direction [12]. Fig.1 shows node-to-cluster communications after clustering.

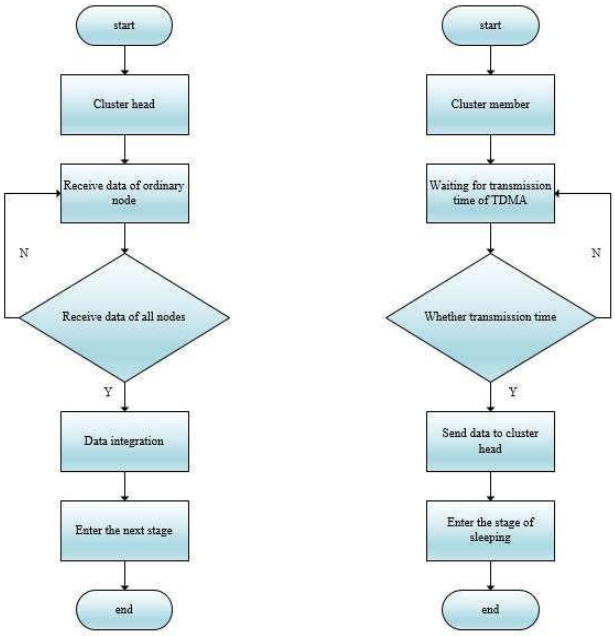

Fig. 1 Communication flow chart contained by a node cluster

Next, we use the same parameter settings as shown in [13] for different algorithms with the same parameters as TAB.I.

Table I. Reproduction Parameters

Number of Nodes (N)	100, 200
Network Size	$100 \times 100\ m^2$
Initial Energy (Normal)	$E_0 = 0.5J$
Probability to be CH (P)	0.1
Data Aggregation Energy cost	$EDA = 50nJ/bit$
Packet Size	4000 bits
Transmitter/Receiver Electronica	$E_{elec} = 50nJ/bit$
Transmit amplifier	$\epsilon_{fs} = 10pj/bit/m^2$
Transmit amplifier	$\epsilon_{mp} = 0.0013pj/bit/m^4$
α (super)	1
β (advanced)	2
m	0.5
m_0	0.4
Fitness function probability p_1	0.7
Fitness function probability p_2	0.3

Clustering is an important clustering method. When using segmentation clustering, the cluster's number of clusters and centres must be determined and subsequently divided into the object and finally obtained the same number of clusters. Clustering density is a common clustering method. The feature of this clustering method is to find the node cluster and use the node as the cluster head with the highest surrounding node density. The surrounding nodes are excluded after determining a cluster head. The head option for other cluster heads is then determined until a threshold between cluster heads is reached. Grid clustering divides the possible data object attribute value interval into a grid unit set. Once the data object falls into the grid unit, the cluster head is calculated. Lattice clusters are rated higher and need only define the grid and determine the object to calculate the cluster head and cluster [13] compared to other clustering methods. And standard comparison indicators are shown in Fig.2below.

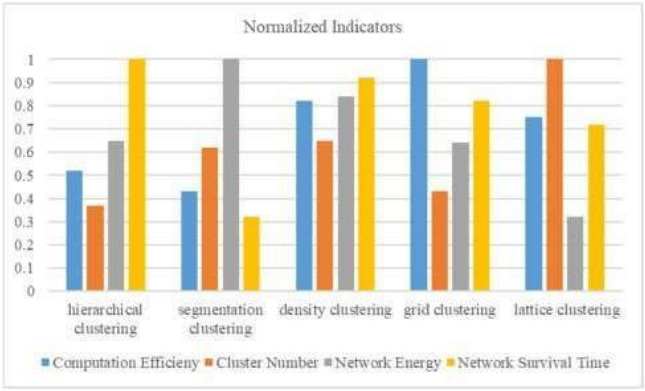

Fig.2 Normalization of various clustering algorithm indicators

Comparing different types of algorithms can find the advantages of different clustering algorithms. Grid-type clustering, for example, has higher computer efficiency and can accomplish quick cluster head and cluster calculation and separate clustering algorithms. It can maximize cluster

balance, decrease network energy loss, and extend network survival. Density clustering combines various clustering algorithms' benefits. It's a balanced algorithm.

VI. CONCLUSION

In summary, this paper focuses on heterogeneous wireless sensor clustering and routing algorithms. Comparing the LEACH algorithm and clustering algorithm, an adequate optimization of the LEACH algorithm and the method for selecting density clusters can extend the network's lifetime and reduce significantly applied energy consumption. The main advantages of its application are: (1) Cluster head nodes are spread equally across the network, and cluster head nodes exist in spare locations, effectively avoiding poor connectivity due to inadequate energy supply. (2) Cluster head algorithm is feasible. Once the cluster head is determined, the non-cluster head nodes also have the property, ensuring cluster load balance and facilitating equal distribution of network energy.

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