Hierarchical Data Transmission and Processing Analysis of Sensor Network System

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Abstract—Hierarchical structure is the method and means of data transmission in sensor network system. The large-scale application of sensor network system and a large number of data acquisition will produce massive data. In order to reduce the load of sensor network processor system and make data transmission more reliable and convenient. For the transmission and processing of streaming and structured data, the data can be processed hierarchically and dimensionally. Hierarchical processing can effectively reduce the load of the network system; Dimensionality reduction can effectively compress the amount of data to reduce the time of data transmission and processing. Hierarchical operation is a necessary step for data transmission and processing in sensor networks, and has been applied in large-scale data transmission and processing algorithms.

1. Introduction
Based on the basic theory of Internet of things and the basic method of sensor network, combined with the application of sensor network and the process of data transmission, this paper discusses the hierarchical processing of sensor network data. From the perspective of information processing, sensor network can be divided into three levels.

1.1. The first layer is the cooperative perception of local areas
Multiple sensors of the same or different types can perceive the target together, and obtain multi-dimensional and rich sensing data. Through the information processing and fusion of local areas, high-precision and reliable sensing information can be obtained.

1.2. The second layer is data processing in the transmission process
For the further aggregation and fusion of the sensing information for wireless transmission network, the application layer coding and transmission protocol optimization of adaptive transmission link state, and the data security transmission processing, the mass information can be efficiently, reliably and safely transmitted.

1.3. The third layer is the common support, service decision and coordination control based on various Internet of things applications on the application support layer
The information of sensor network is a huge amount of information. It is necessary to use the time and space correlation characteristics of the sensing information to realize the hierarchical storage and retrieval of information in different space areas, and improve the utilization rate and efficiency of
information acquisition. The system integrates the functions of data filtering, data transmission, data aggregation and data processing, which can improve the overall efficiency of large-scale sensor network application system to a certain extent.

![Three layer data transmission and processing structure of sensor network](image)

**Figure 1 Schematic diagram of three layer data transmission and processing structure of sensor network**

**2. Dimension reduction of data**

With the development of information technology, especially the application of sensor network technology, system users will be regardless of time and place, can easily obtain a lot of information, the amount of data obtained will grow exponentially. These data have the characteristics of fast update, higher dimension and unstructured.

At present, there is no effective method to deal with these data. The traditional data analysis method is often ineffective in dealing with data sets, even in some cases. The knowledge and rules contained in the data cannot be known and acquired, which will lead to data failure. People are eager to understand and explore the mystery between these data. How to effectively use these high-dimensional data is the basic problem faced by the system.

In many cases, we can first reduce the dimension of the data to a reasonable size, while retaining as much of the original information as possible, and then send the dimension reduced data into the information processing system. This is very useful. The dimension reduction algorithm is also a part of some machine learning and data mining methods. It is an effective method to deal with massive data, combining with some specific business data requirements.

Dimension reduction algorithm is mainly divided into linear dimension reduction algorithm and nonlinear dimension reduction algorithm. The essence of dimensionality reduction is to find the way of projection transformation, from high dimensional space to low dimensional space. There is a minimum embedding algorithm, which can well reveal the manifold structure of data under the constraint of keeping the local isometric and angle unchanged.

**3. Hierarchical data transmission structure of sensor network**

Wireless sensor network (WSN) is a kind of network technology which involves many subjects and spans many research fields. It is a network mode in which a large number of sensor nodes scattered in the monitoring area transmit information through wireless communication. Wireless sensor network needs to establish a set of algorithm protocol and hierarchical structure with independent routing maintenance function according to its own network characteristics and communication needs.

In this paper, we design an efficient and responsive hierarchical routing protocol and structure, which aims to reduce the data transmission delay and improve the overall network life cycle.

In sink data collection node and sensor node, unit information containing data interest type field is defined to ensure information availability.

Sink node defines a cluster of nodes.
Sensor node. All kinds of sensor network nodes form hierarchical sensor network structure.

Figure 2 Schematic diagram of hierarchical data transmission in sensor network

Wireless sensor network is composed of sensor nodes and sink nodes. Because the sensor nodes are powered by batteries, the energy consumption of each node may affect the life cycle of the whole network. In order to improve the life cycle of the whole network, the survival time optimization model of wireless sensor network is studied, and the adaptive multi area hierarchical routing algorithm (sarmal) supporting survival time optimization is designed. MATLAB simulation results show that the performance of sarmal algorithm is better for the network with sparse node distribution or large monitoring area, and the designed algorithm can better prolong the network survival time.

In the hierarchical structure of sensor network, the hierarchical form of collection node, family node and sensor node is formed.

| Aggregation node | Family node | Sensor node |
|------------------|-------------|-------------|
| Sink             | 0           | 01 02 03 04 05 06 07 08 |
|                  | 1           | 11 12 13 14 15 16 17 18 |
|                  | 2           | 21 22 23 24 25 26 27 28 |
|                  | 3           | 31 32 33 34 35 36 37 38 |
|                  | 4           | 41 42 43 44 45 46 47 48 |
|                  | 5           | 51 52 53 54 55 56 57 58 |
|                  | 6           | 61 62 63 64 65 66 67 68 |
|                  | 7           | 71 72 73 74 75 76 77 78 |

Figure 3 sensor network hierarchical sensor node arrangement diagram

Wireless sensor networks (WSN) are rising rapidly in wireless communication. Wireless sensor network is composed of a large number of scattered sensor nodes. Sensor nodes provide to users through collecting data in monitoring environment and data fusion. In the deployed sensor network, it is an important research topic to construct the network topology structure, which makes the data collected by sensor nodes return to users in the way of the least energy consumption.

When the information devices in the sensor network are integrated into the object and the objects in the system have certain intelligence and autonomy, the data calculation can be completed between multiple objects through the embedded intelligent algorithm and its interaction. This interaction makes the amount of data interaction between each object and the external reduce several orders of magnitude.

Because the amount of data collected by sensors can be large, scalable cloud services store data. A
data retention policy should also be developed to clean up unnecessary data on a regular basis. The more data you own, the longer you save, the higher the cost of storing the data. Less data means less insight and historical reference. Priority and balance must be made between cost and the amount of data to be stored.

4. Summary
This paper studies the sensor network architecture and hierarchical data collection algorithm, through the analysis of sensor network data transmission and processing algorithm, aiming at the two aspects of network energy and network load, proposes hierarchical data collection algorithm. It has the most important significance for the development and application of sensor network.

In the hierarchical data acquisition model, a family node is added between the sink node and the sensor node. The sensor nodes are divided into regions. In each region, multi strategy is used to select the family nodes in the group, which are generated by the fusion of the member nodes. To achieve the purpose of reducing network energy. The family node nearest to the sink node is selected as the agent, and the priority algorithm is adopted to establish a minimum data aggregation spanning tree structure with the sink node as the root, the family node as the branch, and other sensor nodes as the leaves.

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