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Routing Algorithm Experimental Teaching Design of Wireless Sensor Network for Internet of Things Engineering Specialty

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Abstract: Wireless sensor network is a core course of Internet of things engineering and routing algorithm experiment is a key and difficult part of this course as it has a high demand for related theoretical knowledge. In practical teaching, students are typically exposed to ambiguous understanding of algorithm and poor simulation results in the analysis of relevant experimental results. For this reason, experimental cases of density routing algorithm design in the experimental course are involved and advantages and disadvantages of different algorithms are thoroughly investigated by optimizing algorithm design and improving the simulation experiment verification link. In this way, the students' capability of algorithm optimization and verification can be enhanced.

1. Introduction

The subject of Internet of things engineering in our university is aimed at cultivating application-oriented undergraduate talents, which received the first students in 2017. However, the subject construction and talent training experience are still faced with some deficiencies, and the building of practical teaching system is still under improvement. Therefore, it is imperative to strengthen the reform of practical teaching system of the subject Internet of things engineering. At present, our university is seizing the development opportunity of "applied technology transformation" to lay a solid foundation for engineering subjects. Our Internet of things engineering education is highly practical, and cultivation of students' practical ability of system engineering shall be enhanced in talent training [1] The wireless sensor networks is a basic course of Internet of things engineering, whose purpose is to let students systematically understand relevant theories and core key technologies of wireless sensor networks, so as to lay a solid foundation for future research and development related to Internet of things. The course involves a great deal of theoretical knowledge of algorithms and large number of important and difficult contents, which raises higher requirements for students' practical ability, thus being a challenge for our practical teaching design [2]. Taking the routing algorithm experiments in the course of wireless sensor networks as an

example, this paper discusses the ideas and methods of improving and optimizing the practical teaching of related subjects, which can not only strengthen the quality of talent cultivation in practice, but also improve the teaching practice of teachers.

The routing algorithm is the foundation and core of wireless sensor networks technology. According to different requirements, the data information collected by each node is transmitted to the base station nodes. In the whole process, how to improve the overall energy efficiency of the network has become one of the most important issues. Different from the traditional wired networks, the stability and low power consumption have to be fully considered when designing the routing protocol under limited resources due to the limited size, power supply and storage capacity of nodes in wireless sensor networks [3]. Different application environments have different requirements for energy consumption, data transmission rate and reliability of routing, so the routing algorithm has to be optimized according to the actual situation. Under the current technical conditions, considering the hardware limitations of sensor nodes, optimizing the routing algorithm between nodes can effectively alleviate the dependence of wireless sensor networks on the node hardware performance.

2. Experimental

2.1. Objectives

With an improved density routing algorithm experiment as a specific case, this paper introduces the design and practical effect of experimental teaching of the routing algorithm. The experiment is divided into four class hours, which includes such three aspects as theoretical analysis, experimental design and result analysis. Students are required to review the theory before class, then design a reasonable experimental scheme according to the experimental requirements and tasks, and then write the relevant algorithm implementation code and analyze the test results based on the simulation platform. Besides, combined with the other two kinds of routing algorithms taught in the theory lectures of this course, they are required to design experiments to analyze and compare the efficiency of the three kinds of routing algorithms, comprehensively analyze the test results of different dimensions, and master several key elements that affect the routing algorithm, and finally finish the experiment report on time. Meanwhile, teachers shall follow up in time, guide carefully and evaluate the final results [4].

2.2. Design of Density Routing Experiments

The density routing algorithm introduces the factor of energy around nodes, which can accurately analyze the energy supply between local areas, and avoid the problem that many routing protocols only consider the residual energy of a single node. The density routing algorithm considers the influence of surrounding nodes in node selection, which can achieve the optimal routing.

Based on the simple routing algorithm simulation experiments in the past, this experiment design requires students to understand the algorithm idea accurately and explore the routing efficiency under the influence of different parameter environment according to the experimental requirements, which serves to promote students' basic knowledge about this subject and improve their ability to analyze the routing experiment. According to the number of remaining hops in the node density routing algorithm, we establish the optimal routing node set model considering the energy of the surrounding environment. The algorithm implementation is mainly divided into such two parts as selection of neighbor nodes and establishment of routing. In the experimental steps, we ask students to optimize the algorithm according to the improved density routing algorithm and the idea of anti-collision, and then analyze the results according to simulation experiments. Meanwhile, the routing

efficiency under several different constraints is compared and analyzed. The experimental steps are shown in Fig. 1.

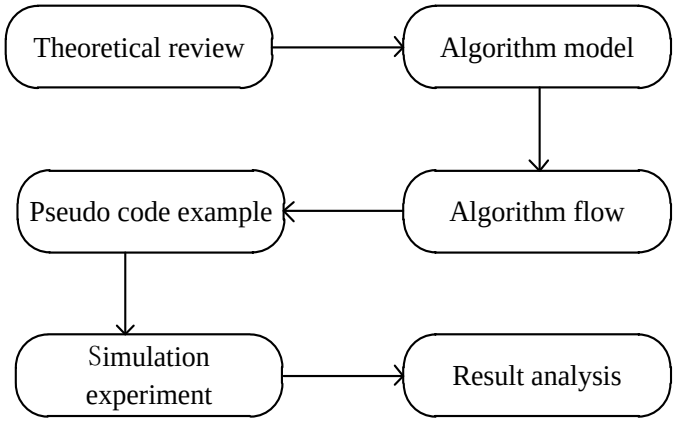

Figure 1: Experimental steps.

2.3. Simulations

In order to evaluate the density routing algorithm performance, Matlab is used as the experimental simulation platform to conduct the simulation experiment and compare with other routing algorithms. Here, DBR algorithm (depth information-based wireless sensor networks density routing algorithm) and Epidemic algorithm (opportunistic network routing algorithm) are selected as the comparison objects. By comparing the results of three routing algorithms under the same simulation conditions, the routing efficiency is analyzed to deepen students' understanding and mastery of the routing algorithm [5].

3. Results and Analysis

3.1. Simulations Results

3.1.1. Effects of Node Quantity on Packet Transmission Success Rate

A fixed transmission range is set in the experimental design. According to the experimental results, the relationship between the success rate of packet transmission and node quantity with the change of node quantity is analyzed. For example, the transmission range of nodes is set to 10 m, and the number of node quantity is gradually increased from 30 to 150 to analyze the relationship between the success rate of packet transmission and node quantity of the DBR algorithm, the Epidemic algorithm and density routing designed in this experiment. As shown by the simulation results in Fig. 2, with the increase of node density, the success rate of packet transmission of three kinds of algorithms are all on the rise. The epidemic algorithm adopts the flooding strategy, which leads to more forwarding opportunities in case of sparse nodes, and thus the obvious success rate of data transmission. However, with the increase of node quantity, the flooding strategy will cause serious network congestion, causing the success rate to decline. The DBR algorithm and the proposed algorithm can effectively control the number of data copies of source nodes and prevent redundancy, which ensures the success rate of data transmission. Compared with the DBR algorithm, the algorithm designed in the experiment is provided with a dynamically selected data forwarding strategy, which can deliver data copies to more active nodes to increase the success rate. Therefore,

the success rate of data transmission of the algorithm designed in the experimental is better than that of the DBR algorithm and the Epidemic algorithm.

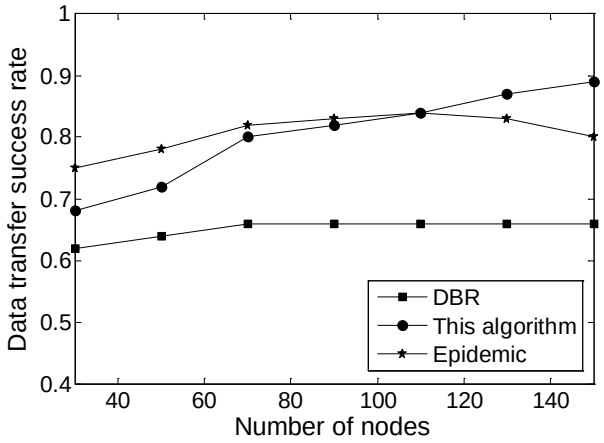

Figure 2: Influence of number of nodes on data success rate

3.1.2. Effects of Transmission Distance on Data Transmission Success Rate

Based on the analysis of the effects of the node quantity on the packet transmission success rate, the students are guided to set the effects of transmission distance on the data transmission success rate in the experimental analysis. The node quantity and transmission distance range are set independently by students to carry out simulation experiments and result analysis. By comparing the three simulation results, conclusions of advantages and disadvantages of the algorithms can be drawn. At the same time, the main factors leading to such advantages and disadvantages can be analyzed. the Epidemic algorithm and density routing designed in this experiment. The experimental results are shown in Fig. 3.

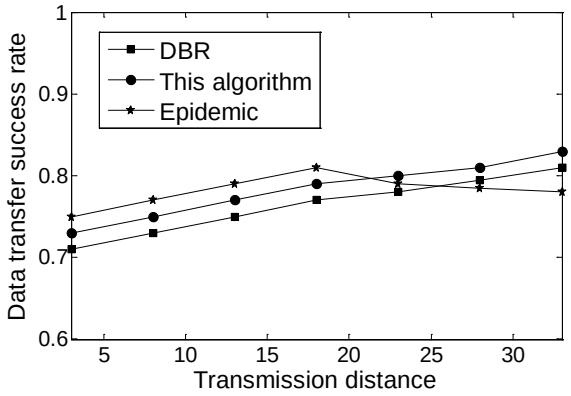

Figure 3: Influence of transmission distance on data transfer success rate

3.1.3. Other Factors

In wireless sensor networks, the load of each node is not completely uniform, and the energy consumption distribution will increase with the increase of actual energy distribution. The number of surviving nodes, residual energy and other factors can directly affect the network energy consumption and routing. Therefore, based on the simulation results above, we can also guide students to perform the experimental analysis of the effects of node distribution on node life cycle,

and explore ways to reduce the network energy consumption by adjusting the distribution mode of network nodes.

3.2. Experimental Results

The content setting and difficulty of this experiment are designed based on the theoretical study in class and after-class assignments of the subject of Internet of things. Before the experiment, the density routing optimization algorithm of this experiment has been explained in detail, related experimental tasks have also been arranged, and experimental guidance materials have been issued in advance to specify the content and tasks of this experiment. As shown by the experimental results, most of the students can correctly understand the routing algorithm design, complete the simulation experiments according to the requirements, and carry out the preliminary analysis of the results. During the experiment, most of the students learn to consult relevant technical documents and are able to learn independently. Meanwhile, many students can actively combine the hardware resources available in the laboratory to explore the independent development and design of routing algorithms based on different levels and different application fields. The experimental design and feedback of the experimental effect have both reached a good level or above.

4. Conclusions

Taking the practical teaching reform of wireless sensor networks of Internet of things engineering as an example, and combined with a specific experimental design and practice of routing algorithm optimization, this paper discusses the comparative analysis methods of different algorithms in the multi-dimensional parameter environment, and deeply analyzes the key factors affecting the routing efficiency through students' participation in the simulation experiments. In this way, the students can master the theoretical knowledge and experimental methods more clearly, thus achieving better quality and effect of experimental teaching. With the rapid development of the Internet of things industry, there exists a huge demand for professional application-oriented talents. In the talent training program, paying attention to the cultivation of professional practice ability and strengthening the reform of professional practice teaching can effectively mobilize the enthusiasm of teachers and students, which plays a role in promoting the professional theory and experimental teaching level.

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