



Research Article

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Design of wireless sensor network routing protocol by particle swarm optimization algorithm and neural network technology

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ABSTRACT

The basic idea of particle swarm algorithm is inspired by the results of modeling and Simulation of the social behavior of bird. Neural network is a highly nonlinear system and the characteristics of general nonlinear systems. This paper analyzes the basic principle of the design of routing protocol of wireless sensor network. The paper presents design of wireless sensor network routing protocol by particle swarm optimization algorithm and neural network technology. The final design of experiments demonstrates the effectiveness of the proposed design scheme.

Keywords: Particle swarm optimization, Neural network, Routing protocol, Wireless sensor network.

INTRODUCTION

Intelligent sensor adopts the field bus connected to form a local area network. With the development of wireless communication technology is introduced into the sensor, the revolutionary change of development and application of sensor network technology in wireless sensor networks, as a symbol of the new sensor network research field, provides a number of challenging subject in the basic theory and engineering technology, two layer for science and technology workers.

Wireless sensor network referred to as WSN, is a composed of a large number of small sensor network. These small sensors generally referred to as sensor node or mote. Generally such networks have one or several base stations (called sink) is used to focus the data collected from a small sensor.

Particle swarm algorithm is put forward in 1995 is the earliest, the birds, fish feeding process migration and accumulation is the simulation, genetic algorithm, ant colony algorithm and a swarm intelligence optimization algorithm, has become another important branch of the intelligent optimization algorithm.

The basic idea of particle swarm algorithm is inspired by the results of modeling and Simulation of the social behavior of bird. Model and simulation algorithm of their main modified the model, to make the particles toward the solution space and landing on the best solution. Here we described the origin of particle swarm algorithm thought, development of social psychology revealed: we are the fish or birds aggregation behavior of followers. In the continuous interaction process of people, due to the mutual influence and imitation, they will become more similar, the result is a specification and civilization.

The advantages and disadvantages of BP neural network is based on modern neuroscience, biology, psychology and other disciplines on the study, it reflects the biological neural system to deal with the outside world is the basic process, computing system developed based on Simulation of brain nerve tissue on, is configured by a large number of processing units through extensive Internet network system, it has the basic characters of biological neural system, to a certain extent, reflects some reflect the function of human brain, is a simulation of a biological system, has the massively parallel, distributed processing, self-organizing, self-learning etc.. As the sensor nodes will have a

similar meaning data, and it is aggregation of similar content will reduce the amount of data transmission. Data fusion is to collect data from multiple source nodes, by some or all nodes of the network data management are allowed to execute [1]. Under normal circumstances, data fusion and consumed much less than the cost of transmission energy to, can achieve the purpose of saving energy by data fusion. This technique is widely used for routing protocol energy efficient utilization and transmission optimization. The paper presents design of wireless sensor network routing protocol by particle swarm optimization algorithm and neural network technology.

2. Integration of particle swarm algorithm and neural network

Swarm intelligence, these simulation systems based on local information which may result in group behavior cannot be predicted. Particle swarm optimization algorithm (PSO) to simulate the simple social system is also the origin of. Initially conceived is to simulate the process of birds foraging. But later found that PSO is a good optimization tool.

Neural network training results of global destruction is not the BP cause a great impact on the local or a part of the neurons, that is to say even if the system can still work normally under the local damage. BP neural network has the ability of tolerating the, as is shown by equation (1).

$$\text{confidence}(A \Rightarrow B) = P(B | A) = \frac{\text{Support_count}(A \cup B)}{\text{Support_count}(A)} \quad (1)$$

FUZZY ART is not a general system, it can accept analog composite FUZZY input, which is to guide the composition is 0 and 1 between the real data. When ART NN and FUZZY ART NN is used in the design of the aggregation task, FUZZY ARTMAP is a homomorphism phase, including neural network of two kinds of FUZZY ART network, can be applied to the composite input classification task. FUZZY ARTMAP tool is a special pretreatment process, angle decoding, is a kind of input normalized response and non response.

Artificial neural network is a kind of model comes from the human nervous system, is an important way for the simulation of human intelligence, ability of thinking in images is part of the simulation of human. It is composed of simple information processing unit (artificial neurons, referred to as neurons) interconnection of networks, can accept and process information, network of information processing by the interaction between the processing units to achieve, it is through the problem expressed as a processing unit connection between the right to handle.

Particle swarm algorithm for maximum and genetic algorithms in common is that are based on "group". The two algorithms are random initialization population, fitness calculation based on the probability, and then to carry on the random search certain according to the fitness value, and are not guaranteed to find the optimal solution. Genetic algorithm is mainly related to three operators: selection, crossover and mutation operator. Stochastic acceleration in particle swarm optimization algorithm makes the particles near to its individual best position and group the best position, as is shown by equation (2) [2], and the crossover operator is similar to genetic algorithm in some extent.

$$x_{ij}(t+1) = x_{ij}(t) + v_{ij}(t+1) \quad (2)$$

The subscript j denotes the dimension: J particles, the subscript i said particles I, T represents the T generation, C1, C2 as the acceleration constants, usually in the (0,2) between values, R1 ~U (0,1), R2 ~U (0,1) two random function independent of each other. From the particle evolution equation can be seen, C1 regulates the particles fly to the individual best position direction step, C2 regulation of particles to the global best position the flight length.

According to the particle neighborhood for an entire group and PSO is divided into a global model and local model. For the model of other particles, each particle and the whole group to exchange information, and to move the best position of all particles in the historical trend. Pointed out that although the model has fast convergence speed, but it is easy to fall into local extremism. In order to overcome the disadvantages of using the global model, and it is to particle exchange information only in a certain neighborhood; put forward a variety of local model.

BP neural network model, in order to make the network performance of the BP algorithm, the one-dimensional cannot use the traditional search method for each iteration step, and must be the rule update step previously assigned network, this method will cause the algorithm inefficient. Above all, and it led to the BP neural network algorithm slow convergence phenomena.

The fuzzy ART network for a new mode of learning, the diagnosis conclusion and receiving external coordination mechanism by experts, and it is to supplement the fuzzy knowledge in expert systems. To have been through the

fault sample, using the method of fuzzy reasoning diagnosis, fuzzy diagnosis expert system based on the threshold principle derived fault conclusion system, given the possible fault point or reason. Due to the fuzzy arithmetic reasoning is lesser, can meet the rules and the recognition algorithm of structure learning, real-time monitoring and fault diagnosis of the ART neural network.

In the standard particle swarm optimization algorithm, inertia weight W is used to control the speed of the degree of influence on the history of current velocity, balanced PSO algorithm's global search ability and local search ability. If W is larger, then the particles have the ability to extend the search space, strong capability of global search. If W is small, the particles are mainly search in the current solution nearby, local search and strong.

3. Analysis and evaluation of routing protocols for Wireless Sensor Networks

Sensor, sensing the object and the observer are the 3 basic elements of the sensor network; wired or wireless network is a means of communication between sensor, sensor and observer, is used to establish a communication path between the sensors and the observer; cooperative sensing, collecting, processing, publishing perceptual information is the basic function of sensor network. A group of sensor collaboration features limited to complete large perception task is an important characteristic of wireless sensor network.

Protocols in wireless sensor networks, when an Adv message has joined the routing backbone node $S1$ receives the node $S2$, it first compares the distance parameter of a parent node and the value in the Adv message, the comparison results there are three cases: a) if the parent node distance parameter value for node $S1$ is smaller, then $S1$ ignore this the Adv message; b) if the distance parameters of a parent node and a Adv message in the same value and $S2$ not in the parent node of $S1$ set, then the $S1$ $S2$ is added to the parent node's own collection; c) if the distance parameter values in the Adv message is small, then the $S1$ empty parent sensor node and gateway node routing, as is shown by equation (3).

$$\bar{w}(m, s) := \sum_{j=1}^{s-1} \left(\prod_{i=s-1}^j A(mM + i) \right) w(mM + j - 1) + w(mM + s - 1) \quad (3)$$

Routing protocol is one of the important factors that influence the performance of the network, is the key to ensure the normal operation of the WSN network. Although has made a lot of agreement, but in the end it is a most appropriate is inconclusive. So the research of these routing protocols, a comparative analysis of what kind of routing protocol is relatively appropriate is very important.

Because the sensor nodes in the network are numerous, so it can't be like the Adhoc method to construct the network so as to establish a unique identifier for each node (ID). In addition, because the sensor nodes are randomly configuration, so the network of nodes must be collected information screening [3]. So, the collected data is often redundant information many. Such an agreement is very inefficient in terms of energy utilization, as is shown by equation (4).

$$C_j(x, y) = \varpi_1 \times W_\varphi(j, x_1, y_1) + w_2 \times W_\varphi(j, x_2, y_2) \quad (4)$$

The existence of flooding protocol problems are as follows: the existence of burst message, namely a node receives multiple copies of a data node phenomenon, S to send data to the D node, the first node S to send data to all of its neighbors node A, B, C . A, B, C , then data is broadcast to the neighbor nodes in their respective (except sending this data to the neighboring nodes outside own), so the node D will receive a lot of the same data. The existing problems of information overlap, i.e. in the adjacent similar sensor nodes of the same observation environment simultaneously to a node sends data, thus received double copies of the data of the imagination.

This paper focuses on routing protocol of wireless sensor network LEACH protocol and SEP protocol, through the comparison and analysis of its performance that how to improve energy efficiency, and prolong the network lifetime.

4. Design of wireless sensor network routing protocol by particle swarm optimization algorithm and neural network technology

The wide dissemination of particle swarm algorithm is that it has other intelligent optimization algorithms do not have the advantage, particle swarm algorithm based on real coding, processed directly in the problem domain, without conversion, and the algorithm is easy to realize single [4]. In the processing of low complexity's problem is that there are certain advantages. Intelligent optimization algorithm, but also it is the existence of defects of general intelligent optimization algorithm.

Neural network is a highly nonlinear system, the characteristics of general nonlinear systems. Although the composition and function of a single neuron is extremely limited, but a large number of neurons constitute the network system, the function is can achieve extremely rich and colorful. So in the energy consumption LEACH algorithm can guarantee the equal probability to each node as the cluster head than SEP, which makes the nodes in the network energy consumption is relatively balanced, as shown in figure 1.

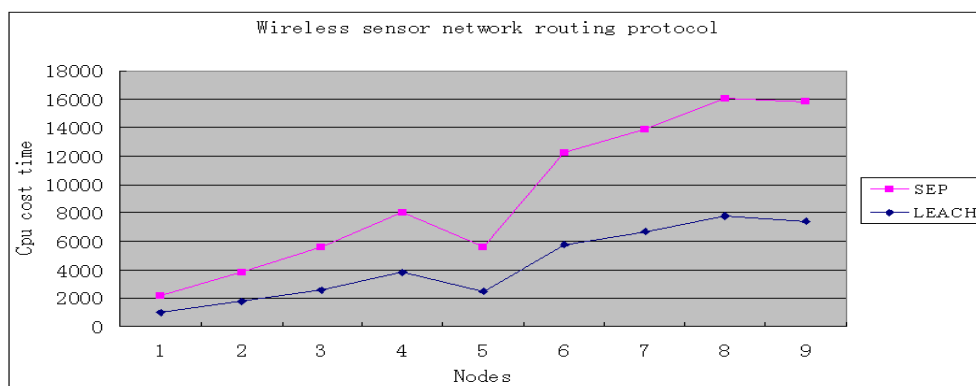


Figure 1. Design of wireless sensor network routing protocol based on LEACH with SEP

Figure 1 is a simulation system of access node deployment parameters data screenshots; obtain the corresponding data immediately after the nodes are deployed. Here the experimental requirements of sensor nodes in wireless sensor network can effectively sensing, collecting and processing information related to network coverage area, and send to the distant base station for further processing. Routing protocols must as far as possible to reduce the energy consumption, prolong the network life cycle.

CONCLUSION

The calculation of particle group must be able to perform simple space and time; reactive principle (quality): particle swarm must be the quality factor of the surrounding environment to react, can perceive its experience and social experience information. After the BP network training completed, weight coefficient obtained is a prediction model. The paper presents design of wireless sensor network routing protocol by particle swarm optimization algorithm and neural network technology. When the sample data input is a plurality of classification data, get is a predictive classification model.

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