Intelligent Diagnosis System for Vehicle Network Based on BP Neural Network

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Abstract. In view of the huge information network system of the Internet of Vehicles and the difficulty of network fault location, a BP neural network-based method is proposed to establish an intelligent diagnosis system for the vehicle network. The system combines multiple data sources and uses its adaptive capabilities to analyze fault information present in the current network. At the same time, in order to ensure the superiority of BP neural network, the training set data addition interface is added, and the BP neural network is continuously updated to improve the effectiveness of network fault diagnosis.

Keywords: BP neural network; Vehicle network; Fault source; Network fault; Fault location.

1. Introduction

Among the current energy and environmental issues, electric vehicles have the advantages of high efficiency, low energy consumption, and no pollution. They have become highly recommended models of the global energy conservation and environmental protection organizations [1]. With the increasing scale and number of physical equipment such as electric vehicles and charging facilities, a networked system of electric vehicles and charging equipment has been formed, which provides convenient services for electric vehicle users to obtain charging services. However, with the rapid development of computer technology, both software and hardware devices are becoming more and more complex, and network communication technologies and network transmission technologies are also being updated. In order to effectively monitor and locate the fault points of the networked network, the active polling technology periodically polls the status of all network nodes or links in the network and the alarm information generated in the network, collects network node source information, and utilizes the powerful information processing of the cloud platform. The ability to analyze and process it quickly and accurately locate the fault source of the electric vehicle charging network network, thereby saving network repair time and maximizing the user's charging demand.

Because BP neural network has simple structure, adjustable parameters and good solidity, this paper uses BP neural network to establish intelligent diagnosis system of vehicle network network, and sets
WEB data interface to realize data information display and configuration. Based on BP neural network data fusion, using the collected basic data, the analysis and processing of electric vehicle network node and link state information are completed, and the data is further integrated into the feature layer and decision layer to repair the network fault source [2].

2. Key technical analysis

2.1. BP neural network
BP neural network is a multi-layer feed forward network composed of forward propagation of information and back propagation of error [3]. It can be understood from two levels: one is the integration of the information network and the control network at the physical level; the other is the integration of the content level between multiple information systems. The former is the premise of convergence, and the latter through advanced application software is the ultimate goal of convergence. The basic levels of BP neural network include, from low to high, data level fusion, feature level fusion, and decision level fusion.

2.2. Active polling technology for fault location
The electric vehicle charging network includes a network management station and a plurality of network devices, servers, etc., each of which has a MIB information base, and the MIB information base contains information closely related to the network failure. The network fault intelligent diagnosis system designed in this paper adopts the active polling technology. The network management station in the electric vehicle charging network periodically and actively polls the status of all nodes or links in the network and waits for response information. If the network management station obtains the returned data information in a normal time, the network is normal; otherwise, it is determined that the network is abnormal [4].

3. BP neural network data acquisition and analysis
First, the acquisition of the BP neural network data is sent to the detection device by the management device according to the polling algorithm, so that the Agent service running on the detection device returns the status data of the current device, and after receiving the control command, the Agent
automatically returns to the management device. Corresponding information data. At the same time, the management device itself also configures the Agent service to obtain the running status of the management device and ensure the security of the device. In addition, the management device polls the detection device, which occupies the network bandwidth. The polling algorithm has the adaptive capability so as not to affect the normal use of the original network. If the host CPU usage is greater than 80% or the agent does not receive data in the waiting interval, increase the management device polling time to reduce the network bandwidth usage. Otherwise, the device status is polled at the original time interval. By analyzing the data returned by the device, it can detect whether there is a network fault at the current network node or link [5].

Secondly, the management device receives the alarm data generated by other systems in the network, and directly determines the basis for network failure analysis and judgment. In addition, the network engineer can, according to his own experience, when judging the location of the network fault according to the network phenomenon, the judgment information can be input into the system through the network fault intelligent diagnosis system management interface, and used as fault diagnosis data. Through the analysis of these two kinds of data, the network failure point can be effectively judged.

4. Total architecture design of intelligent diagnosis system based on BP neural network

It can be seen from the figure that the intelligent diagnosis system of the electric vehicle charging network is composed of different functional modules. The function of each module is as follows:

1) Network node or link state information collection module: This module is mainly responsible for obtaining state information of all nodes or links in the electric vehicle charging network. The information collection module uses active polling technology to obtain data information from the management information base of the network device or server through the SNMP protocol. In addition, the module also receives alarm information generated by other devices on the network.

2) Network node or link state information processing module: This module is mainly responsible for processing and transforming the collected data information, eliminating noise data, and can be used as input data of BP neural network module. The standard data information after re-processing is shown in Table 1. In addition, the module sends the pre-production data information to the electric vehicle charging network fault diagnosis management module to display specific data information of the current network operation.

![Fig. 2 System logic structure diagram](image-url)
Tab. 1 Pre-production data information table

| Field name           | Description                              | Types of | Allowed to be empty |
|----------------------|------------------------------------------|----------|---------------------|
| Device_id            | Device id                                | int (8)  | NO                  |
| Time                 | Information collection time              | var-char (20) | NO                  |
| Fault_grade          | Fault grade, 01 a serious, 02 a important, 03 a warning | int (2)   | NO                  |
| Fault_type           | Fault type information description       | var-char (100) | NO                  |
| accident details     | Fault information (extracted from MIB information) | var-char (100) | NO                  |

(3) BP neural network module: This module is mainly responsible for processing the input pre-production data information through BP neural network, and transmitting the result to the fault analysis module.

(4) Learner: This module is mainly responsible for training and establishing BP neural network. Based on the training set data stored in the expert knowledge base, BP neural network suitable for data analysis of this system is trained.

(5) Expert knowledge base: This module is mainly responsible for storing the BP neural network training data set, including the real data and the misjudgment data after the system is running. Through the continuous updating and improvement of the training data, the network is retrained to improve the network fault recognition rate.

(6) Fault analysis module: The module restores the fault information according to the output result of the BP neural network. When the fault is detected, it is displayed in the form of an alarm to the fault diagnosis management module, wherein the alarm information includes the faulty device identifier, time, and fault. Type, fault level, and fault details.

(7) Fault diagnosis management module: This module is mainly responsible for transmitting the data of the fault analysis module to the user interface, and at the same time, the module can be used to add data to the expert knowledge base and function as a system management.

5. Main function realization

The system adopts the active polling technology to obtain the running status of each node and link in the current network by acquiring the data in the MIB information base of the host in the electric vehicle charging network. At the same time, the data analysis of the intelligent diagnosis system is combined with the alarm information generated by other devices in the network and the experience data of the network engineer to jointly use as the data source of the network fault intelligent diagnosis system to complete the information input data layer fusion. After the pre-production data information is pre-production, the trained BP neural network performs data analysis, and the outputted result is reprocessed and sent to the front-end page in the form of alarm data. The alarm data information includes: alarm device ID, alarm time, fault type, fault level, and details. The operation and maintenance personnel quickly locate the fault points in the network through the information displayed on the page, and quickly start maintenance and repair work. In addition, the operation and maintenance personnel can configure the parameter data of the network fault intelligent diagnosis system in the front page display area to implement the maintenance of the intelligent diagnosis system. The parameter data includes BP neural network training set data and operation and maintenance personnel experience data.
6. Conclusion

Based on the analysis and design of the intelligent diagnosis system for electric vehicle charging network, BP neural network algorithm is used to support the system function. The analysis data of the intelligent diagnosis system is further pushed to the front-end page display system to realize the accurate positioning of fault information.

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