Design of Electrical Remote Control Teaching System Based on Intelligent Ubiquitous Learning Network Model

Zhuang Gewei

Power Science Research Institute of Shanghai Electric Power Company, Shanghai 200000, China
zhuanggewei4756@163.com

Abstract. The traditional teaching system of electric remote control remote control teaching problem of low precision and intelligence in ubiquitous learning network model is put forward for this electric remote control teaching system design, system framework design based on electric remote control teaching, collection and detection module design, sound identification of hardware design, automatic tracking sensor design, speech recognition software design, software design, realized the electric remote control the design of the teaching system, experimental data show that the proposed intelligent ubiquitous learning under the network model of teaching system design, electric remote control remote control teaching with high precision.

Keywords: Ubiquitous intelligence · Learning network model · Electric remote control · Teaching system design

1 The Introduction

In the increasingly developed communication technology, information technology, radio frequency identification technology and other new technologies are constantly promoted, a kind of ubiquitous network architecture that can realize direct communication between people, people and machines, people and objects, and even between objects and objects is increasingly clear, and gradually into People’s Daily life. In the U network of ICT convergence technologies, the focus of development has shifted to specific services rather than “technologism”. The goal of pan-network construction is also to provide users with better application and service experience. However, the remote control teaching system realized by traditional technology, especially the remote control teaching system of electrical and mechanical majors with strong operability, has various problems. Therefore, this paper proposes the design of the electric remote control teaching system under the intelligent ubiquitous learning network model.

Literature [1] with the high degree of industrialization in modern society, and the continuous progress of science and technology, electrical control automation technology has become the development trend of modern industrial technology. The development of
remote electrical automation system based on embedded technology. This paper mainly studies the design and analysis of remote electrical control automation system based on embedded system. Literature [2] discusses the design and implementation of scheme I from three aspects of training equipment body, upper computer and lower computer, and discusses the design and implementation of scheme II from three aspects of training equipment body, upper computer and lower computer. Literature [3] compares the test, analysis process and actual use effect of various schemes, and launches from three parts: training equipment body, lower computer control part and upper computer simulation software. The training equipment body adopts the modular structure of the combination of patch cord and mesh plate, which is more widely used and more effective.

Intelligent ubiquitous learning under the network model of electric remote control architecture is the most critical teaching system design and network technology, the wireless user context in a network environment (environment), perceived performance, heterogeneous wireless access networks coexist with synergy, heterogeneous network mobility management, advanced data management technology (including NID, Profile management, content management, etc.), cross-domain cross layer optimization technique. At the same time, it also puts forward specific Suggestions on standardization. The research on ubiquitous network standard system mainly includes the following contents: the technical characteristics and application objects of ubiquitous network; Ubiquitous network system architecture; Functional modules and components in the system; Interface between modules; Data marks (acquisition, processing, transmission, storage, query, etc.); Application of service standards; Information security, personal privacy protection, etc.

2 Electrical Remote Control Teaching System Design

2.1 Frame Design of Electric Remote Control Teaching System

The intelligent remote control teaching system based on the learning network model is a kind of system designed by using the intelligent learning network model. In order to ensure the real-time performance of the teaching system, Virtual Reality Transport Protocols is selected as the system communication protocol module. The Virtual Reality Transport Protocols module is used to realize data communication in multiple geographical locations in the teaching system. At the same time, the Virtual Reality Transport Protocols module is used to enable all the hardware in the teaching system to work together and share resources.

In order to ensure the stable operation of the system, run the extension framework module USES hadoop data frame module, architectural patterns adopted B/S structure, core components used the HDFS and graphs, and used the Virtual RealityTransport big data frame module as the communication protocol module system, realized the big data frame module connected to the computer administrator, relying on Internet technology, improve the running speed of the system.

Based on the analysis of traditional electronic control remote teaching system, the electronic control teaching system module design is divided into teaching information system management information storage module and information retrieval and analysis module, the main design is divided into two modules. MIS management information
storage module, through the large data source, the use of SQL statements, the information in the electronic control teaching system for sampling and analysis, and information storage. The information retrieval and analysis module contains a microprocessor, which converts the information according to the retrieval information instruction input from the water supply end of the system, forms the logical control word structure, analyzes the management information of the teaching information system, and then retrieves the information. Table 1 shows the command word structure with the aid of call analysis logic.

**Table 1.** Retrieves the analysis logic control word structure

| Serial number | Logical control word structure | Significance                      |
|---------------|--------------------------------|-----------------------------------|
| 1             | A00100101                      | Transformation                    |
| 2             | 0 A 01001                      | Processing interruption           |
| 3             | 10 A 1001                      | Internal serial port receiving    |
| 4             | 010 A 100                      | Synchronous reception             |
| 5             | 0100 A 100F                    | Peripheral interrupt              |
| 6             | A 100100H                      | Generate electrical signal        |
| 7             | 010011H A                      | External output                   |
| 8             | FF-EFHF                        | I/O output data information       |

Information analysis module to be obtained by the microprocessor will obtain information instruction and logic control structure transformation, makes the module to analyze data to be obtained, internal DSP buffer are also beginning to action at the same time, the analysis of the received signal is converted into electrical signals to be obtained, to speed up the information analysis module performs data information analysis is taken to be obtained.

Through the design of the system communication protocol module, the operation extension framework module and the information system module, the main framework module of the electrical remote control teaching system is designed.

### 2.2 Design of Data Acquisition and Detection Module for Electric Remote Control Teaching System

Teaching system data acquisition and detection module design is the electrical remote control teaching system hardware, two more important hardware modules, is the data acquisition module and data detection module. The data acquisition module of the electrical remote control teaching system contacts directly with the electrical equipment to capture relevant network data. The schematic diagram of the data acquisition module of the electrical remote control teaching system is shown in Fig. 1:
The execution power of the data acquisition module of the electrical remote control teaching system can be set according to formula (1):

\[ R = \frac{vDP}{fL_d} \]  

(1)

Where, \( D \) stands for voltage coefficient of electrical equipment; \( v \) represents current coefficient of electrical equipment; \( F \) represents the operating safety factor set; \( L_d \) represents the environmental coefficient of electrical equipment. According to the set power of the data acquisition module of the electrical remote control teaching system, the buffer size is calculated [4], as shown in formula (2):

\[ Q = \frac{f \cdot D(S - x) \times R}{\rho} \]  

(2)

Where, \( R \) stands for set execution power, unit m; \( S \) stands for copy rate, per bit/S; \( \rho \) represents the current network bandwidth in MB; \( X \) is the delay effect factor.

The data acquisition module of the electrical remote control teaching system is based on the link layer driver to copy the acquired data and send it to the protocol analysis module. After the protocol analysis module is separated, the separated data is sent to the data detection module design. The detection of network data by data detection module is realized by means of rule file, rule loading module and database.

### 2.3 Speech Recognition Hardware Design of Electrical Remote Control Teaching System

In order to make the electric control distance teaching system can run in the complex electrical equipment. Microcontroller Unit; MCU is composed of speech acquisition,
speech processing, feature extraction, speech recognition and other modules, and the Field Programmable Gate Array is divided into each module through FPGA (field-programmable Gate Array). Provides a protocol stack for data transfer between each module.

Besides, in addition to teaching, the Internet of things technology is applied to arrange the sound sensor, connect the sound sensor with A/D analog-digital conversion chip, and convert the collected analog signals into digital signals. The selected A/D analog-digital conversion chip should meet the requirements in Table 2, and the parameters given in the following table are the minimum values [5]. The selected A/D ADC chip parameters should be greater than those listed in the table below.

| Project                  | Parameter requirement | Remarks                        |
|--------------------------|-----------------------|--------------------------------|
| Conversion rate SPS      | 1Msps                 | Number of conversions per second |
| Resolution bit           | 12bit                 | Primary conversion bandwidth    |
| Output interface         | SPI                   | SPI flash                       |
| Encapsulation condition  | SO patch              | More suitable for teaching environment than dip |

Taking the converted digital signal as the research object, the converted digital signal is collected by the speech acquisition module, and the speech information is acquired by the speech processing module, feature extraction module and speech recognition module, and stored in the static random access memory (Stram). In addition, in order to ensure good communication effect, quartz crystal resonator is used in the electronic control distance teaching system to reduce interference and other electromagnetic waves. Select the SPI flash communication interface for data communication. Display the display with LED. Press the button to complete the process. The PC side USES the JAVG module to connect. It is the hardware component of a remote electrical control teaching system, as shown in Fig. 2.

![Fig. 2. Hardware composition of electrical remote control teaching system](image-url)
Physical network sensor Identification technique, is refers to the use of Radio Frequency Identification technology (Radio Frequency Identification, RFID) will sound sensor outside teaching combined with wireless network protocol zigbee technology, short distance transmission at low speed, using infrared technology, bluetooth technology as a whole, at the same time the use of multiple sound sensor to stereoscopic teaching voice signal recognition [6]. Its iot sensor recognition technology is composed of three layers: perception layer, network layer and application layer. The perception layer includes data collection and data short-distance transmission. The data collection is the sound sensor, and the author of the data transmission adopts short-distance transmission. Based on the network, RF identification technology connects adjacent sound sensors for long-distance transmission of data, and transmits the acquired analog signals to A/D analog-to-digital converter chip, which then processes the data in the next step. Figure 3 shows the organization chart of iot sensor identification technology.

![Fig. 3. Organizational structure of iot sensor identification technology](image)

In order to ensure the validity of the data, the rfid distance should not be greater than the effective distance required by formula (3) [7].

\[
S = \frac{\partial [e^2 \cdot n]}{\partial W \cdot n}
\]

Where, \( e \) represents the conversion rate of sound sensor, unit Msps; \( W \) stands for resolution of sound sensor, unit bit; \( N \) is the coefficient of interference.

The factors that affect the interference coefficient mainly include the interference speed, the voltage of full load electrical equipment, the interference condition of electrical equipment and so on. Based on the hardware structure design of electrical remote control teaching system and the introduction of sensor recognition technology of Internet of things, the speech recognition hardware design of electrical remote control teaching system is completed.
2.4 Design of Automatic Tracking Sensor for Electric Remote Control Teaching System

The electric remote automatic tracking is very necessary in the electric remote control teaching system, which is convenient for teachers to solve the trouble of repeated adjustment. Self-tracking sensor a device used to identify a tracking target and determine whether obstacles exist in the tracking path. Designed to take into account the teaching system of automatic tracking features, on the basis of conventional sensors increase the SDI - MAHRS device, SDI - MAHRS device using ultrasonic interference and diffraction principle, through the device of the single crystal of launch ultrasonic wave, using the ultrasonic wave interference and diffraction signal processing results, identify the target tracking objects with their own actual distance and the size of the obstacle exists in the path [8]. Add the sdi-mahrs device structure diagram, as shown in Fig. 4.

Fig. 4. Schematic diagram of sdi-mahrs device structure

Among them, 1 represents the shell of the sdi-mahrs device, 2 represents the circuit board, 3 and 4 represent the ultrasonic interference and diffraction image processor, respectively, 5, 6 and 7 represent the u-blox neo-6 m module, u-blox neo-10 m module and u-blox neo-20 m module, respectively.

At the same time, in the design process of the automatic tracking sensor, it is also necessary to ensure that the various signals sensed can be converted into signals that can be easily measured, and the corresponding signals can be input into the autonomous control module, which will issue instructions to control the automatic tracking system. Since the current is easy to transmit and measure, the current is used as the output of the automatic tracking sensor.

Through overall structure design of automatic tracking system, based on ultrasonic interference and diffraction characteristics, complete the automatic tracking sensor design, automatic tracking target identification and route planning is interference route automatic tracking system is the core of the teaching system, automatic identification and tracking route planning is also a kind of serial port protocol process design, process design by tracking, process design to realize the science reasonable path planning.

Considering the stability of the communication among the environment information acquisition module, the autonomous control module and the motion performance module, the method of Socket streaming Socket is used to design the target recognition and route planning process. As a transmission control protocol, streaming socket can
ensure reliable connection-oriented transmission and guarantee the orderliness and non-repeatability of target identification and route planning [9]. The flow chart of specific target identification and route planning is shown in Fig. 5.

![Flow chart of automatic tracking target recognition and route planning](image)

Fig. 5. Flow chart of automatic tracking target recognition and route planning

### 2.5 Speech Recognition Software Design of Electrical Remote Control Teaching System

In analog A/D analog-to-digital conversion, the high-definition recognition program of teaching voice signal should first add condition sequence at the A/D analog-to-digital conversion position of analog signal, so that when analog signal is converted into digital signal, it has a unique time sequence sign, and set the time sequence of recognizing current digital signal as \( t \), and then the high-definition recognition program of teaching voice signal aims at the time sequence The three digital signals of \( T-1 \), \( t \) and \( T+1 \) in the column are reorganized to form a complete voice command. The process diagram of the teaching voice signal recognition program is shown in Fig. 6.

![Process diagram of teaching voice signal recognition program](image)

Fig. 6. Process diagram of teaching voice signal recognition program
When the teaching interference is accompanied by a large electromagnetic wave, the analog signal obtained by the sound sensor will appear a certain degree of noise. After a/D analog-to-digital conversion, the noise will form a large number of interference signals. In order to reduce the impact of the environment, the converted digital signal is processed for noise reduction, and the noise reduction principle is shown in Fig. 7 (a, b).

![Fig. 7. Schematic diagram of noise reduction processing of teaching speech signal recognition](image)

In the above figure, (a) represents the normal acoustic digital signal. Affected by the surrounding environment, the noise is generated at the inflection point of the normal acoustic signal, as shown in figure (b). Figure (c) represents the original analog acoustic signal. Due to the influence of the propagation distance and the surrounding environment, the original model acoustic wave may have the phenomenon of attenuation, which is shown in figure (d).

For the convenience of calculation, it is assumed that the original sound wave does not produce attenuation. In order to reduce the generation of clutter, the multi-a/D conversion is controlled, and the control function is shown in formula (4).

\[
f(x) = \lim_{t \to \infty} \left( \frac{S \cdot O}{t \cdot q} + z \right) dx \tag{4}
\]

Where, \( O \) represents the measured acoustic impedance of the environment, in PA s/m³; \( Q \) represents the measured propagation speed, in M/S; \( t \) represents the measured pressure, in KP.

According to the clutter suppression function, the attenuation of the original wave is calculated in reverse. Because of the more clutter, it is greatly affected by the surrounding environment. It shows that the greater the attenuation degree of the original wave is, the attenuation degree is calculated by using the reverse derivation, and the compensation calculation of the sound wave is carried out according to the attenuation degree, as shown in formula (5).

\[
w(x) = \lim_{t \to \infty} \frac{w \cdot \eta}{n \cdot j} f(x) \tag{5}
\]

In the formula, \( \eta \) stands for signal transmission frequency, unit: kHz; \( J \) stands for signal transmission distance, unit: m; depending on the suppression of clutter and the compensation of attenuation, the noise reduction design of electrical remote control teaching system is realized and the speech recognition of electrical remote control teaching system is completed.
2.6 Implementation Software Design of Electrical Remote Control Teaching System

The software design of the electrical remote control teaching system is based on the hardware design. It uses the data source identification module, data acquisition module, protocol analysis module, data detection module, rule loading module parameters to determine the rule file, module communication mode and realize the design process of the electrical remote control teaching system operation.

Based on the software design, the user executes the application program, controls the electrical remote control teaching system, sets the BPF buffer based on the web console, which is used to store the execution command, and realizes the user’s control of the electrical remote control teaching system by calling out the execution mode and using the safety filter on the basis of the protocol stack [10], whose user controls the electrical remote control teaching system Schematic diagram, as shown in Fig. 8:

![Process diagram of user controlled electrical remote control teaching system](image)

Fig. 8. Process diagram of user controlled electrical remote control teaching system

In Fig. 8, the protocol stack is a set of communication protocols for each module communication. In order to be compatible with the data source identification module, data acquisition module, protocol analysis module, data detection module and rule loading module, the protocol stack uses single ICP/IP protocol for communication. At the same time, in order to prevent the intrusion data from hijacking the detection system, load the data filter, and improve the performance of the electrical remote control teaching system Operation safety. The implementation software design of electrical remote control teaching system is realized.

3 Simulation Test Experiment

In order to ensure the effectiveness of the design of the electrical remote control teaching system (hereinafter referred to as the remote control teaching system) under the intelligent ubiquitous learning network model, the simulation test and analysis are carried out. In the analysis process, the conventional remote control teaching system and the remote control teaching system under the conventional learning model are used as the experimental comparison objects to verify the accuracy of the teaching remote control.
3.1 Experiment Preparation

In the experiment, the past teaching data is used as the experimental object to carry out the simulation experiment, and the past teaching data is used as the experimental object, including the known teaching content, to analyze 12.5%, 25.0%, 37.5%, 50.0%, 62.5%, 75.0%, 87.5% of the teaching data process.

3.2 Experiment Process

This experiment uses different teaching data methods to analyze and compare the completed teaching process, and uses the past parameters to verify the accuracy of the method. Therefore, it is necessary to build a long-distance control teaching system, long-distance control teaching system, long-distance control learning mode, long-distance teaching mode that does not contact the teaching results, etc. suitable for the previous experimental environment.

In the process of the experiment, firstly, the experimental environment is established, which is basically in line with the development of the actual situation. The time function is used to control the development of the situation.

3.3 Analysis of Experimental Results

According to the time process, the remote control teaching system, the conventional remote control teaching system and the remote control teaching system under the conventional learning model are obtained. According to the situation prediction in different time periods and the recorded data, the experimental results data table is formed, as shown in Table 3:

| Stage of teaching facts | Remote control accuracy | Conventional remote control teaching system | Distance control teaching system based on conventional learning model |
|------------------------|-------------------------|--------------------------------------------|------------------------------------------------------------------|
|                        | Remote control teaching system | Conventional remote control teaching system | Distance control teaching system based on conventional learning model |
| 12.5%                  | 60.5%                    | 80.4%                                      | 50.4%                                                             |
| 25.0%                  | 66.7%                    | 60.5%                                      | 48.6%                                                             |
| 37.5%                  | 69.8%                    | 54.1%                                      | 45.2%                                                             |
| 50.0%                  | 70.0%                    | 48.7%                                      | 48.5%                                                             |
| 62.5%                  | 75.4%                    | 62.2%                                      | 54.5%                                                             |
| 75.0%                  | 76.4%                    | 68.2%                                      | 54.8%                                                             |
| 87.5%                  | 87.5%                    | 79.8%                                      | 68.7%                                                             |

From the experimental results, it can be seen that the traditional remote control teaching system has a high sensitivity in the initial stage of teaching facts, but in general,
the system is greatly influenced by the stage of teaching data, and as more information is received, it is easy to cause errors in judgment. In the traditional teaching mode, the remote control teaching system has high stability, but the overall teaching progress is slightly lower than the existing remote control teaching system.

Through the statistics and calculation of the experimental data, the remote control accuracy of the remote teaching system reached 61.56%, the remote control accuracy of the traditional remote teaching system reached 55.96%, and the remote control accuracy of the traditional learning model reached 55.96%45.17%. Remote control teaching system is more effective than traditional remote control teaching system.

4 Conclusion

Based on the electric control of the remote teaching system framework design, acquisition and the design of the detection module, voice recognition, automatic tracking sensors, voice recognition software, hardware implementation of software design, realized the electronic control of the remote teaching system design, in order to guarantee the effectiveness of the design system, through the simulation test of experimental data show that the proposed intelligent flood in the design of the remote control system of teaching under the network model has higher accuracy and the remote control of teaching the design has good application prospect. In order to provide a certain theoretical basis for the design of electronic control distance teaching system.

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