Next Generation Wireless Sensor Network Based Japanese Remote interactive practical teaching platform

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Research Article

Keywords: Next generation Wireless sensor network, Japanese teaching, Interactive Japanese teaching, Distance Japanese teaching, Database design

Posted Date: July 20th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3065496/v1

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Abstract

In order to solve the problem of lack of practice in Japanese teaching, a design of Japanese remote interactive practical teaching platform based on wireless sensor network is proposed. In terms of hardware, it mainly refits interactive communication, wireless sensor network, microprocessor and other equipment, and adjusts the interface circuit. The Japanese teaching data and relevant Japanese teaching resources generated in the process of Japanese Teaching of practical courses are stored in the corresponding database table according to a certain format, and the logical relationship between database tables is used to update the database. With the support of database and hardware equipment, the software function of the platform is designed from multiple modules such as platform user role, interactive practical teaching and management, practical resource management and distribution, practice project information release, practice investigation statistics and platform operation safety. Through the above design, the operation of Japanese remote interactive practical teaching platform is realized. The test results show that there is no significant difference in the function realization of the design platform, but when multiple users are online at the same time, the interaction performance of the design platform is stronger, that is, the operation performance of the platform has obvious advantages.

1 Introduction

Today's society is in the stage of rapid development of information technology. Firstly, productivity has been transformed into science and technology, which is also the backbone of promoting reform in the field of education in our country. The Ministry of education clearly pointed out that the core of reform and development in the field of education should integrate the information-based education factors, integrate educational information into the national information development strategy, and deploy the educational information network in advance to provide effective means and power for China's education development [1–2]. With the continuous development and popularization of wireless sensor networks, the Ministry of education has put forward the "three links and two platforms" plan, which will promote the integration of wireless sensor network and education industry, and build an integrated platform of "Internet plus education". At present, digital education resources have become popular in the classroom [3]. Japanese teaching based on wireless sensor network has become an inevitable development trend in the field of education.

Reference [4] Studies and implements an interactive light augmented reality teaching system for numerical optimization teaching The system uses aruco algorithm for multi-target tracking and recognition, realizes the simulation and visualization of numerical optimization process based on javascript technology, and designs and develops a prototype augmented reality system The operation shows that the above system has strong real-time and interaction, vividly presents the working principle and process of numerical optimization algorithm, can effectively improve learners' learning efficiency, and is an innovative teaching method. Reference [5] proposed an interactive virtual garment design system based on Internet platform The user logs in to the system through the user layer, and the display layer uses three-dimensional scanning technology to scan the human head, trunk and other information,
collect human data, project and process the collected human data to obtain human contour, select interpolation algorithm to denoise the obtained human contour, and extract the feature points of human contour after denoising through corner detection method. The final contour line is obtained by using the final feature points, the three-dimensional human body data file is generated and transmitted to the interface layer. The interface layer designs the clothing through style design, adding color and pattern, adaptively adjusts the clothing pieces by using the global optimization method to realize the clothing design, and tries the designed clothing through the virtual fitting module until it meets the needs of users. The experimental results show that the size accuracy of the system is higher than 99.5%, the number of iterations of human body size adaptive adjustment is less than 30, and the designed clothing has a high matching degree with the user's body shape. However, the function of this method in practical operation needs to be further improved. Based on digital twin technology, Reference [6] can build a digital twin platform connecting real teaching space and virtual teaching space, and become the "digital artery" of online teaching space. The digital twin platform can be divided into online learning feature analysis technology and virtual real teaching space fusion analysis technology. Through the deep integration, mapping and mirror image between "online teaching" and "online learning", it can inject new digital productivity into online immersion teaching. Based on this, explore the online immersive teaching process design and technical application of digital twin podium from the two aspects of teaching and technology, that is, teaching data collection and management based on hybrid platform, teaching data analysis and modeling based on multidimensional analysis, data application based on precision teaching and precision management, and online immersive Teaching experience based on augmented reality technology. Then design its teaching process. The purpose is to promote the formation of digital and intelligent classroom and the innovative application of digital and intelligent integration in teaching through the multi-source data fusion, virtual and real integration and mapping of digital twin podium and the integration and optimization of teaching services, so as to form a new form of classroom data interaction and mapping based on big data, and then innovate and reshape the modern education system.

In addition to the above problems, the current Japanese teaching platform is mainly based on the traditional Japanese teaching mode [7–8], and there is a problem of low interactivity in the operation of the platform. Therefore, this paper realizes the optimal design of the Japanese remote interactive practical teaching platform from three aspects of hardware, database and software, in order to improve the Japanese teaching system and application performance of Japanese teaching platform.

2 Design of hardware platform for Japanese remote interactive practical teaching

The Japanese interactive Japanese teaching platform provides students with more opportunities for practice and operation. Due to the characteristics of low cost, high efficiency and full functions, the platform has been widely used in most colleges and universities and has greater application advantages compared with the traditional practical courses [9]. In order to solve the interactive performance problem of the current Japanese practice course Japanese teaching platform and the realization of some
Japanese teaching functions, this paper makes a specific analysis of the requirements, objectives and design process of the platform. The design goal of the Japanese remote interactive practical teaching platform is to ensure the Japanese teaching effect of practical courses, enrich the interaction between users and the platform, and effectively improve the realism and immersion of the Japanese teaching platform. Driven by the platform design purpose and the analysis results of design requirements, determine the basic design framework of the platform [10–11]. The platform is divided into three parts for specific design, including hardware equipment, software function program and database environment. The selection of hardware equipment should follow the principles of advanced technology, economy and application in the course, as well as the requirements of feasibility, maintainability and operability, so as to determine the optimal scheme of the equipment. The hardware equipment provides support for the data storage of Japanese teaching platform and the realization of Japanese teaching function, and realizes the visualization of Japanese teaching process. In order to improve the Japanese teaching function and operation performance of the platform, based on the traditional hardware platform, the wireless sensor network, microprocessor, memory and other modules are optimized and modified, and the connection interface and circuit of the hardware platform are adjusted.

2.1 Interactive communication wireless sensor network

The purpose of building interactive communication wireless sensor network is to provide technical support for the transmission of Japanese teaching resources, real-time Japanese teaching data and the latest Japanese teaching data, improve the transmission performance and transmission rate of wireless sensor network, and then improve the interaction efficiency of the platform [12–13]. Wireless sensor network is mainly composed of client, server and connection link. The specific wireless sensor network results are shown in Fig. 1.

In the wireless sensor network, the client is the main receiver of Japanese teaching information. The client has no requirements for installation and form. After logging in to the web server, it can log in to the platform through embedded plug-ins. It has the functions of real-time Japanese teaching video playback, Japanese teaching resources reception and so on. At the same time, the client also has the functions of sending Japanese teaching messages and submitting homework. In order to ensure the safe operation of the platform, the data transmission protocol needs to be installed on the client port. Under the constraints of HTTP protocol, the client can transmit data to the platform server through the firewall [14–15]. The wireless sensor network adopts IIS server based on windows. The server is mainly used to be responsible for the registration, login, user authority management, platform management, information release and other tasks of platform users. Under the management mechanism of the server, the client can apply to the platform for task scheduling. When the server passes the application, a transmission link is automatically generated within the network to realize the rapid transmission and interaction of data. In addition, it is also necessary to configure the switch equipment in the network, define two VLANs respectively, change their IP address without modifying the mask, then add routes between the two VLANs, and use the "enable" command to activate the routing function. Finally, add a default gateway for the switch and
enter "default" to define the default route. This address is the IP address of the router in the interactive communication wireless sensor network.

2.2 Microprocessor

The microprocessor model is selected according to the core, working frequency and chip memory storage capacity. The selection of platform microprocessor core is destined to be based on the requirements of the operating platform to be run by the interactive Japanese teaching platform, and the working frequency of the platform determines the data processing ability of the microprocessor to a great extent. The fluctuation range of master clock frequency of common microprocessor chip platform is 20mhz-133mhz. Different chips have different processing methods and effects on the clock [16–17]. Generally speaking, the storage capacity in the chip product is small, and the outline memory device needs to be installed in the process of platform design. Therefore, without considering the memory storage capacity of the chip, the ARM microprocessor of S3C4510B is selected as the central processing unit of the Japanese teaching platform.

2.3 Interface and circuit design

As the model and operation mechanism of some hardware devices in the interactive Japanese teaching hardware platform have changed, it is necessary to adjust the connection mode of interfaces and circuits in the hardware platform to ensure that all devices in the hardware platform can operate normally and cooperatively.

2.3.1 Microprocessor chip interface circuit

There are 208 pins on the selected S3C4510B microprocessor chip, and each pin is packaged in QFP. The S3C4510B chip pins can be divided into three types: input, output and input / output. The output pins are mainly used for the control or communication of external devices of the microprocessor, The pin of input / output type is the bidirectional data transmission channel between microprocessor chip and peripherals [18]. The connection and control of microprocessor chip pins are shown in Table 1.
Table 1  
S3C4510B chip pin connection setting table

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Pin name</th>
<th>Pin description and connection mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin49</td>
<td>LITTLE</td>
<td>Large and small terminal mode selection pins, pull up or connect to the power supply</td>
</tr>
<tr>
<td>Pin55</td>
<td>FILTER</td>
<td>Use PLL power and connect with capacitor</td>
</tr>
<tr>
<td>Pin63</td>
<td>TMODE</td>
<td>Test mode, pull-down or grounding to make the chip in normal working mode</td>
</tr>
<tr>
<td>Pin71</td>
<td>nEWAIT</td>
<td>External waiting for request signal, pull-up connection</td>
</tr>
<tr>
<td>Pin76</td>
<td>CLKOEN</td>
<td>The clock output is allowed or prohibited. Connect the high level to make the output in the formula in the allowable state</td>
</tr>
<tr>
<td>Pin80</td>
<td>XCLK</td>
<td>Clock source, connected to the output of active crystal oscillator</td>
</tr>
<tr>
<td>Pin82</td>
<td>NRESET</td>
<td>Reset pin to realize low-level reset. Under the normal working state of the platform, the pin is in high-level state</td>
</tr>
<tr>
<td>Pin83</td>
<td>CLKSEL</td>
<td>Clock selection, high level = xclk, which is directly used as the working clock of the platform; Low level = xclk is used as the working clock of the platform after circuit frequency doubling</td>
</tr>
<tr>
<td>Pin108</td>
<td>ExtMREQ</td>
<td>External host bus request signal, pull-down connection</td>
</tr>
</tbody>
</table>

2.3.2 Power circuit

The purpose of setting the power supply circuit is to provide stable power support for multiple hardware devices in the hardware platform. In the interactive Japanese teaching platform, combined with the selection results of each device, 5V and 3.3V DC power supply are required. Therefore, it is necessary to install a transformer equipment based on the traditional power supply circuit to realize the mutual conversion between 5V voltage and 3.3V voltage [19–21].

2.3.3 Crystal oscillator circuit

The crystal oscillator circuit is mainly used to provide the working clock to the platform CPU and other circuit equipment. The design and connection results of the crystal oscillator circuit are shown in Fig. 2.

Under the action of crystal oscillator circuit, the hardware platform can obtain higher working frequency with lower external clock signal, and effectively control the high-frequency noise caused by high-speed switching clock.

2.3.4 Other interface circuits

Other interface circuits specifically include memory interface circuit, serial interface circuit, JTAG interface circuit, expansion board interface circuit, etc. [22–23]. Taking the serial interface circuit as an example,
the circuit uses RS-232-C standard, which is the serial data transmission bus standard. This standard adopts 9-core D-type plug for connection. The connection of each pin in the serial structure circuit is shown in Table 2.

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Pin name</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCD</td>
<td>Data carrier detection</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>Data receiving</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
<td>Data transmission</td>
</tr>
<tr>
<td>4</td>
<td>DTR</td>
<td>Data terminal preparation</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Land</td>
</tr>
<tr>
<td>6</td>
<td>DSR</td>
<td>Data equipment preparation</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>Request send</td>
</tr>
<tr>
<td>8</td>
<td>CTS</td>
<td>Clear send</td>
</tr>
<tr>
<td>9</td>
<td>RI</td>
<td>Ringing indications</td>
</tr>
</tbody>
</table>

### 2.4 Database design

Database is the core and foundation of interactive Japanese teaching platform, which provides sufficient data support for the realization of Japanese teaching function. The design of database has a set of standardized and reasonable design process, which can be roughly divided into four steps: demand analysis, conceptual structure design, data model establishment and database implementation and maintenance. According to the requirements of Japanese teaching platform [24–25], each data table is designed to save relevant data, establish the entity relationship between each module, and obtain the relationship of each main data module in the database.

All data in the database are stored in the corresponding database table according to the type. The database table established in the designed Japanese remote interactive practical teaching platform includes student user information table, practice course introduction information table, course schedule information table, information announcement information table, example explanation information table, Japanese teaching progress information table, teacher user information table Administrator user information table and practical video and audio resource information table [26–28]. Taking the question answering type data in the Japanese teaching platform as an example, the database table is used to save the question information raised by students in the Japanese teaching process of practical courses.
and the question answering information is replaced by teachers in the background management. The specific design of the database is shown in Table 3.

Table 3 Database table

(1) Japanese teaching task list

<table>
<thead>
<tr>
<th>Field identification</th>
<th>Field name</th>
<th>Field type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese teaching task ID</td>
<td>tID</td>
<td>varchar(40)</td>
</tr>
<tr>
<td>Japanese teaching task description</td>
<td>tDescribe</td>
<td>text</td>
</tr>
<tr>
<td>Japanese teaching task types</td>
<td>tType</td>
<td>varchar(20)</td>
</tr>
<tr>
<td>Japanese teaching task score</td>
<td>tPoint</td>
<td>int</td>
</tr>
<tr>
<td>Japanese teaching task status</td>
<td>tState</td>
<td>varchar(10)</td>
</tr>
<tr>
<td>Japanese teaching task start time</td>
<td>tStarTime</td>
<td>varchar(20)</td>
</tr>
<tr>
<td>Japanese teaching task creation time</td>
<td>tCreateTime</td>
<td>varchar(20)</td>
</tr>
</tbody>
</table>

(2) Japanese teaching record

<table>
<thead>
<tr>
<th>Field identification</th>
<th>Field name</th>
<th>Field type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese teaching record ID</td>
<td>recordID</td>
<td>varchar(40)</td>
</tr>
<tr>
<td>Student account ID</td>
<td>userID</td>
<td>varchar(40)</td>
</tr>
<tr>
<td>Task ID</td>
<td>tID</td>
<td>varchar(40)</td>
</tr>
<tr>
<td>Japanese teaching records</td>
<td>recordAnswer</td>
<td>varchar(10)</td>
</tr>
<tr>
<td>Student achievement</td>
<td>recordResult</td>
<td>int</td>
</tr>
<tr>
<td>Start time</td>
<td>recordStart</td>
<td>varchar(20)</td>
</tr>
<tr>
<td>Completion time</td>
<td>recordEnd</td>
<td>varchar(20)</td>
</tr>
<tr>
<td>Learning feedback</td>
<td>recordBack</td>
<td>text</td>
</tr>
<tr>
<td>Task status</td>
<td>recordState</td>
<td>varchar(10)</td>
</tr>
</tbody>
</table>

(3) Japanese teaching resource table

<table>
<thead>
<tr>
<th>Field identification</th>
<th>Field name</th>
<th>Field type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese teaching resources ID</td>
<td>rID</td>
<td>varchar(40)</td>
</tr>
<tr>
<td>Description of Japanese teaching resources</td>
<td>rDescribe</td>
<td>text</td>
</tr>
<tr>
<td>Types of Japanese teaching resources</td>
<td>rType</td>
<td>varchar(10)</td>
</tr>
<tr>
<td>Japanese teaching resource path</td>
<td>rPath</td>
<td>varchar(100)</td>
</tr>
<tr>
<td>Creation time</td>
<td>rCreateTime</td>
<td>varchar(20)</td>
</tr>
</tbody>
</table>

(4) Question answering database table

<table>
<thead>
<tr>
<th>Field name</th>
<th>Field description</th>
<th>Data type</th>
<th>Field length</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>Question number</td>
<td>int</td>
<td>20</td>
</tr>
<tr>
<td>num</td>
<td>Ask user student number</td>
<td>varchar</td>
<td>50</td>
</tr>
<tr>
<td>name</td>
<td>Ask user name</td>
<td>varchar</td>
<td>50</td>
</tr>
<tr>
<td>content</td>
<td>Question content</td>
<td>text</td>
<td></td>
</tr>
<tr>
<td>date</td>
<td>Issue release time</td>
<td>date</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>IP address</td>
<td>varchar</td>
<td>50</td>
</tr>
<tr>
<td>passid</td>
<td>Audit authorities</td>
<td>varchar</td>
<td>20</td>
</tr>
<tr>
<td>redate</td>
<td>Reply time</td>
<td>date</td>
<td></td>
</tr>
<tr>
<td>teacher</td>
<td>Respondent</td>
<td>varchar</td>
<td>50</td>
</tr>
<tr>
<td>reply</td>
<td>Reply content</td>
<td>text</td>
<td></td>
</tr>
</tbody>
</table>

Similarly, we can get the design results of other types of database tables, convert the real-time Japanese teaching data generated in the platform into the corresponding format according to its type [29–30], and store it in the corresponding storage space to realize the dynamic update of the database.

3 Software function design of Japanese remote interactive practical teaching platform

In the process of Japanese practical course interaction, the main functions of the platform include course learning, problem discussion, homework practice, remote video course, course assignment and submission, etc. [31]. In the software platform, different users have different functional permissions. The specifically designed platform software functional framework is shown in Fig. 3.
Determine the course content of the Japanese teaching platform according to the Japanese practice course system, and set the corresponding functional permissions in combination with different user roles.

3ds Max 8.0 is used to realize the modeling of various scenes, and the corresponding three-dimensional model is built according to the actual operation environment [32]. For example, the actual operation of industrial automation equipment needs to build a practical working environment in the experimental environment, and connect the operation interface with the peripheral equipment. When clicking or knocking the peripheral equipment, the scheduling and operation of the virtual scene can be realized, so as to realize the control of the operation process.

The functions of the platform administrator include login and exit, teacher management and department management. The administrator can manage the teacher user information through the teacher management template, authorize different user roles, and maintain the operation order of the Japanese teaching platform. The teacher’s role in the platform can set up courses on the platform, control the Japanese teaching progress of the course, and quickly solve the problems fed by students in the process of Japanese teaching. The functions for learning users include main test, course selection, Japanese Teaching of practical courses, submission of homework and online test. According to the Japanese practical course system and process, students choose the content to learn on the platform, and transfer the video and audio to the database according to the practical courses for Japanese teaching. In the process of Japanese teaching, questions can be raised in the interactive module of the platform in combination with the course content. At the end of one stage of Japanese teaching, students have the qualification online test and enter the test module to realize the whole Japanese interactive Japanese teaching.

Combined with practical teaching objectives, it can be divided into basic objectives and advanced objectives. The basic objectives are to enable students to basically master and apply the theoretical support in practical courses, while the advanced objectives are to cultivate students’ innovative and practical ability and complete practical projects independently [33]. In view of the above two objectives, the software module of the interactive practical teaching platform is divided into two parts: in class practice and extracurricular practice. In order to improve students’ autonomous learning, the credit system has been introduced into the Japanese teaching platform. Students can enter the next stage of learning after obtaining enough credits through the previous stage of learning, finally obtain practical projects and obtain the final practical teaching results. Combined with the demand analysis results and design objectives of the interactive practical teaching platform, the software content is divided into multiple modules and designed and implemented one by one.

### 3.1 Platform user role module

The user roles set in the interactive practical teaching platform are administrator object, student object and teacher object. In the process of user role management, the platform administrator manages all kinds of users, including teachers and student accounts, groups users, and imports or exports user lists.
In addition, the administrator can grant and manage the permissions of different users. The basic authority of teachers can include publishing online courses, course resource management, assignment and review, information exchange, release of practical projects, etc. The functions that students can realize include online autonomous learning, course selection, upload and submission of homework, resource download, information exchange and online testing.

3.2 Interactive practical teaching and management module

The interactive practical teaching in the platform requires the mutual cooperation between the roles of students and teachers. First, students open the course list and fill in the basic information such as the name and number of the selected course, the name and student number of the selected course in the interface to realize the course selection operation of students. In practical teaching, teachers can transfer files, such as Japanese teaching courseware, to all or designated student clients. Teachers can control file transmission and automatically run files after resource transmission. The designed Japanese teaching platform also supports the functions of video and audio Japanese teaching. The teacher client realizes voice, broadcast and video operations through microphones and cameras, and transmits them to the main interface of the student client in real time. At the same time, students can also complete the communication and interaction between students or between teachers and students through hardware devices such as microphones and cameras [34]. In addition, in addition to the Japanese teaching mode of teachers, students can also choose the independent learning mode. After logging in to the Japanese teaching platform, students can download plug-ins such as book reader and network player on the client, view the existing Japanese teaching courseware and resources on the Japanese teaching platform, and complete the corresponding practical homework. The independent learning function provides an entrance for online discussion and tutoring and Q & A. students can arrange learning time and manage students' progress according to their own needs. At the same time, in the attitude of being responsible for the quality of Japanese teaching, teachers will also track and manage students' real-time learning and make objective evaluation.

3.3 Practical resource management and allocation module

Practice resource management is mainly managed by the platform administrator for all kinds of Japanese teaching resources, announcements and notices in the platform, including courseware resources released by teachers, examination question bank and other information and resources stored in the database. It can initialize the platform, clear all kinds of resources in the database, and be used to dynamically change the information of the notification bar at any time.

3.4 Practice project information release module

The release of practical project information specifically includes network module management, column management, project content release, text content management, etc. This module mainly realizes the management of platform display content style, deletion, addition, modification and other editing functions of column and project content. Generally speaking, teachers and administrators have the
authority to release time project information, and students are the audience of practice project information release.

### 3.5 Practice investigation statistics module

Due to the particularity of practical courses, a single test paper form cannot be used as the standard of Japanese teaching investigation in the investigation process. Generally speaking, the investigation of practical teaching effect is divided into two parts: theoretical investigation and practical investigation, in which the theoretical investigation is to obtain the test paper results in the form of traditional test paper examination. The practical investigation needs to be graded according to the performance and achievements of students in practical projects. Calculate the theoretical score and practical score according to a certain proportion, get the final score of students' interactive practical investigation, and query the score results through the investigation module of the platform.

### 3.6 Safety platform operation module

In order to protect the information security of platform users and ensure the smooth progress of interactive practical teaching, it is necessary to ensure the stability of platform operation. Therefore, intrusion detection programs need to be run in the background during platform operation [35–36]. Use the latest technology between (0,1) to initialize the connection weight and threshold, select any sample and provide it to the platform, and use formula 1 to calculate the output of each functional unit of the platform and the output error of the current iteration.

\[
\begin{align*}
    y_{jk} &= O_{jk}^{L} \\
    E_{jk} &= \frac{1}{2} (y_{jk}^* - y_{jk})^2 
\end{align*}
\]

Where, \( L \) is the output layer of the data, \( O_{jk}^{L} \) and \( y_{jk}^* \) respectively represent the output results of the input node and the output results of the output layer, \( E_{jk} \) represents the iterative output error, and \( y_{jk} \) is the k-th learning example. Then adjust the learning rate and momentum factor. The adjustment process can be expressed as:

\[
\begin{align*}
    \eta(t) &= \begin{cases} 
        0.7\eta(t-1), & E(t) > 1.04 \cdot E(t-1) \\
        1.05\eta(t-1), & E(t) < E(t-1) \\
        \eta(t-1), & \text{else} 
    \end{cases} \\
    mc &= \begin{cases} 
        0, & E(t) > 1.04 \cdot E(t-1) \\
        0.95, & E(t) < E(t-1) \\
        mc, & \text{else} 
    \end{cases} 
\end{align*}
\]
Where, $\eta$ and $mc$ represent the learning rate and momentum factor respectively, and the weight and threshold of the platform node are adjusted in combination with the solution results. Select the next required sample and perform the above steps until all samples are trained. Select the maximum error $E_{\text{max}}(N)$ solved in the calculation process, and use formula 3 to adjust the error judgment.

$$E_{\text{max}}(N) \leq e (3)$$

Where, $e$ represents the optimal control value. If the conditions in Formula 3 are met, the learning ends and there is no external intrusion. Otherwise, the output intrusion detection result is abnormal, and the platform operation early warning program needs to be started.

### 4 Platform Test

In order to test the Japanese teaching function and application performance of the Japanese remote interactive practical teaching platform based on wireless sensor network, the platform test experiment was designed.

#### 4.1 Test preparation

The release and exchange of Japanese remote interactive practical teaching information is temporarily hosted on the web server of the campus network. The server model is Windows 2000 advanced server + SQL Server 2000. The CPU device and network card device in the server are Pentium VI 2.4GHz and 10 / 100 / 1000m adaptive network card respectively. The model of the platform client terminal used in the experiment is mainly the computer equipment of Chinese Windows95 / 98 / 2000 / NT / XP, and some mobile terminals are set as the client of the Japanese teaching platform. The designed Japanese remote interactive practical teaching platform is developed under Windows XP Professional, and it is transplanted to Windows 2000 advanced server environment in the process of platform release. For the ASP file code of the software part of the interactive Japanese teaching platform, it can be directly imported into the Notepad for defense, and finally stored as a file in * .ASP format. As for the production and modification of the platform interface, Macromedia studio tools are used to professionally process the animation, page and graphic effects of the front-end display effect of the platform, and provide a visual page environment. In addition, in order to ensure the stable operation of the platform software program, the C++ running tool is installed in the main test computer. The tool can call the file in * .ASP format and realize the operation of the platform through the reading of program code.

The online interaction requirements of the Japanese teaching platform make the platform put forward higher requirements for the experimental data set. The experimental data for online transmission is designed, and the Japanese teaching information is encapsulated in the data frame for subsequent experiments. The experimental configuration is shown in Table 4.
Based on the above data, taking the designed Japanese remote interactive practical teaching platform based on wireless sensor network as method 1, the interactive Clothing Virtual Design System Based on Internet platform in reference [5] as method 2, and the online immersive teaching system analysis and process design based on digital twin platform in reference [6] as method 3, the following experiments are carried out.

### 4.2 I/O performance

Comparing the I/O performance of different methods can directly reflect the advantages and disadvantages of the platform. The platform operates for a long time and gives the same number of instructions to the test methods to test the I/O performance of the three methods. The comparison results are shown in Fig. 4.

It can be seen from Fig. 4 that the I/O performance will decrease with the increase in time. The optimal I/O performance of method 2 and method 3 is only at the beginning of the operation of the platform, which will directly lead to the poor degree of video streaming and the small number of services available. However, the number of services of method 1 continues to increase in the first five minutes, and remains above 6000 even if it decreases in the future. This is because method 1 includes a portal and a streaming video server. Therefore, in the process of streaming video, it greatly improves the flexibility of video, effectively caches data, and improves the I/O performance of the platform.

### 4.3 Peak signal-to-noise ratio
During the transmission process, the platform will undergo compression and other processing, resulting in the reduction of its peak signal-to-noise ratio. Therefore, five groups of English and Japanese teaching videos with completely different attributes are selected to compare the peak signal-to-noise ratio after streaming the video by the three methods. The comparison results are shown in Fig. 5.

According to the data in Fig. 4, the peak signal-to-noise ratio of method 1 is always not less than 31dB under any environment, while the peak signal-to-noise ratio of method 3 is slightly lower than that of method 1, but higher than that of method 2, and the peak signal-to-noise ratio of method 2 is too low, resulting in too blurred video and reduced learning efficiency. The first method is to reorganize the information of Japanese teaching video containing multiple elements before designing the platform, and then effectively save and manage it. In this process, the video quality can be greatly improved, so the peak signal-to-noise ratio of method 1 is increased.

### 4.3 Time cost

According to the purpose of the platform performance test, six groups of experiments are set up respectively, and the number of users online at the same time in the experiment is 10, 20, 30, 50, 100 and 200 respectively. Under different platform load pressures, the operation data of the background of the platform is retrieved, and the time consumed by students' homework upload is observed. In order to ensure the uniqueness of experimental variables, the file size and content of students' uploaded homework are the same. The performance test results obtained through data statistics and comparison are shown in Table 5.

<table>
<thead>
<tr>
<th>Number of concurrent users / person</th>
<th>Method 1 time overhead/s</th>
<th>Method 2 time overhead/s</th>
<th>Method 3 time overhead/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2.8</td>
<td>3.3</td>
<td>3.2</td>
</tr>
<tr>
<td>20</td>
<td>5.6</td>
<td>7.2</td>
<td>6.6</td>
</tr>
<tr>
<td>30</td>
<td>8.5</td>
<td>11.4</td>
<td>10.2</td>
</tr>
<tr>
<td>50</td>
<td>14.3</td>
<td>21.4</td>
<td>18.5</td>
</tr>
<tr>
<td>100</td>
<td>28.6</td>
<td>39.3</td>
<td>36.7</td>
</tr>
<tr>
<td>200</td>
<td>57.1</td>
<td>75.5</td>
<td>69.3</td>
</tr>
</tbody>
</table>

It can be seen from the data in Table 5 that with the gradual increase of the number of concurrent users in the platform, the average time overhead of function operation gradually increases, in which the average time overhead of method 2 and method 3 is 26.35s and 24.08s respectively, while the average time overhead of method 1 is 19.48s, that is, the design platform has more advantages in operation performance.
4.4 Experimental results and analysis of signal conversion rate

The signal conversion rate is regarded as the execution of remote communication signal processing task. One computer is set as the server and another computer is selected as the client. During the experiment, the three methods are carried to the server and client respectively. Because the signal transmission, reception and conversion are closely related to the platform hardware and cannot be displayed by the platform itself, the third-party software is used to monitor the change of remote communication signal of the teaching platform during operation and output it in real time. After statistics, the experimental results are shown in Fig. 5.

According to the experimental results of connecting signal conversion rate of each teaching platform shown in Fig. 5, among the three groups of experimental results, there is an obvious downward trend in the signal conversion rate between 30s and 40s during the operation of method 2 and method 3. Within the effective experimental time, the signal conversion rate is low and does not achieve the ideal effect; In the experimental results of method 1, the signal conversion rate of remote connection always keeps increasing in the effective experimental time, which shows that the platform can realize stable communication connection in a short time and has higher application efficiency.

4.5 Marking function test

The score of the test paper is described as one of the three functions of the interactive test paper marking platform, and the correct scores are given by the teacher in the practice of the test paper marking function, and the scores are given respectively.

According to the analysis of Fig. 6, the score difference between method 1 and manual marking is mostly within 4 points, the score difference between method 2 and manual marking is mostly between 3 and 8 points, and the score difference between method 3 and manual marking is mostly between 5 and 10 points, which shows that the platform of this paper has high fairness.

5 Conclusion

At present, the information age marked by multimedia has become a powerful supporting technology for the revolutionary reform of pedagogy. People pay more and more attention to the advantages of distance teaching based on artificial intelligence network. The complexity and concurrency of distance teaching system and the personalized characteristics of teaching are very suitable for artificial intelligence technology. This research applies wireless sensor network to the design of Japanese teaching platform, which greatly improves the application effect of the Japanese teaching platform and provides a certain reference for professional Japanese teaching.
Data Availability

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

Funding

This work supported by Research project of Humanities and Social Sciences of Jiangxi University of Science and Technology "Investigation on standardization of Japanese Public Signs in Jiangxi Red Tourist Attractions and Countermeasures" (RW1914); Education and Teaching Research Project of Jiangxi University of Science and Technology "Exploration of the Practical and Interesting Teaching Methods of Second Foreign Language Japanese" (JY1715); The Survey and Research on the Connotative Development Level of Private Colleges in Jiangxi Province (CANFZG21125)

References


Figures
Figure 1

Topology of wireless sensor network of interactive Japanese teaching platform
Figure 2

Crystal oscillator circuit diagram of the platform

Figure 3

Functional block diagram of Japanese teaching platform software
Figure 4

I/O performance of different methods
Figure 4 Peak signal-to-noise ratio of three methods

Figure 5
Figure 5 Experimental results of signal conversion rate of remote connection on different teaching platforms

Figure 6
Figure 6 Test of marking function on different platforms

Figure 7

(a) Method 1

(b) Method 2

(c) Method 3