Design and Internet of Things Development of Network Teaching Resource Base System for Educational Technology

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Abstract. With the deepening of the application of Internet of Things in education, its role in promoting education and teaching has become increasingly obvious, but the corresponding is that the application of Internet of Things in education has remained in the experimental stage, and can not be applied on a large scale. Therefore, according to the characteristics of the educational application of the Internet of Things, this paper designs and completes a new educational resource database management system of the Internet of Things. The system consists of three parts: the core layer, the access layer and the performance layer. It has good expansibility and shields the complexity of the Internet of Things technology, and meets the needs of ordinary teachers and students to rapidly develop the educational application of the Internet of Things. The research results show that through the analysis of the status quo of network teaching in colleges and universities, a web-based intra-campus network teaching system software platform is established to solve the problems in higher education. At the same time, the experimental system also helps the experimenter to deeply study the basic technology of the Internet of Things.

Keywords. Network teaching, Resource library system, Internet of things

1. Introduction
The Internet of Things refers to the use of information-sensing devices such as radio frequency identification devices, global positioning systems, infrared sensors, and laser scanners to connect items to the Internet in accordance with agreed protocols for information exchange and communication to achieve intelligent identification. A form of network that locates, tracks, monitors, and manages [1]. The Internet of Things is the extension and expansion of the Internet to the physical world. The Internet of Things uses the Internet as a platform to construct an information network with perceptual functions using radio frequency technology and sensor communication technology to realize intelligent identification and management of objects and objects [2]. With the continuous development of the Internet of Things technology and the continuous deepening of the application research of the Internet of Things, the role of the Internet of Things in promoting education has become increasingly apparent. Especially the campus one-card project based on RFID has given a lot of technical support to the improvement of management level, which has become the necessary content of current education informatization, that is to say, the application of Internet of Things education management has been basically popularized [3]. In order to meet the needs of talent cultivation in higher education...
and realize the overall reform of higher education, it is an effective teaching method to use intramural network in teaching. It is also the only way to change traditional teaching methods and improve teaching quality [4,5].

In order to enable the students majoring in communication, information, electronics, computer, automatic control and sensor technology to understand the principles, implementation methods and typical applications of the Internet of Things, this paper designs and implements an Internet of Things teaching experiment system [6]. Starting from the basic technology of the Internet of Things, this system designs the basic architecture of the Internet of Things system based on wireless sensor network and radio frequency identification technology, and realizes the application cases of the Internet of Things in intelligent logistics, smart home and smart medical care [7]. In 2013, the research on the design of university resource sharing network teaching system based on cloud computing was put forward [8]. Subsequently, relevant scholars have studied the development and design of network teaching resources [9]. The use of Internet of Things technology for classroom experimental teaching and extracurricular inquiry learning (such as physical chemistry experiments, field environment surveys, etc.) is one of the important applications [10]. The Internet of Things based on wireless sensor technology can realize the change of exploratory experimental methods and the repeated use of experimental materials; for the experiments with high risk and long distance, it can effectively protect students' safety. With the development of computer technology and Internet of Things technology, it provides an opportunity to build a new learning environment with virtual and real integration [11,12].

On the basis of actively learning the predecessors' evaluation of online learning, it analyzes and mines relevant beneficial results, and summarizes the strategies of online learning evaluation, including evaluation requirements, content, tools, feedback, etc [13]. Incorporating the "Internet of Things" technology while reforming the traditional teaching mode, the introduction of the Internet of Things technology has established a new networked, digital and intelligent teaching model for traditional teaching reform [14]. This evaluation system can not only collect virtual learning information, but also obtain students in the experimental process through the transmission terminal in the Internet of Things [15]. Due to the essential difference between the educational resources of the Internet of Things and the traditional static multimedia resources, it has the characteristics of diversity of data sources, dynamic persistence of data stream reception, geographical and timeliness of data, complexity of data security maintenance, etc [16, 17]. Therefore, the education resource database system of the Internet of Things can not directly use the traditional education resource database system, but needs to be redeveloped to meet the needs of the new education application model of the Internet of Things [18]. As a supplement to the traditional face-to-face teaching, network teaching can solve the problems of students' buried in copying blackboard books in class, lack of self-study resources, inconvenient communication after class, and is more easily accepted by teachers and students [19].

2. Methodology
The Internet of Things (IOT) is a concept emerging with the development of radio frequency technology and sensing technology in recent years. It refers to the connection of any item with the Internet through radio frequency identification devices, infrared sensors, global positioning systems, laser scanners and other information sensing devices, according to the agreed agreement, for information exchange and communication, in order to achieve intelligent identification, location, tracking, monitoring and communication. Managed network [20]. For educational institutions, on the one hand, inquiry learning is an important measure of basic education reform in China. The activities can be welcomed and supported by educational decision makers, educators, teachers and students, as well as by education funds. On the other hand, the combination of educational concepts and information technology can better exert the application mode of educational benefits and promote the occurrence of effective teaching and learning [21]. Each experimental device is embedded with digital attributes and use help information, which can greatly improve the experimental results, and automatically issue an alarm when the experimental equipment is used improperly. Thereby reducing
unnecessary damage to instruments and equipment, and achieving digital, networked and intelligent experiment learning.

The two-way goal in teaching is also the general principle of test paper design. When designing a test paper, the two-way goal is expressed concretely as a two-way detailed list of tests. It is the "blueprint" for compiling the test. Teachers should put forward the scope of examination content and the total amount of questions. According to the relevant attributes of the two-way detailed list and the question bank, computers can select different objectives, different difficulties and different contents of the questions. Objective: To organize a paper with reasonable distribution. Table 1 and Figure 1 below are examples of two-way goals.

| Knowledge point                      | Number of items | Percentage (%) |
|--------------------------------------|-----------------|----------------|
| Force category                       | 24              | 13.67          |
| Evolution of the concept of force    | 20              | 10.69          |

Figure 1. "Mechanics" test two-way detail

How to ensure that the generated test papers can meet the different needs of students to the greatest extent, and have randomness, scientificity and rationality, and selecting an efficient, scientific and robust algorithm is the key to automatic test paper generation. In the school network teaching system, a variety of algorithms are combined to achieve the automatic test and exercise system. Questions are classified according to difficulty and the ratio of each difficulty is listed in Table 2 and Figure 2.

| Extraction ratio (%) | Degree of difficulty |
|----------------------|----------------------|
| 35                   | 0.89                 |
| 25                   | 0.71                 |

Figure 2. Classification by topic difficulty and extraction ratio of each difficulty topic

Through the analysis of the typical project of IOT education application, it can be concluded that the current general mode of IOT education application includes the following main links: determining
the application field, that is, determining which aspects of the teaching effect will be improved by using the Internet of Things technology. It can be in terms of competence, such as the ability to improve students' comprehensive use of information to make reasonable inferences and scientific conclusions. The entire IOT education resource library system adopts a layered design, and in a large aspect, it consists of an access layer, a core layer, and a presentation layer. For the more complex core layer, a layered design is used in its interior. Each layer is invoked through a predefined interface. As long as the interface remains unchanged, each layer can be independently developed and deployed to ensure the maximum scalability of the system. The combination of functional collective organizations is accomplished by setting permissions. According to the different function sets, the system is divided into four main modules and several sub-modules to design step by step. Thus, it provides an interface between schools and the outside world for mutual communication and mutual perception.

In network teaching, learning evaluation information is mainly collected from students’ daily learning activities. Construct the hierarchical model of network learning evaluation. The hierarchical model of learning evaluation is constructed, as shown in Table 3 and Figure 3.

### Table 3. Learning evaluation hierarchy model

| Learning attitude | Online test times | Total time of study (h) |
|-------------------|-------------------|------------------------|
| General           | 87                | 5                      |
| Good              | 83                | 3                      |

### Figure 3. Learning evaluation hierarchy model

The node layer is composed of a wireless sensor node, a wireless relay node, and a wireless gateway, and forms a wireless network through a repeater or a router to collect, process, and transmit data. The wireless sensor node is composed of various types of wireless sensors, large-capacity battery packs, high-gain antennas, etc. and is responsible for generating and transmitting sensor data. The wireless relay node is responsible for relaying the data. The community self-service health care station based on the Internet of Things is constructed to identify the identity of the key monitoring objects in the community by RFID technology, collect the physical signs through the Internet of Things, remind the abnormal indicators and notify the community doctors to take treatment measures. Users of this system include administrators, teachers and students, which have different rights. The system is based on B/S structure. As long as the client can access the Internet, it can log in and use the system. Therefore, the design of the system only aims at the design of the server side of the Web server and the server side of the back-end database. It consists of two parts: the front-end user page and the back-end management.

### 3. Result analysis and discussion

The development of the whole Internet of Things educational resource database involves all aspects from the bottom embedded development to the top Web interface development. It is a huge system engineering. But the author believes that besides the core software architecture, we should also do a
good job in the development of the three aspects of Internet of Things resources: input, storage and use. In the initial stage of the application of multimedia education, multimedia courseware is the main form. Basically, it first determines the application field, then begins to design materials, then develops courseware, and finally implements the teaching process. Obviously, the limitations of the initial application mode of multimedia education are consistent with the limitations of the current IOT education application model. After the initial stage, the multimedia education application quickly transitioned to the stage of multimedia education application mode with the educational resource library as the core. In addition, the evaluation index system starts from the learning activities of students from various angles, and is divided into index modules of learning attitude, learning effect, interaction ability, practical ability and resource utilization ability according to the students' online learning process. This indicator system is in line with the characteristics of current college students' learning, and is characterized by scientificity, typicality and strong feasibility.

The field content in the student table is much more than the teacher table. It is the same as the teacher table. The student ID must correspond to the student ID number. All other fields must belong to these two fields. Other fields can be added or changed. But this is an important link between teachers and students, and there must be no mistakes. The directivity of students in choosing courses must be unique, especially when different teachers teach the same course. This requires that the data configuration of teacher ID in the curriculum must be accurate. The following Table 4 and Figure 4 are the structural components of the network teaching resource database system.

### Table 4. Structural components of the network teaching resource library system

| Field       | Number of fields | Field length |
|-------------|------------------|--------------|
| Teacher     | 23               | 9            |
| E-learning  | 18               | 6            |

![Figure 4. Structural components of the network teaching resource library system](image)

The set with x types of questions is recorded as: w, the total score of the y type in the test paper is: d, and the reference time of the x question type in the test paper is: w, then:

\[
g_{c} \cdot d \cdot w(x, y, d) = \exp \left( -\left( \frac{d_{e}}{r_{e}} + \frac{d_{c}}{r_{c}} \right) \right)
\]

(1)

Generally, the number of questions under the x type of the test paper is: n, so that the fraction of each question in the x type can be obtained. Assume that the scores of each item are equal under each item type:

\[E(x) = \sum_{x=1}^{n} E_{i}
\]

(2)

Or, in turn, give a small score for each question in the x question type in the test paper:
Set the difficulty level set to: Di, we expect the total score of the i difficulty level: u, then the relationship with the full value is:

\[ D_i = a + \sum_{j=1}^{N} b_j p_j + r_j Y + u \] (4)

Let the set of scopes be: Y. We expect that the n scopes can be divided into: Di, and the relationship between the n scopes and the full score is as follows:

\[ D_i = a + \sum_{j=1}^{n} b_j \ln(p_j) + r_j \ln(Y) + u \] (5)

Assuming that the set of competency levels is: a, we expect the total score of the first competency level to be: Y, then the relationship between the total score and the full score is as follows:

\[ \ln(D_i) = a + \sum_{j=1}^{n} b_j \ln(p_j) + r_j \ln(Y) + u \] (6)

Modern education requires that while giving students knowledge, students’ abilities should be trained. Giving knowledge is the means and cultivating abilities is the goal. This constitutes the two-way goal of modern education, as shown in Figure 5. Therefore, when designing test papers, it is necessary to examine not only students’ knowledge but also their abilities.

![Bidirectional target map](image)

**Figure 5.** Bidirectional target map

According to the subject of research study and the progress of user learning, the system may be interested in users, other users are interested or scored high, the number of views is many, the best resources in the same field or the best resources in similar fields are pushed to the user, so that Quickly realize the co-construction and sharing of resources, embodying the idea that “using user interaction data can create great value”. RFID is an important part of the Internet of Things technology. Its main function is to equip each person or object with a unique identity code to identify all people and objects. In each application case of this system, RFID is used to identify objects and persons respectively to verify their legitimacy. Teacher module has the functions of courseware making and courseware management, uploading and managing the courseware of the course taught, assigning and correcting the homework, communicating with students online to answer students’ questions, submitting exercises and test questions after class, marking papers online, grade management, question bank management, personal information and teaching course management.

Generally, the gradient descent method adopts the extended R rule. In view of the fact that the search direction of the second iteration of the algorithm must be orthogonal, the characteristic function of the neuron proposed by W for its algorithm must be derivable, as follows:

\[ D(p_i) = A \frac{m(1-r)}{p_i} \] (7)
When setting an input node to be A, the implicit node is m, and the output node is Qt neural network, the resulting result will produce a matrix:

\[
A_t = \frac{(I + Q) + (I - Q - D)}{2} = I + Q - \frac{D}{2}
\]  

(8)

For all samples, the weighted value matrix w is used to infer the sum of the errors and errors that express the output of each sample. Here, the error formed by each sample is expressed as:

\[
w(t) = w_2 + \left( w_1 - w_2 \right) \frac{T - t}{T}
\]  

(9)

Among them, n is the output of the calculated data, K is the output of the sample, and the sum of the output errors of the final sample of ej is:

\[
e_j = -k \sum_{i=1}^{n} f_i \ln f_i
\]  

(10)

Analysis of the training curve in Figure 6 shows that the convergence speed of the neural network is faster than that of the previous network curve. The convergence speed and efficiency of the neural network can be increased by nearly 28.63% and the convergence stability is higher. The accuracy of sample analysis can be close to 98.74%.

\[\text{Figure 6. Schematic diagram of error convergence curve}\]

Considering the technical characteristics of the Internet of Things, it is common for the same data to be read multiple times or incorrect data to be read. The application must filter out invalid data as much as possible. Of course, full filtering is impossible. The application model of the Internet of Things education will also experience a similar growth cycle. With the development of technology and the popularity of applications, the application model of the Internet of Things education will also develop into the application stage with the educational resource library as the core, but the impact of the inherent characteristics of networked resources (data generated by IOT devices). In order to effectively realize the evaluation of students' learning process, Web data mining technology and online analytical processing technology are used to analyze and deal with each learning behavior of students in the network. Based on the evaluation system, a more objective and comprehensive evaluation result of students' online learning is obtained, so as to improve the efficiency of learning evaluation. At the same time, in order to prevent students from information lost in the process of inquiry, personalized resource push strategy is designed for the internal resources of the platform to help students quickly get the resources they need.

4. Conclusions
This paper presents a general scheme of the teaching experiment system of the Internet of Things, designs the application cases of the system applied to intelligent logistics, intelligent home and intelligent medical care, and realizes the software and hardware of the system. This system covers the key technologies of the Internet of Things, such as RFID, sensors, etc. Through this experimental system, students can learn the technology of the Internet of Things in depth. It is also envisaged that
the resources of the Internet of Things can be reused conveniently through the courseware of Internet of Things education application based on this. Of course, the successful popularization of this solution is based on the number of resources in the Internet of Things education resource database and the corresponding courseware. However, how to use the Internet of Things to organically combine more evaluations of learning links, making the evaluation results more scientific, objective, accurate, and more convincing, and further research is needed. The emergence of this model will be inevitable. The sooner we start research and construction, and complete the corresponding standardization work, we can produce irreplaceable application value at the lower cost of education. In the follow-up study, we will put the theory into practice.

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