Research on Key Technologies of Equipment IETM

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Abstract. The development of equipment IETM is a complex project because of the difficulties in data and interaction technologies. The paper comprehensively applies computer technology to research data of equipment IETM. The conceptual data model was established. Data identification and storage were studied, and data programming was studied. Advanced human-computer interaction is applied to equipment IETM. The interactive interface of IETM is designed. Data interaction technology was studied, which provides effective basis for the development of the Equipment IETM.

Introduction

The structure of new equipment is very complex, and there are huge amounts of data on the use of equipment, maintenance data, and circuit data. There are many problems in the technical Information design, production, update, use, maintenance, management, teaching and training stage. In order to solve the above troubles, equipment IETM was developed. At this stage, the equipment IETM system is in a preliminary research stage, and there are many difficulties in key technologies such as data programming and interactive technologies [1]. The paper combines advanced computer technology, which is applied to equipment IETM system, in order to ensure the advanced nature of IETM. The paper proposes a research program for key technologies of equipment IETM.

IETM Theoretical Analysis

The S1000D standard version was updated quickly to meet the equipment support requirements. The S1000D standard can be used for both military and civilian, and the technology is versatile. In Europe, IETM is being developed using the S1000D standard. According to the S1000D standard, the United States developed IETM for F17-A aircraft, IETM for Global Haw drones, and IETM for Boeing787. With the continuous development and updating of the S1000D standard, it can meet the needs of various fields, industries, and different equipment. It will become an international IETM standard in the future.

Key technologies of IETM include standardized technologies, ExtendSible markup language (XML), CSDB technology, and interactive technologies. Papers to write technical information and establish data modules, in order to improve the standardization, versatility and sharing of data. Data content is written in XML for enhanced data extensibility and interoperability. The data is stored and managed by CSDB in order to reduce redundancy and increase sharing. According to the S1000D standard, all aspects of data flow is uniformly set in order to improve data sharing. Interactivity has strong expressiveness and can improve learning efficiency.

Research on Equipment IETM Data

Data Analysis

The data module (DM) is the smallest unit of information in IETM. The composition of the DM is shown in Figure 1. The DM is composed of IDSTATUS part and content part. IDSTATUS part includes data module identification, address, security level, cooperation responsibility, and applicability. The content part represents the main part of equipment technical information.
The data information in the equipment IETM is divided into personnel information, composition information, operation information, function information, principle information, fault information, and maintenance information. This information can be summarized as text and non-text classes \cite{2}. Text classes include data that exists as text. Non-text categories are data in the form of illustrations and multimedia. This information is represented by a conceptual data model. The conceptual data model represents basic attributes such as equipment and personnel. The conceptual data model of a certain equipment is shown in Figure 2. A user’s conceptual data model is shown in Figure 3.

**Data of Equipment Identification and Display**

XML is used to define data identifiers. The data identifier transmits instruction information instead of the content entity. Identification is the marking of DMC and PMC. The identifier includes content data module code, data module name, version number, release date and language. As shown in Figure 4.
XML includes Cascading Style Sheet (CSS) and eXtensible Style Language (XSL) display control tools. CSS is a markup language for web page layout. All its information is in plain text. CSS can separate formatting information and text from documents. XSL is a rule which, proposed specifically for the style of XML documents. XSL is an XML application formed by XML language. The XSL processor formats the data of the XML document. XML documents are displayed according to XSL regulations.

XML has three data storage methods. XML is stored directly as an XML document. XML source database was developed. XML is stored in a relational database. Among these three methods, the relational database technology is mature, the application scope is wide, and storage is standardized. Therefore, the XML relational database is used for IETM data storage. The XML relational database stores data in two-dimensional tables. Relational database manages the storage of XML data through the mapping layer. Data module identifier (text ID) is a unique identifier. The content part (XML document) is stored as a whole in a two-dimensional table. The text data map is shot into a relational database table. As shown in table 1.

Table 1. Table text data is converted to a relational database.

<table>
<thead>
<tr>
<th>Field name</th>
<th>type of data</th>
<th>primary key</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text ID</td>
<td>CHAR(50)</td>
<td>Yes</td>
<td>ID Status</td>
</tr>
<tr>
<td>Content</td>
<td>XML</td>
<td>No</td>
<td>Text is stored in an XML field, in the form of an XML document.</td>
</tr>
</tbody>
</table>

**Data Programming**

In the process of data storage, delivery, processing, and publishing, XML is used to describe data. XML can enhance data sharing and versatility. This article studies XML data structures and programming methods. Then the XML data is stored in the database. The XML data structure is a hierarchical model of a tree structure. In the model, each node represents a record type[3]. The lines between nodes indicate the links between records. The content of an XML document consists of a preamble, a main body, and a tail. The preamble is the first part of the document, which contains declarations, processing instructions, comments. The body is the part of the document that stores data. The tail is the end of the document.

In XML documents, fragments are entities. Each entity has a unique name. In the XML document, the content of the entity is replaced by the name. The entity name is replaced by the content of the entity. Entities include internal entities and external entities. The definition of the entity is as follows.
For example, internal entities are defined.

```
<!DOCTYPE filename[
<!ENTITY entity-name" entity- content”>
]
```

External entities are defined.

```
<!ENTITY entity SYSTEM “entity_ URL”>
```

Interactive Technology Research

**Advanced Human-Computer Interaction Technology Is Applied**

IETM can be used on desktop computers, tablets, wearable computers, and embedded computers. The user can select the IETM platform according to the task needs. By applying advanced speech recognition technology, the user only needs to say what to do, and IETM executes the corresponding command, thus freeing the user's hands. Voiceprint recognition technology is applied to IETM data security. Because everyone's voice print is different, only pre-defined users can pass IETM certification. And according to each person's position, technology, level, the user's permissions is also different. It increases the security of IETM. Virtual simulation technology is used to create a virtual 3D environment. The equipment is built into a simulation model. The user interacts with the virtual environment through visual, auditory, and tactile sensors, who wear a wearable computer such as a helmet display or data glove. They are immersed in the virtual environment to perform equipment support tasks. Advanced somatosensory technology is applied. IETM executes commands by detecting user actions. The user's limb interacts directly with the virtual environment, creating an immersive feeling. These advanced technologies can improve training results and save training costs.

IETM interactivity is to provide the basic principles of equipment, using operations, maintenance, and other information through human-computer interaction. Human-computer interaction is in line with human cognitive psychology, which is easy to learn and understand. The key technologies of human-computer interaction include the design of human-computer interaction interface and obtaining interactive information. The interaction process includes the user operating the IETM through the input device. The interactive process is that the user operates the IETM through the input device to issue an access request to the IETM. Then the data in the common source database is called. The internal data is referenced, or the external system is integrated through interaction information organization. Information is output to the interactive function interface to complete the human-computer interaction process.

**IETM Interactive Interface Was Studied**

IETM interface design can meet people's perception, understanding, but also to meet the task requirements, such as use, maintenance and so on. The interactive display interface includes basic display elements and auxiliary display elements. The display requirements for specific information are studied, such as description information, failure information, and part information. Because the IETM browse package is loaded into the web browser, the IETM interactive interface has functions such as search, list, help, and authorization. IETM display interface is more complete and convenient to use, as shown in Figure 5.
Data Interaction Was Studied

In order to meet the equipment support requirements, IETM began to integrate more functions and other systems. IETM integrates the databases used in the equipment design phase, production phase, and use phase. IETM interacts with these databases. Data interactions are conducted in IETM and these databases, and therefore IETM can effectively use equipment life cycle information. IETM can connect external information devices, for example, training simulators, auxiliary equipment supply systems, equipment management systems, remote technical processing systems, digital libraries and other systems. Data can be passed between these systems and IETM for information sharing. Data interaction improves the level of equipment support.

IETM data interaction is the process of identifying and referencing data modules. Users are directed to other documents or other locations in the same document, by data references. The principle of interaction between data is that there are cross-references between different data units, which is the connection from one data module inside to another data module. For example, the value of internalRef is par-01. The value of RefTargetType is irtt02. Internal Ref is assigned to Ref TargetType. The quoting procedure is as follows.

<para>

<internalRef internalRefid="par-01" internal-RefTargetType="irtt02"/>

</para>

With the development of equipment support to the network, information is exchanged between numerous devices. IETM wants to connect with other devices for information exchange. The interaction framework is shown in Figure 6.
Summary

Equipment IETM can solve many problems that exist in the traditional equipment support. Paper studies the key technologies in the development of equipment IETM. Equipment data is modeled and then XML is used for data identification, storage, and display methods. The data model is programmed in XML. The paper designs friendly human-computer interaction functions, in order that data information can be displayed to the user in a variety of ways. The paper sets up reference links for data interaction, so that the data can be easily invoked both inside and outside the system. The innovation of the paper is that the first comprehensive study the plan of interactive technology of equipment IETM. The paper not only improves the human-computer interaction environment, but also improves data interaction efficiency. Research shows that the research plan of the paper is effective and feasible, so as to provide theoretical basis for the development of the equipment IETM.

References