Data Validation for Interactive Electronic Technical Manuals

Jia-ju WU¹*, Gong-liang LI¹,², Zheng CHENG¹, Li-rong MENG¹ and Yong-qi MA¹

¹China Academy of Engineering Physics, Institute of Computer Application, Mianyang Sichuan, 621999 P.R. China
²College of Computer Science, Sichuan University, Chengdu, Sichuan, 610065 P.R. China
*Corresponding author

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Abstract. The interactive electronic technical manual (IETM) is an important component of equipment integrated support informatization. The army requires that the interactive electronic technical manuals delivered by the equipment manufacturer need to comply with the relevant standards and specifications. On the basis of analyzing the standards and standards of interactive electronic technical manual, this paper puts forward IETM data model which is used XML schema. Based on the IETM data model, data validation principles are got in paper. Then this paper gives the implementation of IETM data validation software tool, and describes the application of software. The application proves that the software can support the compilation of manual data module, data exchange and verification of specifications in the process of manual delivery.

Introduction

Interactive electronic technical manual (IETM) [1] is stored in digital form, using text, graphics, tables, audio and video form, technical publications provide basic principle and equipment by means of man-machine interaction operation and maintenance content. IETM, as an important support resource for field level maintenance of weapon equipment, is characterized by interactivity, technical manuals, data interoperability and sharing. In order to play the role of IETM interoperability and compatibility, international organizations to develop a series of IETM standard [2] in order to allow the system to exchange information platform.

The United States Department of defense has formulated the IETM military standard system (short for American military standard), has: MIL-DTL-87268C [3], MIL-DTL-87269C, [4], MIL-HDBK-511[5]. The American Aerospace Industry Association (AIA), the European aerospace and Defense Industries Association (ASD), the American Transportation Association (ATA), and the European Defense Department jointly developed the S1000D standard [6]. Our country published the interactive electronic technical manual, military standard GJB6600 [7] in 2008. GJB6600 standard is the technical text that standardizes China's military enterprises IETM development. The GJB6600 standard is based on the S1000D standard and combines several other standards. The army requires the equipment to be delivered by the developer to meet the relevant standards. Therefore, standard verification is required during the IETM fabrication and delivery acceptance process in IETM. In order to ensure the information commonality and interoperability, most IETM standards recommend the use of extensible markup language (XML) to describe, processing, storage and display of information equipment.

XML Schema

XML Schema and DTD are two methods of data modeling and description. XML Schema has the following advantages over DTD:
1) XML Schema is an open model of content, extensible, while DTD is a content closed model with poor scalability.

2) XML Schema supports rich data types that can fully meet the needs of network applications, especially e-commerce, while DTD does not support data types of elements, and the type definition for attributes is also limited.

3) XML Schema supports namespace mechanisms; on the contrary, DTD does not support it; XML Schema can verify the entire XML document or document locally for different situations, whereas DTD lacks this flexibility.

4) The syntax of XML Schema follows the XML specification completely. It can be used in combination with DOM technology and is more powerful. And DTD grammar itself is also more difficult to learn.

Therefore, both the S1000D specification and the GJB6600 specification recommend the use of XML Schema for interactive electronic manual data modeling.

**IETM Data Model**

IETM data is based on equipment maintenance and support structure. Its smallest minimum management unit is removable logic unit, which is using standard encoding data encoding identification system. Equipment maintenance support structure SBOM nodes represent equipment subsystem, sub-subsystem, component and part. Equipment structure information code is the association between operation principle, manual instructions, packaging operation, maintenance, disassembly, detection / monitoring, fault diagnosis, training data and equipment structure. The IETM data model is shown in the following figure.

![Equipment structure-based IETM data model](image)

According to the IETM’s relevant international standards S1000D [7] and GJB GJB6600[7], the information resource planning technology is used to abstract classification equipment technical data, which includes the description, procedure, fault, maintenance plan, operation, illustrated & parts, wiring and process data information [6, 7]… and so on. The description data model is described with XML like following figures.
IETM Data Validation

IETM data validation is mainly for the IETM manual data files and data model structure and compliance verification rules. The verification principle is shown in the following figure:
First of all, we need to carry out the structural seal test of IETM manual data. After manual data structure verification complete to the Sealing property test, we will be the data structure of the manual data and the corresponding Schema data model for detection, judgment whether they are completely isomorphic tree structure. Finally, the JDOM [8] technology is used to read the nodes of the Schema document tree and the XML document tree to determine whether the nodes of the XML document tree conform to the rules defined by each of the Schema document nodes corresponding to them. Specifically, validation consists of type definition, component validation, group component validation, and property group component validation. IETM data verification software can successfully verify the manual data documents to be verified, and realize the rules based on Schema documents. To satisfy the closeness and isomorphism, the verification software can judge and point out the error information of the XML document and locate it. IETM data validation algorithm is showing in another paper.

**IETM Data Validation Software Realization**

The interactive electronic manual data validation process is:

1) open the already compiled XML document, and then enter the Schema document, since multiple XML documents can share the same Schema document rule, so the Schema document can be kept the default last time entered.

2) verify the validation after the input is completed, and the background will first verify the closeness of the XML document;

3) the closeness test verifies whether the XML document is completely isomorphic to the Schema document;

4) the structure is validated, and then the document is verified by Schema based on the data of the XML. If there is one of the two tests, the document can not be detected.

5) returns the validation result after passing, including the cause of the error and the location of the error.

The interactive electronic manual data verification tools are implemented by using J2EE MVC technology architecture, Java and JavaScript programming language, and JDOM and JAXP parsing techniques. In implementation, we encapsulate the IETM validation software as JAR packages for other function calls. Interactive electronic technical manuals, editing, data exchange, publishing, reading, loading process calls, validation of jar packages, verification and validation of manual data. Manual verification software can also be used for the validation of the interactive electronic manual delivery process.
Conclusions
Based on the analysis of the specifications and data characteristics of the interactive electronic technical manual, this paper presents the data model of the manual and the verification principle of the data. Using J2EE MVC technology architecture, Java and JavaScript programming language, JDOM and JAXP parsing technology to achieve data validation tools, packaged as Jar package. The use of data as a tool for the production, data interchange and delivery process of interactive electronic manuals.

References
[7] GJB6600.1-2008, an interactive electronic technology manual, [S], was released in October 1, 2008 and implemented in December 1st.