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Research on Fiber Optic Gyroscope Test Data Management System

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Abstract

FOG is a new type of angular velocity transducer; it is widely used in aviation, aerospace, marine and other fields. During FOG R & D, the test work costs long time, there are many test data in FOG life cycle, including structured data and unstructured data. This paper analyzed the FOG R & D process, and classified the test data. The paper also analyzed the test data management requirements and pointed out the main problems in the test data management. Based on this, test data management methods and test data management system architecture are given in this paper. Finally, a test data management system with B /S structure is developed.

Keywords*: test data management, fiber optic gyroscope, product testing, test data management system*

1. Introduction

Technical analysis activities (mainly refers to the simulation and testing) are important throughout the product lifecycle. Through technical analysis, you can fully understand the dynamic and static performance of products and the defects that may exist be exposed and addressed as soon as possible, it can reduce risk, reduce time and financial costs and improve product quality. Product quality has become a common concern issue of the modern industrial society and the national economic construction [1]. Product quality control should be reflected in the product life cycle. But the PLM-related theories are generally focused on product design data and ignored the management of product test data. Test data in the enterprise are basically in the form of a document of decentralized management, they lack of uniform maintenance mechanisms, and because of the wide range of data, the format is not uniform, storage and reuse are very difficult, data security is also difficult to protect. Obviously, this confusion of test data management (TDM) status quo cannot meet the current FOG development, and manufacturing agility and collaboration trend, it is becoming the new bottleneck that affect the efficiency of their business. So, product quality control should consider how to manage the test data [2, 3].

China has paid great attention to the study of FOG technology. Beijing University of Aeronautics and Astronautics, Beijing Institute of Technology, Tsinghua University, Zhejiang University and so have been carrying out FOG technology research and development [4]. But test data collection methods of FOG are not advanced. The collection frequency is not high, and the management of test data lack of the support of test data information management platform. Test data acquisition is low efficiency and error-prone, which results in a slow, heavy workload and long cycle work of FOG R & D [5].Products and components' test data can't be effectively and timely feedback to the design, purchasing, and manufacturing department, so the problem can't receive timely treatment. Foreign state-of-the-art FOG companies, such as Honeywell International Inc. in the United States, Japan Aviation Electronics Industry (JAE), the Photonetics of France and Germany SEL Company, they all take full advantage of information technology in FOG product R & D and test data management, which greatly improved the ability of FOG R & D [6]. Compared to the foreign developed enterprises about FOG test data management, there is a large gap, so finding a method to manage these test data is particularly urgent.

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2. Test Data Management and Analysis

The test data is divided into two types, structured data and unstructured data. Generally speaking, structured test data contains the original data and engineering data, they can be interchangeable. Unstructured test data contains multimedia data and document data, the documents exist in different formats, and the multimedia data contains audio data and image data. For details, refer to Figure 1.

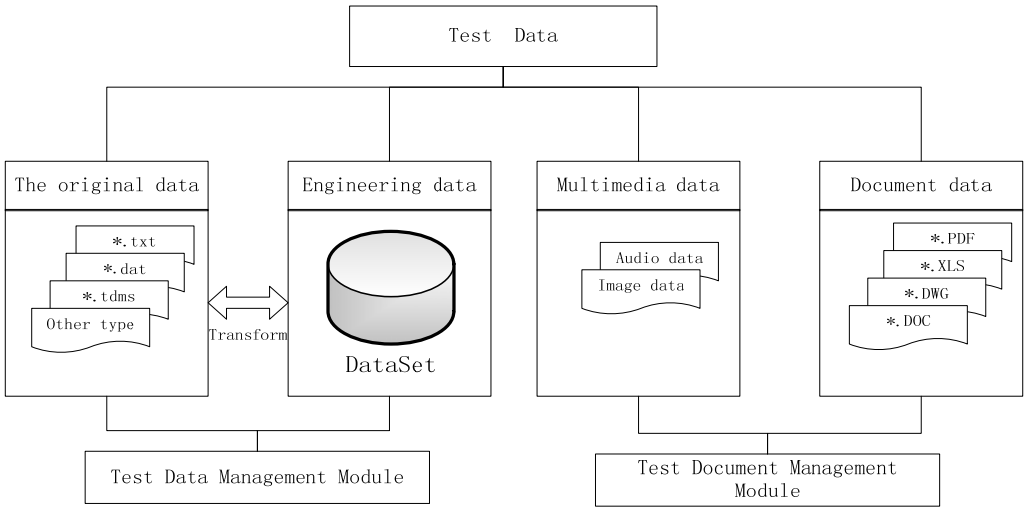

Figure 1. Test data management module

2.1. Structured Test Data Management

The structured data is the main manifestations of the test data. The so-called structured data does not refer to those has been saved to the database, in fact the manifestation of these data is in different file, and the format of these files specification can be easily converted to a binary relation data, as shown in Figure 1. Common sample data file is a typical example: each file consists of multiple lines of data rows; each row of data is divided into a number of indicators, thus forming a two-dimensional matrix form. In practical applications, data may not be the first line of the file, the front there may be some unstructured information such as test time, test instructions and so on. In summary, the management of structured data can be used in two ways:

- Retain the data file
- Parse the data and save to the database system.

The first way in a relatively simple information system or some special applications (such as the data is too large, the users want to save by way of documents) may be adopted. This is because, compared to the relative database systems, file systems are lack of efficient and fine-grained data handling mechanism. It is difficult to read, query, statistics and modify the data in the file, and the transaction processing and access control are also not easy. Only test data stored structured record in the database, the database systems can offer a variety of efficient data processing functions, and give full play to the value of the test data. Software design should take into account many factors, and also have to consider the ease of use. Generally speaking, the TDM structured test data management needs to solve the main problems are as follows:

- How to dynamic maintenance the system metadata structure
- How to implement the automated import of heterogeneous data files
- How to manage vast amounts of data to ensure system performance under the premise
- How to implement fine-grained access control
- How to quickly query and access have been archived data
- How to use the archived test data
- How to customized export data

2.2. Unstructured Test Data Management

In addition to structured data, unstructured data is also important manifestations of the test data, such as a variety of test documents, audio, data, video data, etc., many of the original test instrument output data is also used unstructured file form, as shown in Figure 1. The important features of unstructured data are: the internal structure is not public and the structure is complex, it is difficult to convert two-dimensional relational structure. For the management of unstructured data, we commonly used file index that is unstructured data still stored in document form to the file system, but they will be related to the path and description information which stored in the TDM database, the data synchronize updates.

As opposed to structured data, unstructured data does not require complex analytical and import operations, but this does not represent the management of unstructured data is relatively simple. In fact, the management of unstructured data also needs to address many key issues. For example, check out the documentation needed by the user from a large number of unstructured test document, which require the TDM should be a fast full-text search of unstructured data, and the search results must comply with the relevant permission settings.

Generally speaking, the TDM unstructured technical data management needs to solve the problem as follows:

- How to establish and maintain the organizational structure of unstructured data
- How to associate the unstructured data with structured data
- How to implement the access control of unstructured data
- How to achieve the full-text search of unstructured data in the access control mechanism
- How to use unstructured data which have been archived
- How to ensure synchronization between the database records with the physical file

2.3. The Test Data Analysis and Management of FOG R&D

According to the characteristics of FOG research and development process, test data features are as follows:

- Realistic data is hard to collect and sort
- Storage maintenance costs too much.
- Data distribution is messy, difficult to share and exchange. Due to the diversity of the test data, these data are often difficult to integrate between heterogeneous systems [7].
- A high complexity of computation. The test data can be used to judge the product qualified or unqualified only after they are calculated [8].
- Data is not readily available for reuse [9].
- FOG product R & D and its production process are shown in Figure 2. Before design the test data management system, it is necessary to clarify the FOG development life-cycle [10], FOG testing objects, and the FOG test data classification, etc.

By analyzing FOG R&D processes and related test data, FOG test data classification management methods were proposed. In accordance with the test data types, the structured test data and unstructured test data are shown in Figure 2.

- The structured test data contains FOG dynamic test data, which is the structural features and performance characteristics of the FOG product.
- The unstructured test data refers to the norms, knowledge, technical documents and other unstructured data, which exist in the form of electronic documents.

3. The Basic Structure of Test Data Management System

3.1. Test Data Management System Functional Requirements

FOG test data processing is relatively isolated, dispersed, and lack of standardization. The test data is not fully re-used. There have no deep-level data mining to identify the relationship between the failure reasons of the product and components testing. According to the above, we will establish a test data management system which meets the following requirements.

- Data management in accordance with the process of development
- Data management in accordance with the data classification
- Data information can be shared, data can be efficiently managed
- The data changes frequently, data should be processed timely

- Process raw data to obtain product performance parameters and generate product quality reports
- The system administrator can set a thorough and multi-level permission control policy and security audit mechanism

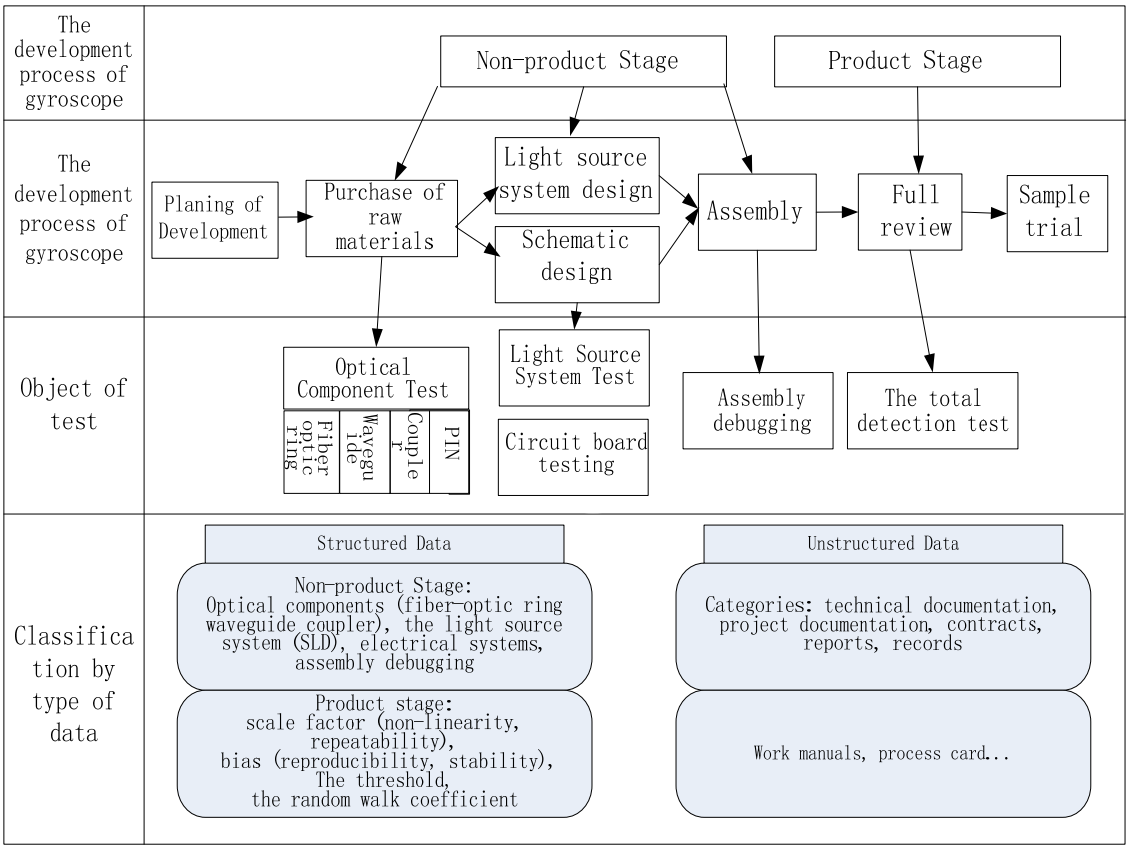

Figure 2. FOG development processes and test data classification

In view of the above requirements, this system adopts B/S mode structure, which is made up of the customer browser and the server software. The system architecture is shown in Figure 3.

The test data management system consists of four layers: the user layer, the application layer, the system management layer and the data layer.

In user layer, application provides the interactive interface. The user interface is displayed in the client browser; the user can make some interrelated operations through the interface.

The application layer covers the main function of the system, and integrates the functions of data input, data output, data querying, document management and report analysis.

System management layer is used to manage the groups, roles, permissions, system anomalies and logs, and it is responsible for managing database access and providing a unified data access interface for the application.

The data layer stores all test data of the FOG products.

3.2. Test Data Management System

3.2.1. Development Platform and Tools

This system is developed based on the Microsoft Share Point platform, the database is SQL Server 2005, this system adopts B / S structure, and the web server is IIS6.0. We use the web part technology for the secondary development, and the Quick Part tools are used to

develop Web Part and then integrate with SharePoint platform. In this system we use SharePoint permissions management mechanism to manage the test data system permissions. Choose C# language and use Microsoft Visual Stuio.NET to develop the system.

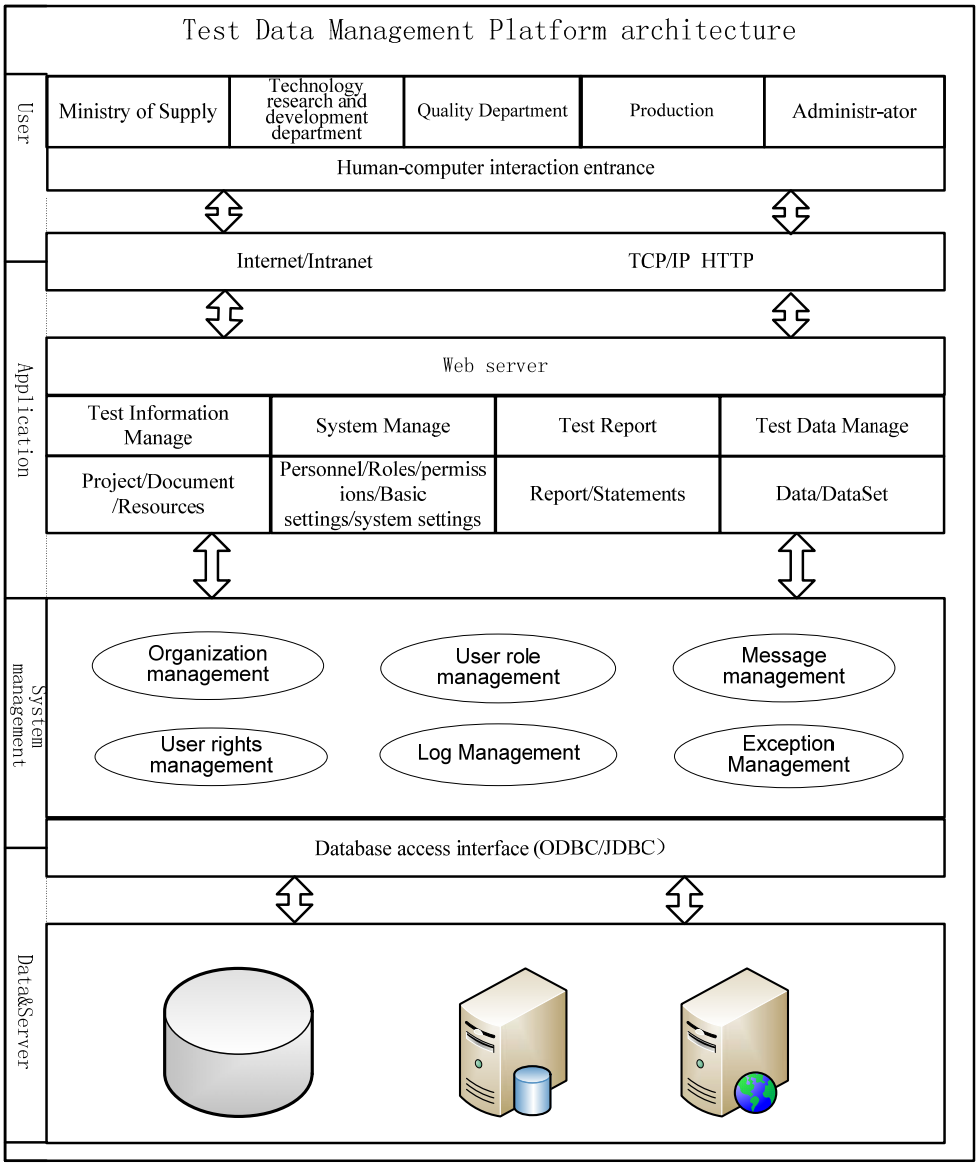

Figure 3. Architecture of test data management system

3.2.2. The System Core Function Design

The FOG test data management system achieves the management of structured data, and unstructured data. The structured data management including the uniaxial, biaxial, triaxial FOG test data entry and query. Unstructured data management refers to the management of documents which were generated in the FOG R & D process. The original test data which generated in the process of product testing can be calculated in the system, and related quality reports were generated, you can see FOG performance parameter information which are presented in the form of tables and graphs, and through these information we can judge whether the FOG is qualified or not. The report can be previewed or printed online. You can upload or download technical documents in the system. Concrete realization of the system is shown in Figure 4.

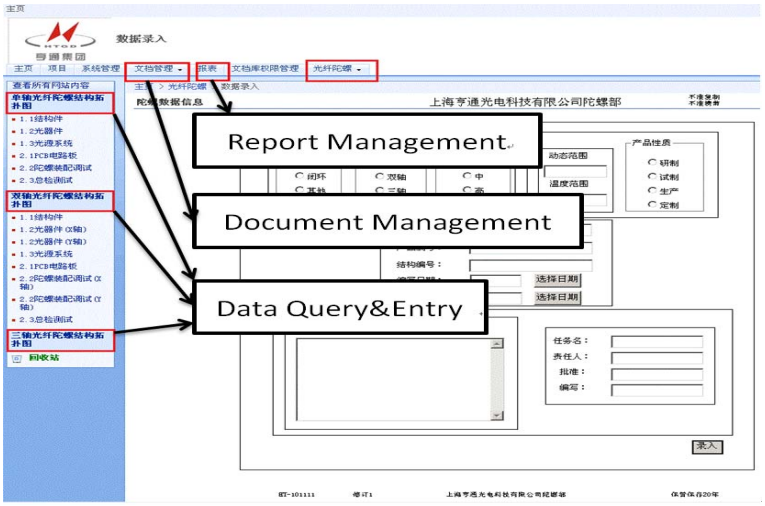

Figure 4. Test data management system home

4. Conclusion

This paper analyzed the FOG R & D process, as well as all the test data generated in the process, and introduced the structured data and unstructured data management. Then pointed out the main problems in the test data management and analyzed the test data management requirements and test data management methods of FOG. We developed a FOG test data management system. The system achieved centralized management of FOG test data in the product life cycle. With the system, we can timely update and manage the test data. This system meet all the demands of FOG test data management, manage the test data in accordance with the data type and R & D process, the test data can be shared in all relevant departments. The system has been applied in an optical technology company and improved the efficiency of FOG R & D.

Acknowledgments

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