Design and application of component-based automatic test system software

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Abstract. Aiming at the problems of low reuse and long development cycle caused by the increasing complexity and scale of automatic test system software, this paper describes the design of a component-based automatic test system software. The essence of this design is to design the general functional modules into relatively independent components by analyzing the software requirements of typical test system, and to carry out the research and development of modular software to improve the reuse rate of software modules. The practice of a large number of projects has proved that the software design of componentized automatic test system accelerates the speed of software development and improves the quality of system products.

1. Introduction

A component is a software unit that can be clearly identified and managed and has certain independent functions. It is also a self-contained software module capable of providing a service. It encapsulates certain data (properties) and methods, and provides a specific interface that developers use to use components and communicate with other components to construct applications.

With a deeper understanding of software reuse, the concept of components has become more broadly defined. It is no longer limited to source code, but extends to software requirements, architecture, documentation, tests, and data, all of which are useful for development activities. All of this information can be called components of reusable software.

In terms of technology, components can inherit and reuse at the binary level. It provides encapsulation of functions and external access to its services through interfaces, making it possible to reuse components without requiring source code. On the engineering side, components can be produced, acquired, and configured independently, allowing them to be seamlessly integrated into software systems developed by third parties. From this perspective, the optimal use of components is to build existing components into an application using a jigsaw approach.

2. Componentized design analysis

The design of automatic test system software should not only consider the support of the software to the current requirements, but also be easy to expand and reuse the system software in the future development, and flexibly adapt to the changing needs of the users of the automatic test system. The traditional test system software usually adopts the "top-down" design, which has certain advantages for the overall design of the system. However, when the overall conceptual design or user needs change, the original work may be overturned and started all over again, resulting in a huge waste of resources. Component-based test software design is distributed and bottom-up, so it can adapt to the changes of user requirements by adding or deleting components.
Automatic test system based on component software development is under the complete architecture according to the specific test task to develop a series of test functional component (existing functional components can be directly used to inheritance), and to establish the unified management of test functional component library, and the function using the test the test functional components in the component library to construct the test system software process. Through the analysis and decomposition of the test task, the matching is retrieved in the test functional component library, and then the required components are assembled and integrated into an automatic test system software. The software development of the component-based automatic test system is shown in Figure 1.

![Component-based automatic test system software development process](image)

**Figure 1:** Component-based automatic test system software development process

A prominent advantage of componentized design is that it can adapt to the needs of users well. When the test requirements change, relevant functional components can be reorganized or modified to adapt to the new requirements, avoiding the situation of affecting the whole body. Because of component has a very high degree of encapsulation system upgrade can be transparent, if necessary, we can increase the types of components to expand the function of the test system, without too many changes to the original component, and follow the uniform interface standard component technology, it also makes the test system has good openness and extensibility.

### 3. Software design of automatic test system

The software of automatic test system should have the characteristics of openness, universality and standardization, and the structure should be layered and componentized. With the help of the infrastructure design of automatic test system software, developers can easily integrate various software and hardware test resources, focus on the development of test applications, accelerate the development of test applications, test program reuse and performance improvement of execution functions, and develop and maintain test applications faster and better.
General automatic test system software with the management of the test resources in the test system, the test component of the task of maintenance management, test procedure, test execution and test data, the management of several main modules, such as advanced test system software also have the ability to develop test application of secondary and convenient user's own response to the new testing requirements. Reasonable software function design can improve the user's efficiency in test application development, test task execution and test data management.

According to the above function allocation, a typical test system software execution process is that the user logs in the software and enters the test execution wizard. In the execution wizard interface, the user creates or selects the type of the tested part and enters the test information (time, place, temperature and humidity, etc.). Each test item is created in the UUT management component by specifying the test program or test sequence, so the test software automatically invokes the corresponding test program (sequence) after selecting the test item. Before the test is executed, the test parameters should be configured, such as instrument parameters, test times, time interval, etc. After the configuration is completed, the test will be executed. During the test, data acquisition will be carried out to obtain the target data. In the process of data acquisition, if there is a display requirement, the data should also be displayed in real time or depicted as a data trajectory map. After the test is completed, data storage is carried out. The usual way of data storage is database storage. According to the specific requirements of the project, data storage is divided into local database and remote database and other types. After the user tests are completed, the test data of each tested part can be viewed in the data analysis and processing component set, and reports can be generated.
4. Application of component technology

The component technology is applied to the automatic testing of microwave components. Based on the component technology, the software of the automatic testing system for cable components and connectors is developed. The whole system software is composed of test wizard component, UUT management component, test program management component, result information storage component, data browsing analysis component, help component and other common functional components, as well as test application assembly and driver assembly. These can provide test information input, data acquisition and storage, data analysis and evaluation, report generation and software help and other functions.

Figure 4 Test wizard component interface diagram

Test application is the core of the whole test system software, which directly reflects the testing needs of users. The main function of the test application is to read the test data from the instrument according to the user's requirements, convert the test data into the indicator data of the tested part through the specific algorithm, and then call the result information storage component to store the data in the database. Test application is the core component of automatic test system software, which directly solves the most concerned needs of users. As the automatic test system is a customized product, different users have different requirements, so test application generally cannot be packaged into a common component for reuse. Because this system involves the integration of the test equipment is only the vector network analyzer and passive intermodulation equipment, so the test application is an instrument development, a test application corresponding to a kind of instrument, with independent operation interface, can undertake instrument configuration, convenient user field test use, Figure 5 is an example.

Figure 5 Test application interface diagram
The data browsing and analysis component mainly provides functions such as querying, browsing, analyzing, downloading and deleting the data stored in the database. Because different users pay attention to different test indicators, the amount and type of data storage are also different, so the reusability of data browsing analysis component is not good, usually according to the specific needs of users, on the basis of the original targeted modification.

5. Conclusion
This paper expounds the characteristics of the component technology and the componentization design of the software of the automatic test system, and introduces the application of the component technology in the actual project with specific cases. Through the above contents, the component-based automatic test system software solves the problem of software resource reuse to a large extent, and has the technical advantages of fast development speed and easy maintenance, which provides a reliable engineering realization way for the rapid customization development of automatic test system software.

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