An Analysis of the Design of a Computer-based Virtual Instrument Testing Platform

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Abstract. With constant change of the type and performance of measured objects, some problems are gradually exposed among measuring equipment in terms of measuring efficiency and quality. In this paper, to obtain more accurate measurements, with data communication as the core, the author builds a computer-based automatic virtual instrument testing platform. Starting from the characteristics of the virtual instrument testing platform, the author analyzes and studies the design of the computer-based virtual instrument testing platform.

Introduction

At present, commonly-used measuring equipment in various fields in China mainly includes signal generators, logic analyzers and programmable power supplies, etc. However, the objects of such measuring equipment are single. The operation difficulty is high. In essence, such measuring equipment functions through data communication. Therefore, we can design a virtual instrument testing platform with multiple signal interfaces and allow the testing platform to set up data communication relationships with multiple measured objects, to realize efficient measurement of multiple measured objects.

I. Characteristics of Virtual Instrument Testing Platform

Overall, the characteristics of virtual instrument testing platform mainly include:

(I) Convenient integration and diverse functions

The virtual instrument can effectively satisfy the integration needs of all kinds of measuring instruments. In practical application, the virtual instrument can make use of its own testing resources to test different measured objects [1] In essence, diverse functions can effectively improve the measuring efficiency of virtual instrument.

(II) Simple operation and accurate results

The simple operation of virtual instrument is achieved by the interface on the testing platform. In actual tests, users can find corresponding functions on the interface quickly and measure various data related to the measured object. Compared with conventional measuring equipment, using the virtual instrument, one can obtain more accurate measurement results related to the measured object.

II. Design of a Computer-based Virtual Instrument Testing Platform

Below, the author will analyze the design of a computer-based virtual instrument testing platform from the following aspects:

Hardware structure of the virtual instrument testing platform

According to functions of the virtual instrument testing platform, the hardware structure should contain a general measurement board, a computer, a development platform and specific measuring instruments, etc. To be specific, the hardware structure of the virtual instrument testing platform.

Software design

For the computer-based virtual instrument testing platform, there are many types of graphical programming software available. Common ones include: firstly, VEE. The application scope of this tool is measuring instruments with a built-in GP-IB interface. Therefore, before selecting the VEE

tool for development and design, we should make a rational choice according to actual needs of the virtual instrument testing platform. Secondly, LabView. This tool has significant advantages in computer-based bus instrument board [2].

For the computer-based virtual instrument testing platform, the communication function requires that the platform should satisfy communication needs of particular measuring instruments with multiple communication interfaces. On the other hand, this testing platform has high requirements for data processing efficiency and quality.

Compared with VEE and other software development and design tools, the functions of Visual C++ are more consistent with design requirements of the computer-based virtual instrument testing platform. For example, this tool provides a clear and concise interface for users to develop and design software. The database function can effectively meet data processing requirements for development on the computer-based virtual instrument testing platform.

III. Design of a Computer-based Virtual Instrument Testing Platform: a Case Study

(1)Overview of design requirements of the computer-based virtual instrument testing platform

The testing platform is a kind of avionics computer testing platform. It must be applied in an aircraft avionics system, so the design quality directly affects the operation quality of the aircraft avionics system. The types of interface signals and bus requirements of this virtual instrument testing platform are shown in Tab. 1.

Tab. 1 Design Requirements of the Virtual Instrument Testing Platform Based on a Certain Model of Avionics Computer

Type of interface signal	PWM signal Discrete signal Analog signal
Bus requirement	Easy integration Normative and good Good information transmission capability

Hardware structure design of the computer-based virtual instrument testing platform

(2)Computer system

According to design requirements of the computer-based virtual instrument testing platform, the hardware structure can be designed as shown in Fig. 1. The computer functions are generated by the following principle: to set up connections with various testing resources, with PXI bus interface as the medium. In actual operation, the user’s operation and software startup allow the computer to generate the functions of data collection and processing and complete accurate testing of various products [3].

(3)Testing resources

The signal testing and data collection of testing resources are realized by PXI bus testing instrument. For the virtual instrument testing platform based on a certain model of avionics computer, testing resources mainly include: firstly, PXI-6552 resources. During the operation of virtual instrument testing platform, the platform is responsible for collecting all kinds of serial bus signals [4].Secondly, PXI-5102 resources. During the operation of virtual instrument testing platform, these resources will generate digital pulse signals [5].

Taking PXI-6258 digital I/O board in hardware structure of the virtual instrument testing platform for example, the performance is shown in Tab. 2.

Tab. 2 Performance of PXI-6258 Digital I/O Board

Relay off (on) time	Less than 5ms
Solid-state relay output current	Less than 150mA
Solid-state relay output level	±60VDC
Digital input current	Less than 2mA
Digital input level	±60VDC

(4)Connection system

For this virtual instrument testing platform, the role of connection system is to help set up a connection between testing resources and measured object. The adapter in the connection system is responsible for setting up a connection with the measured object. The connector in the connection system is responsible for setting up a connection with testing resources. Here, the connection system, testing resources and measured object can transmit data accurately and realize measurement function of the virtual instrument testing platform [6].

Software design of the computer-based virtual instrument testing platform

Functional requirements

For this virtual instrument testing platform, functional requirements for software are shown in Tab. 3.

Tab. 3 Functional Requirements for Software of the Virtual Instrument Testing Platform Based on a Certain Model of Avionics Computer

Type of Function	Role
Self-checking	Ensure safe operation of the virtual instrument testing platform
Data storage	Provide data as a reference for subsequent measured objects
Operation prompt	Facilitate the use of users (humanized)

The testing process of software structure

The testing process of this virtual instrument testing platform includes the following steps (see Tab. 4):

Tab. 4 Main Testing Steps of the Virtual Instrument Testing Platform

Function Module	Testing Step
Configuration module	Configure operating environments, such as generating excitation signals and initializing
Self-checking module	Determine whether the virtual instrument testing platform is working normally
Identification module	Determine the identity of a user and provide permissions according to his identity information
Data processing module	Collect signals, store data and compare measurements
Report generation module	Output all test results in the form of report

Conclusion

In order to solve low testing speed and inaccurate test results of conventional measuring equipment, we can design a computer-based virtual instrument testing platform using development and design tools, as well as hardware equipment. In actual tests, there are so many signal interface types on this testing platform that they can provide accurate testing functions for different measured objects. As far as users are concerned, the virtual instrument testing platform is characterized by simple operation and easy application, etc. These characteristics enable users to get good experience from the measuring process. Since the virtual instrument testing platform is time-saving, the measuring efficiency of users is high.

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