Software Design of the Detection Device for the Performance of the Faucet based on LabWindows/CVI

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Abstract. Flow and sensitivity are two important indicators for measuring faucet performance. This paper designs a PC software based on the LabWindows/CVI development platform for the faucet flow and sensitivity detection system. The main function of the software is to communicate with the lower computer, control related hardware, and achieve data acquisition and analysis during the test process. Finally, the integration and record of test data is realized through MySQL database. The software runs stably and provides good human-computer interaction and automation services.

1. Introduction
With the rapid development of modern industrial production, faucet performance testing is widely used[1]. The detection device for the performance of the faucet is an important device for determining the flow rate and sensitivity of the faucet, and can provide reference of the quality of faucets for companies. The high-precision detection system for the flow and sensitivity performance of faucets is of great significance to the development of the entire industry.

With its powerful modern computer analysis and data processing capabilities, virtual instrument technology offers a wide range of testing and analysis capabilities through software. It can improve the intelligence level of the instrument, simplify the connection and debugging, greatly reduce the cost, and has high versatility. LabWindows/CVI is a virtual instrument software from National Instruments[2]. Its integrated development environment, interactive programming methods, function panels, and rich library functions greatly enhance the functionality of the C language. It provides an ideal software development environment to develop application systems such as inspection systems, automatic test environments, data acquisition systems, and process monitoring systems.

This paper designs an upper software of high-precision detection system for the performance of the faucet flow and sensitivity based on the virtual instrument software LabWindows/CVI development platform. It mainly completes the lower computer communication, related hardware control and data collection and analysis, and the MySQL database[3] is used to realize the integration and recording of test data and input information data during the test. After examination, the software runs stably, and has convenient human-computer interaction.

2. Software design
According to the process of faucet flow and sensitivity tests[4], the software needs to design the following modules: interface design, data structure design and function module design[5]. The overall structure of the software is shown in figure 1.
2.1 Interface design
A friendly human-machine interface can be designed by applying rich image controls and callback functions of CVI. The software interface includes a login interface and a main interface. The main interface consists of 7 sub-interfaces: tools interface, user management interface, parameter settings interface, flow testing interface, sensitivity testing interface, monitoring interface, and original records interface. The tool interface mainly displays the basic information of the device. The user management interface implements operations such as adding, deleting, and modifying passwords of the user information. The parameter setting interface is to enter information about the faucet to be tested. The flow test interface and the sensitivity test interface are the interfaces of the two test items of the software, the top part of the interface is the fixed test condition setting and the environment information, and the bottom part are the test result and test curve of the two interfaces, wherein the flow test interface can be selected for manual or automatic test mode. The test results can be stored in the database when the test is completed. The monitoring interface is designed as a pop-up window in order to observe the system operation while testing. The original record interface can query current or previous test records and export the data. The software login interface and main interface are shown in figure 2 and figure 3.

The main interface presents after entering from the login interface. The selection buttons of the seven sub-interfaces are fixed on the top of the main interface, and each sub-interface except the monitoring can be switched back and forth interface by tapping. In order to monitor the operation of the device while observing the test interface during the test, the monitoring interface is opened in the form of a pop-up window.
2.2 Data structure design
An effective way to open and display the database by using Structured Query Language (SQL)[6] is required to manage data since huge amount of data is generated throughout the test, including entering information, collected data, and test results. The storage and management of data can be very complicated and difficult by text method, and it cannot be easily and effectively maintained and expanded. Therefore, the software uses a MySQL database to enable systematic and standardized management of various data.

2.3 Functional module design
The function module is mainly composed of submodules such as general test module, data processing
module, data output module and other modules. The general test module implements the transmission of control commands, the drawing of test curves, and the display of test results during the test. Data processing module realizes analysis, processing and storage of test data. The data output module outputs the test results stored in the database to the interface or to the excel table, so that the user can query the original record.

3. Operation of software
In this section, the sensitivity test process is taken as an example to introduce how the software can test the sensitivity of the faucet.

3.1 Input of information
The software is opened to input the correct username and password, and the main interface appears. The default interface of the main interface is the parameter setting interface. In the parameter setting interface, click the "Edit" button, enter the information of the faucet to be tested and click "Apply" to save to the database.

3.2 Process of test
After inputting the information of the faucet to be tested, click the “Sensitivity test” button at the top of the main interface to switch to the sensitivity test interface. The sensitivity test interface is shown in figure 4.

![Figure 4. Sensitivity test interface](image)

Before test, first click the “Edit” button on the right side of the interface to set the test conditions, including the pressure of the hot and cold water pipes and the water temperature in two water tanks. After the input is completed, click the “Apply” button to save the setting information to the database. After setting the test conditions, click the “Open System” button on the interface to send the setting information to the lower computer. At this time, the device starts to adjust the test environment. When the test conditions are reached, the system condition is satisfied at the upper right of the interface, and the light is bright. Then, click the "Angle Initialization" button to set the servo rotation speed and angle. When finished, click the “Apply” button to complete the initialization of the servo. The angle initialization operation is shown in figure 5.
After completing a series of pre-test preparations, simply click on the “Start Test” button, the device will automatically test the sensitivity of the faucet, and the software draws the real-time sensitivity test curve. After the test is completed, the sensitivity test result is automatically calculated and displayed on the interface. Click “Page Save” to save the relevant information of this test to the database. The test in progress interface and test completion interface are shown in figure 6.

3.3 Query historical data

After the user completes multiple tests, click the “Original Record” button to query the test results of the faucet to be tested according to the test time and the test sample number. And the user can select one or more sets of data, click the "Export excel" button to export the data to the excel file, so that the user can export the test certificate. The original record interface is shown in figure 7.
4. Conclusions
This paper designs a software for the faucet flow and sensitivity detection device based on the LabWindows/CVI development platform. The software can automatically calculate test results and draw test curves of the faucet flow and sensitivity test. After testing, the software is designed reasonably, the test function is complete, and the human-machine interface is friendly.

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