Software Design of High Precision Filling Test System Based on LabWindows / CVI

Bin Li*, Xinghang Fan, Jie Chen, Shuo Cheng and Yang Gou

School of Mechanical Engineering and Automation, Shanghai University, Shanghai 200444, PR China

* sulibin@shu.edu.cn

Abstract. Filling technology has a large number of applications in the chemical, food, pharmaceutical and other industries. Filling repeatability is an important indicator in the field of flow measurement. Because of its powerful data analysis capabilities, virtual instrument technology is playing an increasingly important role in the field of automated detection. This paper designs the host computer software based on LabWindows / CVI for a high-precision filling test system. LabWindows / CVI combines a powerful and flexible C language platform with professional measurement and control tools so it can realize the requirements for designing filling system software. The main functions of the software are hardware communication, data acquisition and processing, and export of test results then a user-friendly interface is designed. This article explains the basic program design process, data structure and introduces program functions. The software can run stably and can provide filling test solutions for different test devices.

1. Introduction

In the chemical, food, pharmaceutical and other industries, there are a large number of product filling production lines. Depending on the accuracy of the filling weight, there are different filling processes such as quantitative, timing, and weighing. If the product is a proportioning raw material, the weight error is usually required. It is controlled within 1 ~ 5 ‰, so the weighing and filling process must be adopted [1]. High-precision filling process uses high-precision filling flowmeters to perform flow pulse counting, which can usually control the repetitive filling of important indicators of the filling technology within 5 ‰.

With the development of detection technology, virtual instrument technology is playing an increasingly important role in the field of automated detection because of its powerful data analysis capabilities, strong compatibility, and integrated interactive programming methods [2]. LabWindows / CVI is an interactive C language development software launched by NI Corporation. It combines a powerful and flexible C language platform with professional measurement and control tools for data acquisition, analysis, and display [3]. Lab Windows / CVI is an interactive C language development software launched by NI Corporation. It combines a powerful and flexible C language platform with professional measurement and control tools for data acquisition, analysis, and display [4].

This paper designs the host computer software based on LabWindows / CVI for a high-precision filling test system. It mainly realizes the data communication of the flow meter, the start-stop control of the related hardware, and the collection and analysis of the test data. The test data and parameters are...
finally saved in the MySQL database and used to output the filling records. At last, the program can run stably and achieve the requirements of high-precision filling testing.

2. Software design
The filling test process based on the weighing method, software design includes three processes: interface design, data structure design, and functional module design [5].

Figure 1 shows comprehensive software structure.

![Software structure diagram](image)

Figure 1. Software structure diagram

2.1. Interface design
With rich callback functions and graphical controls provided by CVI, a user-friendly software interface can be designed. This software contains two main interfaces, login interface and main interface.

The login interface assigns permissions and functions that can be used by the currently logged in person according to the entered account information. The main interface is made up of 7 sub interfaces: tool, information management, instrumented interface, user management, calibration setting, filling test and record certificate.

The tool interface is used to enter and modify the hardware parameter information of the current filling system. The user management interface implements the functions of adding accounts, modifying account information, and deleting accounts. The information management interface is used by the tester to enter the current commission and test sample information. The tested instrument interface is used to select the currently tested sample and modify the test medium information. The filling test interface mainly implements the basic high-precision filling test functions, and the record certificate is used to organize the test information and export it to Word file.

The software's login interface is shown in Figures 2 and the main interface is shown in Figure 3.
Figure 2. Login interface

Figure 3. Main interface

2.2. Data structure
It is an efficient way to process data with MySQL database while the whole filling system will generate a large amount of experiment result.[6]
The data of the high-precision filling and testing process can be easily and effectively stored in different tables through SQL database management, and it is convenient for users to conduct data retrieval and data processing later. Based on the powerful functions of the CVI and MySQL databases, the high-precision filling and testing software can achieve accurate data manipulation.

2.3. Functional module design
The functional modules of the software mainly include the input of information, basic test functions, data processing, and data output functions. Basic filling test functions include steps such as sending test parameters, hardware control instructions, and real-time display of hardware information. Data processing functions implements the comprehensive procedure of data processing. The data output module exports the filling data to a Word file in a specified format, and users can conveniently generate filling test certificates and original records.

3. User operation
This section will take a filling process as an example to tell user how to finish a complete high-precision filling test process.

3.1. Input of information
After user enters the correct user name and password, it changes to the main interface and the tool interface is displayed by default. The "Edit" button is used to modify the operation state of the current test device, and then click "Apply" button to save.

3.2. Process of filling test
Finish the modification of the device information, click "Fill testing" button above to enter the Fill Test sub-interface as it is shown in Figure 4.

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

Before starting the test, click the "Open water system" button, and the water source circuit will begin to adjust. After the water source adjustment stability indicator lights up, click the "Edit" button to enter the test parameters for this filling test, including the single filling weight, filling times, filling interval...
and filling method. After inputting the test parameters, click the "Apply" button to save the test parameters. After clicking the "Adjust filling time" button, you can see the estimated filling duration under the current flow. The interface for adjusting the filling duration is shown in Figure 5.

Figure 5. Adjusting filling time interface

After inputting the parameters and adjusting the filling time, click the "Start Test". The software will start the filling test. After each single filling test is completed, the data will be displayed in the table below in real time. When the test is over, click "Save" to save the data into the database. Figure 6 shows the completion condition of filling test.

Figure 6. Filling test completion
3.3. Export of test result

After user has completed calibration test or filling test, click the "Original records" button to enter the data export interface. Click "Generate" and input the corresponding certificate information and click "Confirm", the user can find the exported record certificate in the specified folder. Figure 7 shows the Original record and certificate interface.

![Figure 7. Original record and certificate](image)

4. Conclusions

This article implements a high-precision filling test system based on LabWindows/CVI development platform. This program can realize the automatic filling test process, complete the data collection and processing, and can realize the certificate output of the data. It is convenient for users who have requirements for filling testing to implement a complete and accurate filling testing process.

References

[1] ZHOU Gen-rong, CHEN Rui-xiang, BI Mei-na. Design of monitoring system of high-precision filling production line [J]. Manufacturing Automation, 2015,37 (21): 125-126 + 131.

[2] Fan, J. J. (2018) Research on Water-saving Standards and Certification System of Waterjets at Home and Abroad. Ceramics, 2018(11):48-53.

[3] Chen Yijiang, Huang Rong. Design Implementation and Research of Software Based on LabWindows/CVI [J]. China Computer & Communication, 2019 (16): 55-58.

[4] Wheeldon, J. A., Pintar, F. A., Yoganandan, N. (1997) Modular Data Acquisition System Updated using Labwindows/CVI Graphical User Interface. Biomedical Sciences Instrumentation, 33, 269-274.

[5] Egenhofer, M. J. (1994) Spatial SQL: A Query and Presentation Language. Knowledge & Data Engineering IEEE Transactions on, 6(1), 86-95.

[6] Liu, Y., Duan, F. H., Yang, Y. (2006) Software Development of Electric Servo Test Equipment Based on Labwindows/CVI. Aeronautical Computing Technology, 2006(03):34-36+41.