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Research and Development of Instrument Testing Device based on LabWindows_CVI

Xiaoqiang Liu[1,a] and Hao Liu[1,b]

[1]School of Marine Engineering , Northwestern Polytechnical University,Xi'an 710072, China

[a]liuxiaoqiang21212@163.com, [b]451509255@qq.com

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Abstract.A research scheme of Automatic Testing System based on virtual instrument technique is presented in this paper. The virtual instrument technique is applied into the detecting instrument control system and detecting station is controlled with the programming language Lab Windows/ CVI. This testing platform adopts the design based on HTPXI2010I ，HTPXI3730，HTPXI4387，HTPXI4484 board. During the measurement and control process, the generation and collection of the start signal and the input signal based on the testing platform. Meanwhile, every parameter is collected in real time, saved and generated the test report.

Introduction

With the development of science and technology, the intensity of active detection technology has become increasing. Based on the advanced virtual instrument technology, with the use of Lab Windows/CVI software development platform, this testing device can simulate all kinds of input signals according to the requirement of product, automatically detect, dynamically display the test data and the state signal. At the same time it can provide fault indication and fault location, complete the electrical system function test, store, display and print the test results[1].

Summary of the testing device[2]

This test platform insists of dynamic and power amplification detection. The hardware insists of the adapter, power box, HTPXI4387 multi-function data collection card, HTPXI3730 arbitrary waveform generator and so on. It contains power supply, switching control, PFI digital I/O channels and timing/counting, switching input and output, data acquisition, isolation and PC communications.

Basing on hardware and Lab Windows/CVI software, the software uses the driving function library synthetically, such as VXI, GPIP, RS232 and more than 600 source instrument drivers. It can accomplish the test of switch action, data signal and functional status, then analyzes some signal, records test data and forms the report document.

The software design of testing device

The whole technological process.The software based on the idea of modularization design is divided into power detection and power amplification detection. The power detection included the master-control interface, self-inspection, calibration, data management, equipment maintenance and so on. The connectivity and control box of the products are used for the functional checks. It can complete the motor and voltage regulator testing function. The process of dynamic detection is shown in Fig. 1.

The power amplification detection generates the starting signal. Some indices which include the carrier wave frequency of multi-channel output signal, pulse envelope amplitude, width, cycle and

the phase difference between every path of carrier wave and the first carrier wave are measured with this instrument. Then the results are displayed by graphs and preserved. In the end, it can generate reports. The software process of power amplification detection is shown in Fig. 2.

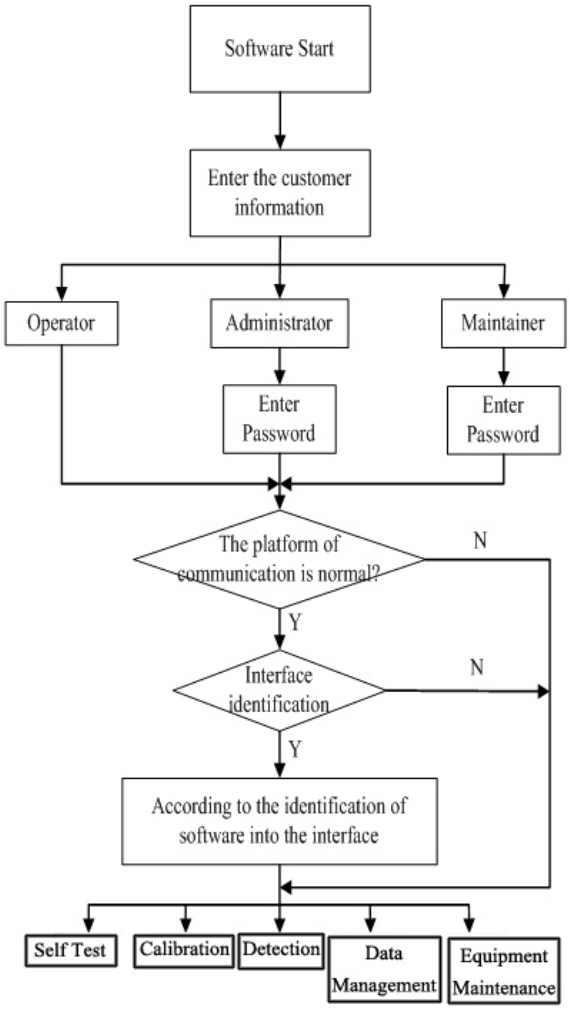

Fig. 1 Dynamic Detection

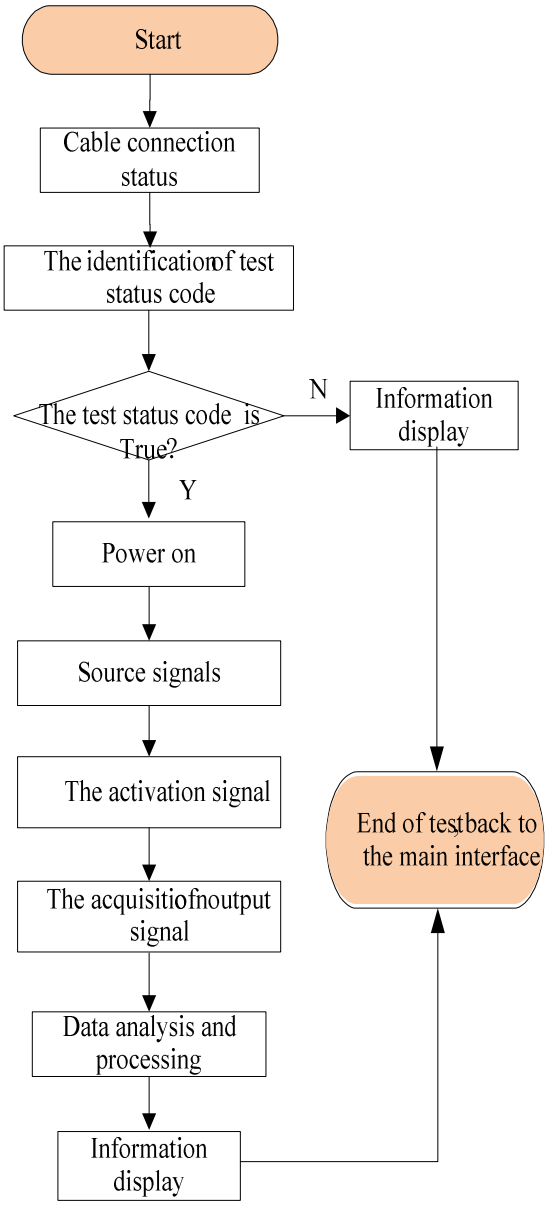

Fig. 2 Power Amplification Detection

The interface of software.

The dynamic module. This module includes the testing function of control box, connectivity, the switch of power supply and motor function. The interface of signal detection is shown in Fig.3.

The power amplification module. When the self-checking module operates, it prompts the users to connect the cable with the adapter. Then the self-checking channel will introspect the voltage, start signal, the load acquisition channel.The detection module completes the acquisition of multi-channel power output signal, analyzes the collected signal and calculates the multiple carrier frequency of the output pulse, the width, amplitude and cycle of envelope.

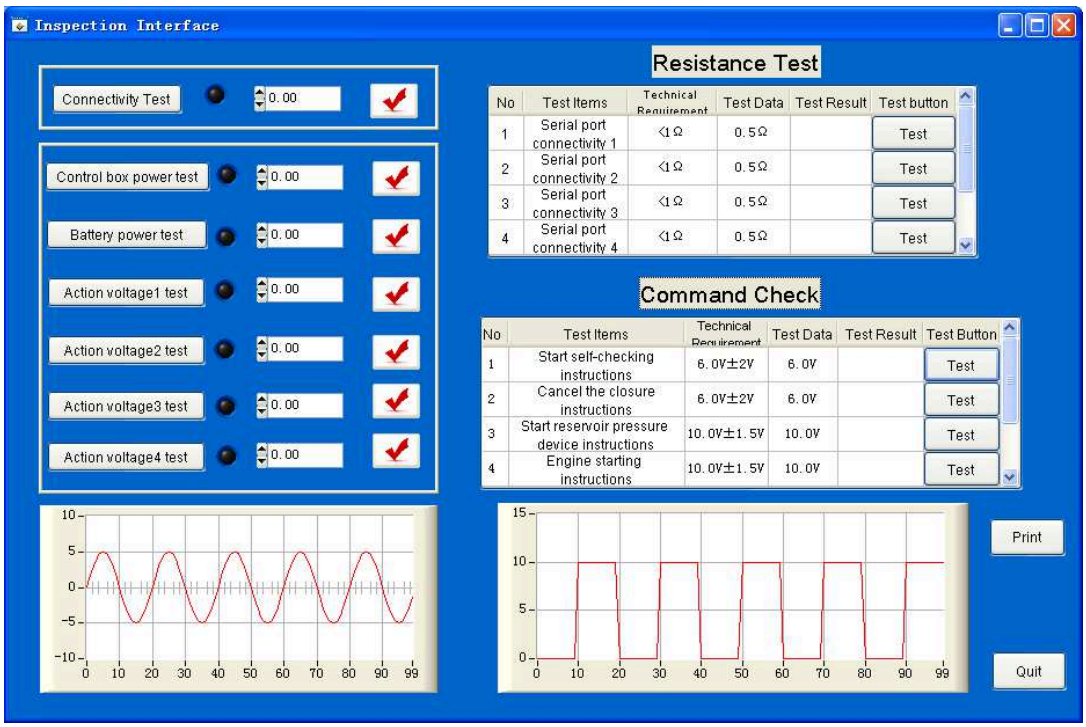

Fig.3 Signal detection interface

The key techniques of the software programming

The main use of signal functions, other functions and programming statements:

Analysis_Pulse(double inputArray[], int number Of Elements, double *width, double *cycle); Calculate the pulse width and cycle of the start signal

Analysis_phase_AMP(double X_wave[],double y_wave[],int n,double *AMP_x, double *AMP_y,double *phase); Calculate the sub function of phase difference and amplitude.

Phase difference and amplitude calculation[3].Two measured sine signal is being se as Eq.1.

$$\begin{cases} x(t) = A\sin(2\pi ft) + N_x(t) \\ y(t) = B\sin(2\pi ft + \varphi) + N_y(t) \end{cases} \quad (1)$$

A and B are the amplitude of x(t) and y(t); Nx(t) and Ny(t) are the noises of x(t) and y(t); The correlation calculation of x(t) and y(t) are shown in Eq.2.

$$R_{xy}(\tau) = \frac{1}{T}\int_0^T x(t)y(t+\tau)dt$$

$$= \frac{1}{T}\int_0^T [A\sin(2\pi ft) + N_x(t)] \times \{B\sin[2\pi f(t+\tau) + \varphi] + N_y(t+\tau)\}dt \quad (2)$$

Due to noise and the signal is not relevant and so as noises, through the points, you can get as shown Eq.3.

$$R_{xy}(0) = (\frac{AB}{2})\cos\psi \quad (3)$$

Phase difference ψ can be got as shown in Eq.4.

$$\psi = \arccos(\frac{2R_{xy}(0)}{AB}) \quad (4)$$

The amplitude of A and B can be obtained by autocorrelation function. Generally, the autocorrelation function is as shown in Eq.5

$$R_x(\tau)=\frac{1}{T}\int_{-T/2}^{T/2}x(t)x(t+\tau)dt=\frac{1}{T}\int_{-T/2}^{T/2}A\sin(\omega t+\tau)\times A\sin[\omega(t+\tau)+\varphi]dt \quad (5)$$

The actual processing signal is the sequence of discrete points after sampling, the corresponding discrete calculation formulas are as shown in Eq.6.

$$\begin{cases} R_{xy}(0)=\frac{1}{n}\sum_{i=0}^{i=n-1}x(i)y(i) \\ R_x(0)=\frac{1}{n}\sum_{i=0}^{i=n-1}x^2(i) \\ R_y(0)=\frac{1}{n}\sum_{i=0}^{i=n-1}y^2(i) \\ \psi=\arccos[R_{xy}(0)/\sqrt{R_x(0)R_y(0)}] \end{cases} \quad (6)$$

N is the number of samples, x(i) and y(i) are the value of the number i sample points separately.

Data Storage[4]

In Labwindows/CVI development environment, it can generate, preview, preserve and print report with templated ideas. The places where will be filled in the data should be marked, it can automatically fill in the blanks with all the data returned. When the software calls Word to generate the report, you only need to add the driving files of word2000.fp and word report.fp into the project to realize the communication between Lab Winows/CVI and Microsoft Word.

The dependent report programs are as follows:

```
WordRpt_Application New (VTRUE, &appHandle);
WordRpt_DocumentOpen (appHandle, pathName, &docHandle);
RptChk (WordRpt_GoToBookmark (docHandle, "num1"));
RptChk(WordRpt_AppendText(docHandle,”value”))；
```

Conclusion

This topic researches and develops a platform for measurement and control which test, analyze and control by the performance figures of the products. The human-computer interaction takes place of the traditional way of independent manual operation. Improving the efficiency of test and avoiding the personnel errors caused by mis-operation. It is convenient to load, preserve and print the state and data of the instrument instantly.

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