Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(6):1099-1104

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Research on function and design of virtual instrument based on LabVIEW Technology

Yuan Cao and Huamin Chen

Nanyang Institute of Technology, Henan Nanyang, China

ABSTRACT

Virtual instrument is using powerful personal computer graphics environment and online help function, the establishment of virtual instrument panel, the instrument control, data analysis, change the traditional instruments use and can improve the instrument's function and use efficiency. LabVIEW is virtual instrument development platform software, to equipment source level with its intuitive and simple programming style, many drivers, a variety of analysis and expression of function support. The paper proposes function and design of virtual instrument based on LabVIEW technology. Experiments show that this method has certain validity.

Keywords: Virtual instrument, LabVIEW technology, Instrument control.

INTRODUCTION

Virtual instrument is the user on general computer platform, the data acquisition hardware necessary support, according to the need of the testing task, to realize and expand the traditional instrument by software design function. The traditional instrument is designed and defined by the manufacturer to function in a closed structure, have a fixed input / output interface and instrument operation panel. Each instrument can only achieve a certain class of measurement function, and is provided to the user to determine the way.

The LabVIEW program called virtual instrument (VI), mainly includes two parts: the front panel (i.e., man-machine interface) and the block diagram of the program. The front panel to panel operation simulation instrument, can observe the set input values, output and realize the chart, text display [1]. The block diagram is using graphical programming language, the equivalent of the traditional program source code. The parameters for the command input to the front panel instrument to perform the corresponding operation.

The virtual instrument can also measure, real-time highly effective on several parameters simultaneously, because almost all processing transmission and data signal is digital signal or software to achieve, so it greatly reduces the interference of environment and system error. In addition, the user also can at any time according to need to adjust the function of virtual instrument, greatly shorten the update cycle instrument in measuring objects change; on the other hand, using the virtual instrument can also reduce the hardware aspect of the test system, so as to reduce the system development cost and maintenance cost, therefore, the use of virtual instrument than traditional instrument.

The main function of testing instrument is composed of three parts: data acquisition; data test and analysis; output display. Virtual instrument is composed of the three parts, the difference is the software system of data analysis and the results of virtual instrument output completely mountain computer to complete. As long as the data acquisition hardware, constitute a virtual measurement instrument based on computer. Virtual instrument is usually a computer, the hardware interface circuit and software of the three parts.

LabVIEW is a virtual instrument development platform software, can support and expression analysis function

equipment source level with its intuitive and simple programming style, many drivers, diverse, created the basis of conditions for users to quickly build their own instrument system needed in practical engineering. But LabVIEW and other computer languages, there is a particularly important difference: the other computer languages are used in the text language production lines of code, and the LabVIEW using the graphical programming language -- G language, the program is the form of block diagram, easy to use, especially suitable for hardware engineers, technical personnel process production line engineering and technical personnel, to learn and use.

2. Analysis of LabVIEW introduction and development environment

Programming system LabVIEW is general; there is a complete any of the huge tasks of programming functions. LabVIEW functions including data acquisition, GPIB, serial port control, data analysis, data display and data storage, etc.. LabVIEW also has the traditional debugging tools, such as setting breakpoints, to display animated data and subroutine (VI) results, step and so on, debugging convenient program.

Using LabVIEW programming, the main feature is the virtual instrument is decomposed into several basic functional modules (equivalent to the integrated circuit hardware design), pin represents an input / output interface module. The programmer can through interactive means, by using the method of graphical diagram design, complete virtual instrument measurement and analysis of logic and functional design. The thinking process of LabVIEW program design process and the design of the instrument is very similar to the people; realize the program block diagram of program code function, to avoid the tedious procedure design from conception to the program block diagram representation [2].

For the construction of virtual instrument, LabVIEW has many characteristics and advantages, such as: graphical programming instrument control and data acquisition; intuitive front panel user interface and workflow schema programming style; the built-in compiler can accelerate the speed of execution; the data acquisition of DAQ function library allows users to collect signal or a control signal, suitable for application to control the rapid and direct; the driver can drive more than 650 kinds of instruments, equipment more than 50 manufacturers; advanced analysis library content rich, for signal processing, statistics, curve fitting and complex analysis; using ActiveX, DDE and TCP / IP network connection and communication; apply to Windows NT / 95 / 3.1, MacOS, HP2UX, Sun and Concurrent real-time computer, as is shown by equation (1).

$$\overline{P}^{(\beta)}(m \mid m) = \left[I - \overline{K}^{(\beta)}(m)\Psi_w(m)\right]\overline{P}^{(\beta)}(m \mid m-1) \tag{1}$$

In the LabVIEW application design a Usb.dll file as a LabVIEW driver and USB. Due to the EZ-USB development system has provided the driver (GPD) interface function, users only need to call these functions and USB equipment. So call it provides function only in the DLL system, greatly saves the development time, improve the development speed.

The core of LabVIEW is VI. VI is an interactive user interface -- the front panel (Front Panel) and similar to the source code of program graph (Diagram). The front panel is received from the program graph instructions. In the front panel of the VI, control (Controls) to simulate the input device, instrument and to supply the data to the VI program graph; and the indicator (Indicators) simulation output device, instrument and display the data or the obtained by the program graph. When a control or indicator is placed to the front panel, LabVIEW in the program graph is placed corresponding to a port (Terminals), this belongs to the control or indicator port cannot be deleted, only delete controls or indicators and it subsequently deleted [3].

$$\lim_{d\omega\to\infty} C_m \frac{2\pi}{d\omega} = \int_{-\infty}^{+\infty} x(t)e^{-jm\Omega t}dt \tag{2}$$

Virtual instrument based on VXI instrument, which is based on VXI (VME bus Extension for Instrumentation) standard bus instrument module and PC as the hardware platform, which is composed of a host box, controller and instrument module. Among them, to control installation in zero slot, called zero slot controller. The VXI controller includes an embedded controller, an external controller and embedded PC control, according to the requirements by test function.

LabVIEW is a general-purpose programming language, has the functions of powerful variety, various, including data acquisition, GPIB, serial instrument control, data analysis, data display and data storage, and even network function. LabVIEW also has a perfect simulation, debugging tools, such as setting breakpoints, single step execution. LabVIEW dynamic continuous tracking mode, continuous, dynamic observation of the data flow and the changes of the program, and it are other than the language development environment more convenient, more effective.

A sophisticated data flow programming model for constructing liberated user program from linear text language used in LabVIEW. Because the execution sequence program in LabVIEW software flow are decided by each block of data. You can also set up the flow chart of synchronous operation. LabVIEW software is a multi thread functions of a multi task system -- with and run multiple virtual instrument.

Using LabVIEW, can generate stand-alone executable file, it is a true 32 bit compiler. Like many important software, LabVIEW provides several versions of Windows, UNIX, Linux, and Macintosh. It is a convenient, hardware, can be changed by software, can realize different instrumentation function, is very convenient, is equivalent to the software or hardware is equation3.

$$b_m = \frac{1}{T}\int^{+T} X(t)\sin m\Omega t dt = \frac{1}{2}b_n \tag{3}$$

The LabVIEW/CVI is to provide efficient programming tools based on text programmers, through three kinds of programming language Visual C++, Visual Basic, LabVIEW/CVI testing system, which makes full use of computer bus, chassis, power supply and software facilities [4]. But by the PC machine and the bus limit, and there is lack of power supply, the higher noise level inside the chassis, slot number is not much, the slot size is small, the chassis unshielded shortcomings.

LabVIEW is used to obtain the data flow programming method, so as to make you free from the apprentice structure programming language based on it. Because the implementation of LabVIEW is determined by the inter block data flow, rather than by the sequence of it, you can generate a synchronization operation diagram, as is shown by figure1.

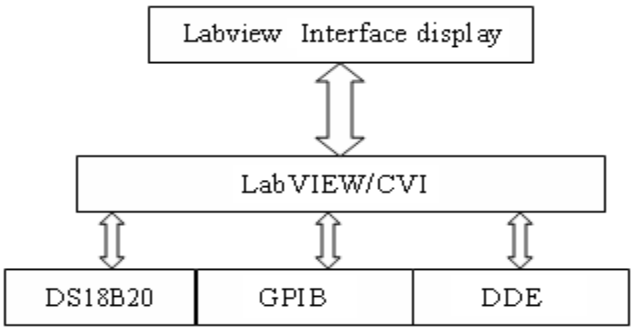

Fig. 1. Structure of LabVIEW

The main function of the system the system is decomposed into two parts, namely, the upper part and the lower part, and then the design. The two parts is to communicate through the computer serial port. At the same time, choose LabVIEW as the software development platform temperature detection system. In the overall design of the system, the software design is the key, also accounted for most of the workload.

In LabVIEW GPIB, VXI and serial VI library using the NI industry standard device driver software to carry on the comprehensive control of the instrument system. You can connect to any GPIB IEEE488.2 interface board NI together control. VXI development system, you can use LabVIEW is too easily as your instrument programming, this system including the VISA.

The LabVIEW in the Windows and Vi module and the window function provided by the Haining window, Hamming window, the triangular window, Blackman, Exact Blackman, flat Top and other VI in a Case structure in the formation of a "window function selection". The data processing module consists of an FFT and a "windows" and other arithmetic unit.

3. Study on the function and characteristic of Virtual Instrument Technology

In virtual instrument measurement results by means of software "in the screen of computer generated, with the traditional instrument panel is similar to the graphical interface by the soft panel to achieve, virtual instrument makes full use of modern advanced technology products and technologies, such as computer, modular data acquisition circuit and bus technology.

Communication of virtual instrument system in bus types can be divided into the following three ways: RS-232

serial bus architecture, general instrument bus GPIB, VXI, PXI architecture and USB serial communication bus architecture [5]. PXI is a PCI extension in the field of instrument, it will PCI bus technology development for test, measurement and data acquisition applications of mechanical, electrical and software specification, thus forming a new architecture of virtual instrument. PXI provides PCI data including 132Mbps rate and the plug and play function of high performance electrical characteristics. Although the performance of these instrument bus is better, but the instrument control system requires control card equipped with a dedicated interface.

$$G(k)=\frac{\sum_{i=1}^{N}u_i Z_i(k)}{\sum_{i=1}^{N}u_i} \tag{4}$$

The virtual instrument platform is the core of virtual instrument; it operates as virtual instrument software, controls the entire virtual instruments work. Control of a variety of modular I/O equipment can be virtual instrument software. The modular I/O refers to the hardware through PCI, PXI, PCMCIA, USB, 1394, GPIB and other interface and virtual instrument platform, to achieve a variety of control functions of the hardware equipment.

The design of front panel is window virtual signal spectrum analyzer. The front panel contains two waveform display, display waveform signal to be analyzed and the amplitude spectrum after FFT diagram: waveform selection can select sine wave, triangle wave, sawtooth wave, Fang Bo experimental signal, the amplitude, phase, frequency and the number of data points is determined by the signal source parameters of the plate on the left side of the window; select the board was set up to add Hamming Window. VI, hanning, Triangle Vi, Blackman Window. Vi etc..

$$c_{m-1}(n)=\sum_{j\in z}\tilde{h}(n-2j)c_m(j)+\sum_{j\in z}\tilde{g}(n-2j)d_m(j) \qquad ,n\in z \tag{5}$$

Analog A / D converter converts input into a digital output, and the amplitude of the signal quantization. With the development of electronic technology, usually the sampling, the retainer with the A / D converter integrated on a chip. Prior to the passage of the above four parts are in PC, is the main part of the data acquisition card. Other related circuit, such as timing / counter, bus interface circuit is integrated on a circuit board, collect; amplify the signal data and analog-to-digital conversion task. A lot of data acquisition card circuit board, also installed several analog (D / A), it is in the PC to the output channel, for converting a digital computer output analog, so as to realize the control function.

The hardware part consists of PC, the data acquisition circuit, signal conditioning circuit and the temperature and humidity sensors and other components, for the realization of the temperature and humidity of the environment information collection and signal into the computer can process; software is developed on the platform of LabVIEW, the main function of programming data collection, processing, display, record etc..

Using the virtual instrument system can collect and record data at any time from the sensors, and statistics, the digital filter, frequency domain analysis and processing, thus realize the monitoring function. At present, the gas sensor is moving fast response, small and economical development; this development caused the development of microelectronic gas sensors. Application of virtual instrument in the measurement, in the laboratory, the development of special virtual instrument system based on virtual instrument development tools, can put a personal computer into a group of testing instrument, used for data / image acquisition, control and simulation.

4. The experimental simulation function and design of virtual instrument based on LabVIEW Technology

LabVIEW and USB driver data exchange and it is so as to realize the USB real-time acquisition and processing system based on LabVIEW application. The USB data acquisition card A/D or D/A and make the appropriate changes to the circuit, can realize all the functions of traditional data acquisition card. Obviously, the integration of the acquisition and processing system has the advantages of USB interface and LabVIEW graphical programming language and traditional acquisition card has the incomparable advantage, not only cost-effective, high universality, easy to develop, simple data processing, and can shorten development time [6]. LabVIEW, it is USB and real-time data acquisition and processing system, test and measurement.

Universal serial bus (USB) is a message based communication bus. This representation is communication between PC and USB equipment by sending instructions and data, and these instructions and data through the bus to text or

binary data. Each USB device has its own set of instructions. You can use the NI-VISA function to read and write to the instrument to send these instructions, feedback and reading instrument.

$$P^{(\chi)}(m|m) = P^{(\beta)}(m|m) = W_X^* \overline{P}^{(\beta)}(m|m) W_X,\ m = 1,2,\cdots \tag{6}$$

The driver interface device LabVIEW itself contains the interface board is produced by NI company, for the data acquisition board is made, LabVIEW cannot directly call. Therefore, the AD7202 data acquisition board drive is the first to solve the data acquisition in LabVIEW problem.

In USB Firmware, adopt synchronous transmission (Isochronous Transactions) and block transfer (Bulk Transactions) two transmission modes. Used to transmit real-time data synchronization mode, block transmission is mainly used to state information transmitting host command signal and USB.

These controls are the input and output port VI. The input control knobs, buttons, and it refer to the rotary input device. Display control refers to the chart, such as lamp display device. Input device input controls analog instruments, to provide data for a program block diagram of the VI. Display device control simulation equipment, to display the program diagram gets or generated data. The computer is used in LabVIEW2010 design, figure 2 shows the temperature detecting interface, namely the front panel PC program. The overall function is receiving temperature data gathered by computer, and the data is displayed and recorded, through the front panel to limit temperature, when the temperature exceeds the limit value, the system will send the alarm signal.

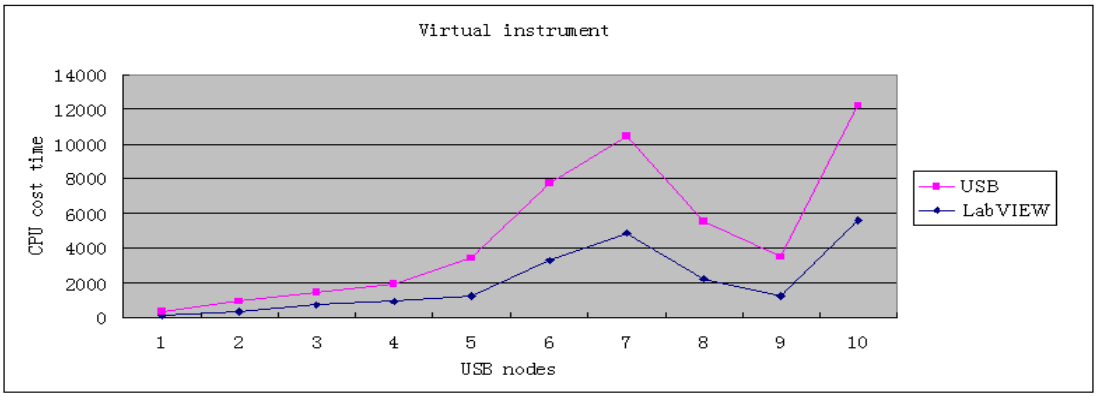

Fig. 2. Function and design of virtual instrument based on LabVIEW Technology

It can give full play to the computer capacity, powerful data processing function, can create a more powerful instrument. Users can accord their own needs to define and manufacturing all kinds of instruments. Virtual instrument is actually an organization in accordance with the needs of the instrument data acquisition system. Research on virtual instrument involve in some basic theories of computer data acquisition and digital signal processing.

CONCLUSION

Debugging LabVIEW program and other computer language writing and debugging a similar, need to find the mistakes in grammar, but graphical programming mode of LabVIEW is relatively simple, greatly improves the efficiency of programming. If there is a syntax error in a VI program, run the button will be in the panel toolbar becomes a broken arrow, said the program cannot be executed.

The virtual instrument can and are more suitable for the measurement of the actual, modular I/O hardware in practical measurement can be used as the data acquisition hardware effectively, and because the measurement precision and the development of testing technology requirements of the higher, more and more parameters to be measured, the automation degree of the test process and test ability requirements more high, in actual measurement, virtual instrument can be very good to meet these needs.

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