Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 29 (2012) 3245 – 3249

Procedia Engineering

www.elsevier.com/locate/procedia

2012 International Workshop on Information and Electronics Engineering (IWIEE)

Design and Implementation of Multifunctional Virtual Oscilloscope Using USB Data-Acquisition Card

Ping Gong*, Wei Zhou

Academy of Medical Imageology, XuZhou Medical College, Xuzhou, Jiangsu 221004 China

Abstract

Based on virtual instrument technology, a multifunctional virtual oscilloscope was designed by using NI USB data acquisition card and LabVIEW software. Its functions included channel selection, signal adjustment, waveform display, time domain analysis, frequency domain analysis, data storage and playback, voltage measurement etc. Compared with the traditional oscilloscope, the designed oscilloscope not only expanded the function, simplified the structure, but also improved economical efficiency. The test practice showed that this virtual oscilloscope had a good performance and a promising application.

keywords: virtual oscilloscope; USB data acquisition card; LabVIEW

1. Introduction

As a kind of general instruments in physics, electronics, communication technology , Oscilloscope is used to measure and analysis all kinds of signal waveforms. Common oscilloscopes include analog oscilloscopes and digital oscilloscopes. Compared with analog oscilloscope, digital oscilloscope has small body, and certain expansion functions in signal analysis, but it has high price and is difficult to maintain, and some functions are not easy to extend and change for the sake of convenience to use for students.

The new metering device that called Virtual instrument has changed the situation. Virtual instrument was the equipment that added the hardware and software in the ordinary computer, might duplicate uses

* * Corresponding author. Tel.: +86-0516-83262243.
E-mail address: gongpingcumt@126.com

1877-7058 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.proeng.2012.01.474

and was provided the instrument visible operation contact surface by the computer display monitor. Based on PC platform, its most functions are implemented by software. It has thoroughly broken the aspect that the traditional instrument only can be defined by the produce factory and the user could not change. Because this kind of instrument hasn't specific physical status, we called it virtual instrument.

Virtual oscilloscope was a kind of general virtual instrument for signal testing and analysis. Nowadays, most of them were using PCI data acquisition card[1-2] and the computer sound card[3-4] as a hardware platform, so its total functions were exposed to environment and lot number in computer. But here, a multifunctional virtual oscilloscope was designed which based on USB data. acquisition card that had many advantages, such as easy to install and carry, difficult to affected by computer's interference environment, not too restrict by computer's lot number, address and interrupt etc.

2. The overall design of virtual oscilloscope

The designed virtual oscilloscope consisted of hardware and software. The hardwares included general computer and USB data acquisition card that could realized the function of data acquisition. A nd the softwares included driver program and the user software that controling the data acquisition and to realized the functions of data collection, display and analysis by card.

2.1. USB data acquisition card

USB–6210 data acquisition card was chosen as one kind of general serial bus, it could plug and play and keep high precision in high sampling rates and belonged to the M series multi-function data collection card. It could support LabVIEW,LabWindows/CVIllqlqw software, and had 16 channel analog input , 16 bits resolution, 250 kS/s single sampling rate of one channel, 4 channel digital input line, 4 channel digital output line, each channel had four programmable input range (+ /-0.2 V-± 10 V), digital trigger, 2 counter/timer , three different terminal mode: difference model, single ended mode and not referenced mode, It supported Windows NT / 2000 / XP/ME / 9 X, Linux operating system platform, etc.

2.2. Software platform

NI corporation's LabVIEW software was adopted as a graph software development enviroment which used all sorts of icons, graphic symbol, attachment etc, which transform the complex, time-consuming, detailed programming language to simple, intuitive and easy graphics programming. It had powerful functions which included numerical function operation, data acquisition, signal processing, signal generation, etc. So it is more than just a programming language, but also a tool which the industry and academia were used to developing data acquisition system, instrument control software and analysis software[5].

3. Software design of virtual oscilloscope

3.1 The front panel design

The front panel was a interface between user and instruments, it could be used to set and adjust oscilloscope's parameters according to the panel's knobs, buttons, etc. In the design process, we horded the user's familiar panel on one hand, on the other hand we also add some new function buttons. the front panel of the designed oscilloscope was showed as following figure1.

3.2 The program block diagram design

The program block diagram design was the key points of the virtual oscilloscope. The whole program block diagram includes four parts, included data acquisition, waveform display and analysis, waveform

storage and playback, voltage measuring. some program block diagrams were showed as figure 2- figure 5.

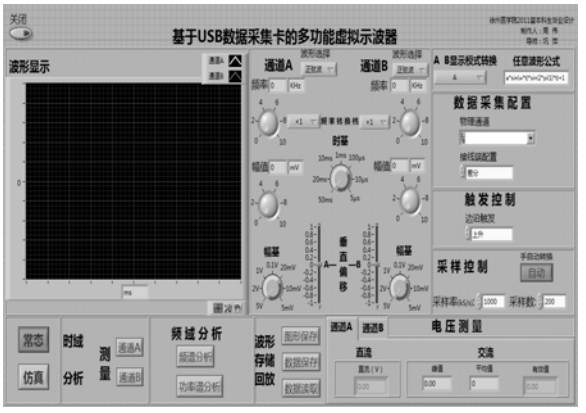

Figure 1 The virtual oscilloscope's front-panel

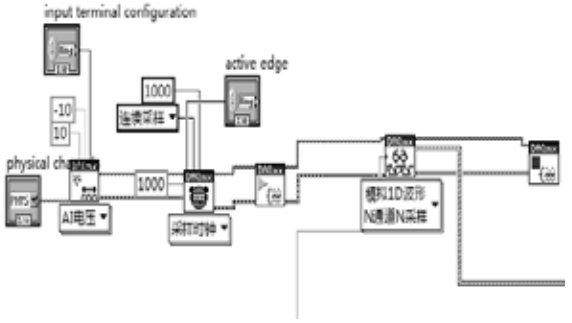

Figure 2 Block diagram of Data Acquisition

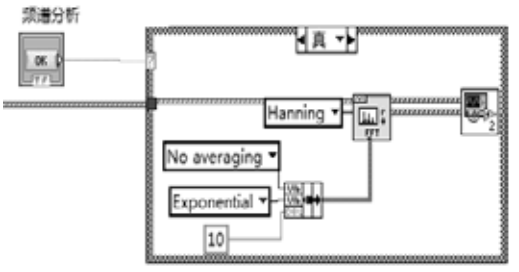

Figure 3 Block diagram of Spectrum Analysis

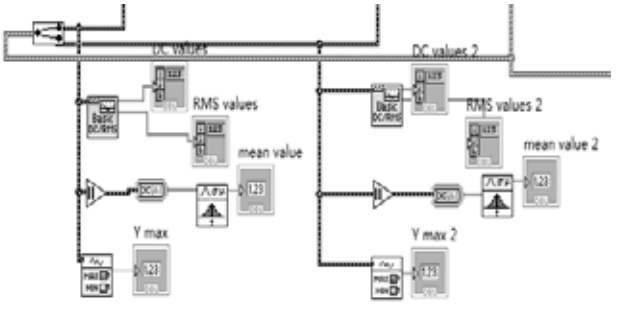

Figure 4 Block diagram of Voltage measurement

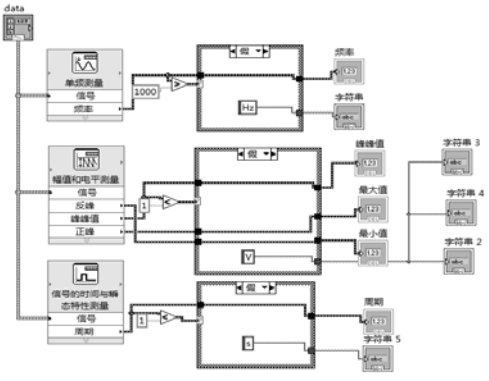

Figure 5 Block diagram of Time Domain Analysis

4.The test practice of the virtual oscilloscope

In order to test the function of the virtual oscilloscope, DF1642D function generator was chosen as a signal source. Put the sine wave of 47.5 HZ, top-top value of 6.2 V which generated by DF1642D into the USB data acquisition card which connected computer, then run the program. The result was showed in figure 6.

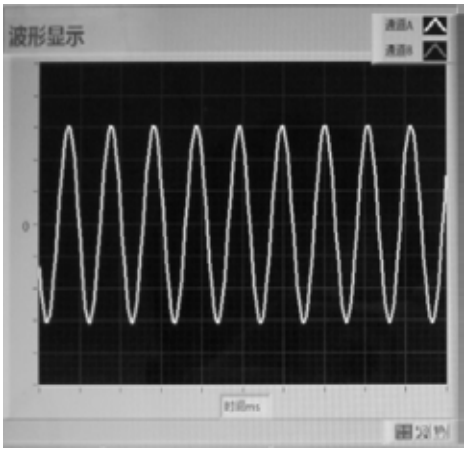

Figure 6 Waveform display

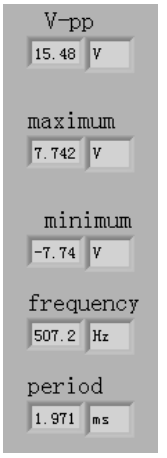

Figure 7 Time-domain result

Time-domain analysis could complete the functions of the measure of the waveform's V-pp, maximum value, minimum value, frequency and period. When the sine wave with 507.2 Hz, amplitude of 7.7 V was put to channel A, click " Channel A" button of time-domain analysis on front panel. the result was showed as figure7, that the total value is 15.48 V, the maximum value is 7.74 V, minimum value is 7.74 V, frequency is 507.2 Hz, period is 1.97 ms. And all other functions can also work well by test.

5. Conclusion

The design and development of multifunction virtual oscilloscope using NI USB-6210 data acquisition card and LabVIEW software was introduced in this paper. The traditions functions in the instrument were still holded, what's more, some new functions such as signal time-domain and spectrum domain analysis, voltage measurement, waveform stored and playback, etc. were developed. It was well-founded to consider, along with the application of the instrument in our school's experiment teaching of biomedical engineering professional, the multi-function virtual oscilloscope would have a promising future.

Acknowledgment

This work was financially supported by the transformation of scientific and technological achievements project of Jiangsu Province(JHZD09-22).

References

[1] Wei Jiang, Fang Yuan. Design of Oscilloscope Based on Virtual Instrument Technique[C]. 2nd International Conference on Power Electronics and Intelligent Transportation System. 2009,284-287.

[2] Xie Jian-Feng, Che Kai-Sen, Huang Lan-Tao.Design of Virtual Oscilloscope Based on Fast Data-Acquisition Card PCI-6143[J]. Process control computer.2010,23(2):3-5.

[3] Aiju Chen, JingJing Liu. A Kind of Virtual Oscilloscope Used in Experiment Teaching Based on Sound Card and LabVIEW[C].Second International Conference on Education Technology and Training.2009,118-121.

[4] ZHAO Xian-ling. The Virtual Instrument based on LabVIEW and Sound Card[C]. International Conference on Computational Aspects of Social Networks.2010,743-745.

[5] Russ Turley, Matthew Wright. Developing Engine Test Software in LabVIEW[J].Autotestcon.1997,575-579.