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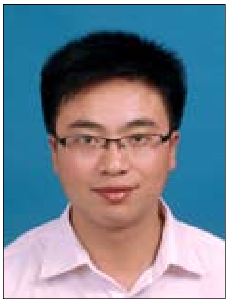

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DESIGN OF DATA ACQUISITION SYSTEM BASED ON LABVIEW

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Abstract. This paper introduces a method of data acquisition and processing based on a virtual instrument. LabVIEW 2014 is the software development platform focusing on the virtual instrument system for data collection and analysis. The basic idea of waveform acquisition and measurement is introduced briefly, and its application to modern motor speed control system is presented. The system can perform data collection, analysis, display, storage, printing and historical playback. It has a good human-computer interaction interface, easy to maintain and expand. The practical application shows that the system is simple and meets the technical requirements of the system test.

Keywords: virtual instrument; data collection; signal processing.

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Problem statement.

With the rapid development of computer technology, automatic test systems are changing dramatically. So are multi-channel data acquisition systems, their central part [1]. A test system based on LabVIEW is widely applied in all spheres of testing and automation because of its small module, high test precision, fast programming environment, and strong data processing ability.

The upper and lower machine acquisition systems composed of a single chip microcomputer and PC have some disadvantages [2], for instance, complexity of development and low data collection efficiency. And the system based on PC using only one data acquisition card and the LabVIEW programming language that can be implemented on Windows provides greater simplicity and practicability of data acquisition, processing, storage, convenient and flexible use [3].

Basic material.

1. Hardware structure

1.1. Hardware introduction

The system hardware structure is shown in Fig. 1. It includes a computer and some data acquisition equipment. The data acquisition card PCI- 818L introduced by Yan Hua can be inserted directly into the PCI slot of the industrial control machine; it supports plug and play and is easy to use. PCI-818L is a high-performance multi-function data acquisition card with 12b ADC with a maximum conversion speed of 40 kHz. It can provide users with 16 single-ended or 8 differential double-ended analog input channels and 1 analog output channel, as well as 16 digital input and output channels (compatible with TTL, TDL). The analog voltage input range can be selected with a jumper switch. In this system, it is chosen to make up ±5 V.

1.2. The data acquisition card drive

The card drive is divided into internal and external [4]. PCI818L is directly inserted into the PCI slot, which belongs to the internal drive. As for the data acquisition card released by the NI Company, users can use the DAQ module library which can be embedded in LabVIEW to operate the collection card after installing the collection card driver. It is cheaper than using the NI Company card and employs the same method.

2. Software design

2.1. Programming

LabVIEW is based on graphical compilation (Graphics, G) language. The software development platform has such functions as data acquisition, data analysis, signal processing, input and output control [5]. Moreover, the development speed time is short, which is especially useful for beginners. LabVIEW has two basic windows — a front panel and a program block diagram. The front panel is used to place controls and display objects; the program block diagram implements graphical language for writing program source code [6].

In this system, the front panel is used to place the window setting such parameters as collection, filtering, storage and playback, and display the waveform and parameters before and after treatment with oscilloscope. The program flow diagram is shown in Fig. 2.

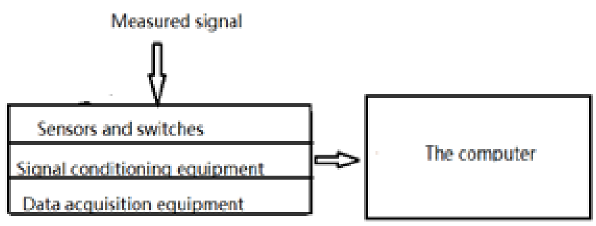


Fig. 1. System hardware structure

2.2. Signal analysis and processing

In practice, although the collected signals are tuned, the distorted wave still exists, and this paper will show hot to extract useful signals from it. Therefore, the collected signals must be processed before the signal is analyzed. The original waveform collected is shown in Fig. 3. The filter effect is shown in Fig. 5,*a*, and it is obvious that the delay time is longer. This is not allowed under strict conditions. The following is a data processing method that can resolve this problem effectively [7].

Let us take the data collected at some time in the first channel as an example to illustrate the effect of this method. The waveform before filtering is shown in Fig. 3, and the signal in the diagram clearly has larger harmonics. When dealing with the collected signal, if the ceiling plus filter cut-off frequency is too small, the frequency is too low, and the filter waveform changes very slowly, which requires less time in the test system; such an effect does not make a substantial difference. The system has a strict requirement on time, so it is necessary to design the appropriate upper and lower cut-off frequencies so as to ensure that the delayed waveform is delayed in an acceptable range. To this end, a data processing method is designed, which proceeds as follows

$$\Delta t = \frac{y_{t+1} - y_t}{y_t},$$

where y_t, y_{t+1} are the data from two adjacent points. Respectively, if $\Delta t > a$, then y_{t+1} is made into y_t, and if $\Delta t < a$, y_{t+1} remains constant.

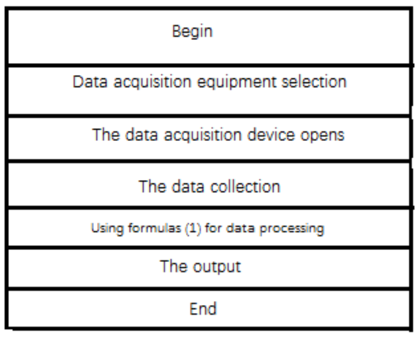


Fig. 2. Program flow chart

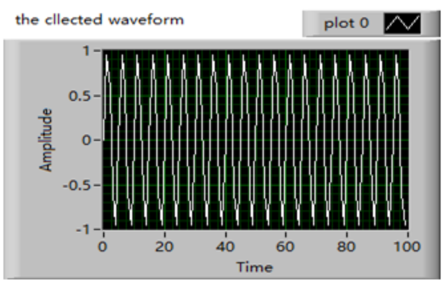


Fig. 3. Waveform before filtering

Data processing is performed by using C language in the formula node in the LabVIEW environment. The program flow chart is shown in Fig. 4.

On this basis, the filter is also used, and the appropriate filtering parameters are set. The butterworth filter is selected and the upper limit is set to 0.45 Hz, the cut-off frequency is set to 0. 2 Hz, and the filter is set to 3. The waveform that is filtered with this method is shown in Fig. 5 b. It can be seen that the delay time of the above signal processing method is short and the filtering effect is good. This has been proved in practice [8].

2.3. Signal test module

The module is used to test the valid value of the signal and the sampling frequency, and the facts are known to collect the parameters of the signal and determine whether the signal is within normal range. If the normal test range is exceeded, the system will call the alarm and handle the signal properly.

2.4. Signal storage and return

The signal is stored in order to save its parameters, so that it can be referenced at any time. The system employs the LabVIEW 2014 built-in storage module files storeage program, where one can choose the stored file formats (such as EXCEL, HTML, etc.) [9]. The playback is for the user to be able to re-observe the data after the data collection and analysis is completed [10]. This system can play the whole data waveform back dynamically after the user saves the data and selects the mode.

CONCLUSIONS. The data processing system under consideration performs collection, processing, display, storage and playback of the signal. Compared with the traditional data acquisition system, it has a lower price, higher usability and shorter development cycle. Data processing is simple and convenient, which greatly reduces the development cycle.

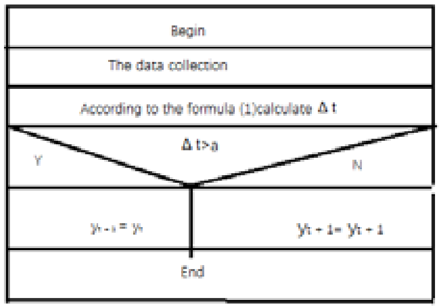
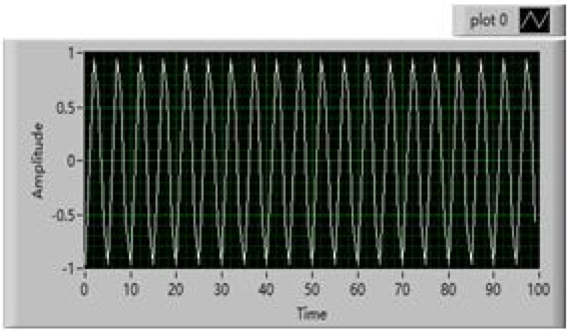
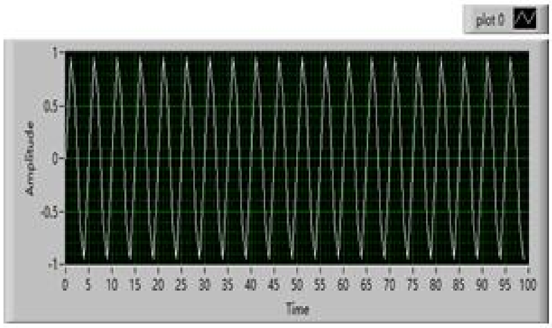


Fig. 4. Program flow chart



a)



b)

Fig. 5. Filtered waveform

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