A Multi-type Data Acquisition Platform Based on LabVIEW

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Abstract. This paper presents a LabVIEW based platform for acquiring multi-type data. With the help of virtual instrument technique, the platform is capable of sampling the current signal, frequency signal, switching signal and resistance signal, judging the validity of data and analyzing the characters of data as well. The framework of the acquisition platform comprises of two parts, i.e., the software part is developed in LabVIEW language and the hardware part is built by National Instruments (NI). In addition to its major functions, the platform supports storing and reviewing the data and analysis results, and possesses a friendly graphical user interface (GUI), which facilitates the maintenance and function extensions. The engineering practices reveal that the proposed platform has advantages of readily-operating and stable functions, and satisfies the diverse requirements of data acquisition.

1. Introduction
The concept of VI (virtual instrument) was introduced by American National Instrument in the 1980s, it is composed of three parts including computer, virtual instrument software and instrument hardware, user can change the function of instrument by modifying software. This system adopt LabVIEW which is developed by NI to develope. The function of LabVIEW’s virtual instrument is very powerful. Virtual instrument is a data acquisition system which is in accordance with the requirements of the organization, and is widely used in computer data acquisition and digital signal processing.

2. Framework of the platform
In this part, we introduce the general components of the data platform, namely the software and hardware. The sketch of the data acquisition platform is shown in Figure 1.

The hardware completes the data acquisition function by adopting the functional modules of NI system, such as current signal acquisition modules, frequency signal acquisition modules, resistance signal acquisition module. The platform samples the current signal, frequency signal and resistance signal through these functional modules, and stores data by industrial control computer, and displays data by liquid crystal display.

The software completes the functional modules’ configuration and the software developing through the driver user interface Max by LabVIEW user develop platform. The software developing mainly includes the current signal analysis (such as effective judgement, filter), frequency signal analysis, resistance signal analysis, and the development of graphical user interface by LabVIEW.
3. Hardware design

The hardware of multi-type data acquisition are composed of direct-current power, industrial control computer, liquid crystal display, NI series products (CPU controller, main chassis, ethernet extended chassis, analog input modules, platinum resistance input modules, high speed digital input and output module, digital input modules) and eight ports ethernet switch. The hardware composition of multi-type data acquisition system is shown in Table 1.

| Sequence | Equipment name                        | Quantity |
|----------|---------------------------------------|----------|
| 1        | direct-current power                  | 1        |
| 2        | industrial control computer           | 1        |
| 3        | liquid crystal display                | 1        |
| 4        | CPU controller                        | 1        |
| 5        | main chassis                          | 1        |
| 6        | ethernet extended chassis            | 2        |
| 7        | 16-Channel analog input module        | 3        |
| 8        | thermal resistance input module       | 18       |
| 9        | high speed digital input and output module | 1    |
| 10       | 32-Channel digital input module       | 1        |
| 11       | eight ports ethernet switch           | 1        |

The hardware diagram of multi-type data acquisition system is shown in Figure 2.
3.1. Direct-current power
The system chooses direct-current power which is 500W 24V 20A. It can change AC 220V input power to DC 24V power, and supply power to every function module.

3.2. Industrial control computer and liquid crystal display
The system chooses industrial control computer which is made from Chinese Advantech Co.Ltd. and 17” liquid crystal display which is used to display and store data.

3.3. NI system
NI helps the engineers which are belonged to the field of test, control and design to deal with the challenge. Through ready-made software, such as LabVIEW, and cost-effective modular hardware, NI helps every field engineers to innovate constantly, shorten the time of product and reduce the development cost. The system mainly adopt products such as follows:
NI cRIO-9023: intelligent real-time embedded controller for CompactRIO;
NI cRIO-9112: eight-slot reconfigurable embedded chassis;
NI 9148: eight-slot ethernet expansion chassis for c series modules;
NI 9208:16-Channel,±20mA,24-bit analog input module which is configured with 37-Pin DSUB to screw-terminal connector block NI 9923;
NI 9217:4-Channel,24-bit,100ΩRTD analog input module;
NI 9401:8-Channel,TTL digital input/output module which is configured with 25-Pin DSUB to screw-terminal connector block NI 9924;
NI 9426:32-Channel,24V, sourcing digital input module which is configured with 37-Pin DSUB to screw-terminal connector block NI 9923.

3.4. Eight ports ethernet switch
It is used to ethernet communicate between the main chassis and ethernet extended chassises to exchange the bottom data. Industrial control computer receives the bottom data through eight ports ethernet switch, and displays and stores the bottom data.

The structural diagram of data acquisition system based on LabVIEW is shown in Figure 3.
Data acquisition hardware mainly refers to DAQ devices. Hardware driver is the especial driver which link the hardware device and industrial control computer, to ensure the natural communication between the hardware device and computer. NI has corresponding driver which is named NI-DAQmx after packaged to every DAQ device. The driver user interface is refer to MAX(measuring and automation explore) which is named as measuring and automation management software, is mainly used to configure and test for hardware\(^1\). Four kinds of NI function modules(such as NI 9208,NI 9217,NI 9401,NI 9426) are configured in the MAX, LabVIEW provide a developing platform to user who can complete the total system’s design with this platform.

### 4. Software design

LabVIEW is a developing environment\(^2\) which has a graphical programming language, and a program compiling platform which is developed by NI, it is convenient to maintain software. Besides LabVIEW platform has many kinds of controls which can be modified by customer\(^3\),it can prompt the design methods of human-machine interface.

#### 4.1. System’s function design

Software design is the center of the total system. Its design is realized through hierarchical modular theory, the system is divided into several modules, modularized program architecture not only make the system clear, but also easy to be maintained. The system software architecture of data acquisition system based on LabVIEW is shown in Figure 4.

![System software architecture](image)

**Figure 4.** System software architecture

#### 4.2. System interface design

The system develops corresponding interface to six function modules.

a) system start up interface

System start up interface mainly refers to check every module’s power and network connection.

b) system menu and function interface

System menu and function interface is a flat structure, it has three tabs which are corresponding to three interfaces:

- display parameter 1
- display parameter 2
- display parameter 3

It can display corresponding software interface when click each tab.
The measurement parameters are displayed in three software interfaces, the display parameter 1 interface mainly displays (4～20)mA current signals, the display parameter 2 interface mainly displays platinum resistance signals, the display parameter 3 mainly displays digital signals.

The background of parameter will change to red blinking status when the parameter’s value exceeds its pre-set upper or lower limit. We can change the parameter’s range, upper and lower limit through modifying the EXCEL file.

c)view history data
There is a button which can open the data log file in the display parameter 3 interface, the path is “D:\Data\XXXXXX”, XXXXX is the data’s date, such as “150525”, it is May 25, 2015. We can open the data log file through choosing TDMS file, and also can open it by double clicking the TDMS file through the path.

The view of the history data interface is shown in Figure 5.

![Figure 5. View of the history data](image)

Attention: we must close the EXCEL file after viewing the data log file.

5. Conclusion
The multi-type data acquisition system is simple, stable, and friendly user interface and so on. The system adopts NI hardware and LabVIEW software platform, it can realize the acquisition of platinum resistance signals, current signals, frequency signals, switching signals, and realize the input data acquisition, analysis, display, storage and review at the same time. It can be used to the field of test and measuring widely.

6. References
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