Design of Multi-channel data acquisition system based on single Chip computer and LabVIEW

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Abstract. Labview is a graphical programming language that creates applications with icons instead of text lines. Because the traditional data acquisition system based on single chip computer is not supported by the upper computer, its storage capacity is limited, no matter what kind of data memory is used, so it has to overwrite and refresh the stored historical data. This system uses the lower computer to collect the analog data, and from the single chip computer to collect the eight channels of data, and to answer the command sent by the host. The host computer is responsible for processing and displaying the received digital quantity. The host and slave communicate with each other using RS-232. The paper presents design of Multi-channel data acquisition system based on single Chip computer and LabVIEW.

1. Introduction
There are two main differences between LabVIEW and most other general-purpose programming languages. First, G programming requires connecting the icons on the block diagram. The program block diagram is then compiled directly into machine code that can be executed by a computer processor. It uses graphics rather than text to represent its own G, and contains the same programming concepts as the most traditional languages. For example, G contains all standard constructs, such as data types, loops, event handling, variables, recursion, object-oriented programming.

The hardware of the speech acquisition system based on the virtual instrument technology is composed of the voice chip MICM, the horn and the amplifier circuit. Its working principle is that the music contained in the speech chip is sent out by the speaker. MIC collects the music signal, amplifies the amplifier circuit, and sends it into the analog input channel of NI ELVIS II data acquisition platform. Then using the virtual instrument software development platform LabVIEW to develop the system software, to achieve the acquisition, analysis, and processing and report generation of the voice signal. The voice signal is analyzed and processed by the computer. By setting sampling points and sampling rates, the data can be analyzed and processed in time domain and frequency domain. The distribution of audio frequency and the characteristics of speech signal can be observed.

In recent years, data acquisition and its application have been paid more and more attention, and the data acquisition system has also developed rapidly, which can be widely used in various fields.

The data acquisition system began on 1950s. In 1956, the United States first studied the test system used in military. The goal is to operate the test system by immature personnel without relying on related test files. And the test task is completed by the test equipment high-speed automatic control. Because of this kind of data acquisition and testing system has the high speed and certain flexibility [1]. It can
satisfy many traditional data acquisition and testing tasks that cannot be accomplished by traditional methods, so it has been approved preliminarily, probably in the late 60s. At home and abroad, there are complete sets of data acquisition equipment and systems are mostly dedicated systems.

In 1970s, with the development of microcomputer, a data acquisition system, which integrates instrument and computer, was born, because of the excellent performance of this data acquisition system. More than the traditional automatic detection instrument and special data acquisition system, it has made a remarkable development. Since 70s, the data acquisition system has been divided into two categories gradually in the process of development. One is the laboratory data acquisition system, the other is the industrial field data acquisition system.

In 1980s, with the popularization and application of computer, the data acquisition system has been greatly developed, and the general data acquisition and automatic test system has appeared. There are two kinds of data acquisition system in this stage. This kind of system is mainly used in the laboratory and also has certain application in the industrial production field. The second kind uses the data acquisition card. Standard bus and computer, this kind of industrial field application in the late 80s of the 20th century, data acquisition has undergone great changes, industrial computers, single-chip computers and large-scale integrated circuits combination. With software management, the cost of the system is reduced, the volume becomes smaller, the function increases exponentially, and the ability of data processing is greatly enhanced [2].

Virtual instrument technology is the result of the combination of computer system and instrument system. It is an important technology in the field of computer aided testing. It promotes the traditional instrument to be digitalized, intelligent and modular. The development of network. Up to now, electronic measuring instruments can be divided into four generations: analog instruments, digital instruments, intelligent and virtual instruments, and the first generation of analog instruments [3]. This type of instrument can also be seen in some laboratories, it is based on the basic laws of electromagnetic induction as the basis of the exponential instrument, such as the index multimeter, transistor voltmeter, pointer ammeter, etc. The second generation of digital instruments. These instruments, which are now quite common, convert the measured values of analog signals into digital signals and digitally output the final results, which are suitable for fast response and higher accuracy measurements, such as digital multimeters.

Digital frequency meter and so on. The third generation intelligent instrument, this kind of instrument built-in microprocessor, can carry on the automatic test and the data processing function, may replace part of the brain husband. It is usually called intelligent instrument. Its function modules are all in the form of hardware or fixed software, no matter it is developed or applied, it lacks flexibility. 4th generation virtual instrument. It is a revolutionary technology bred by the rapid development of computer software technology, communication technology and testing technology, which has led to great changes in the structure, concept and design of traditional instruments. With its emergence, human testing technology has entered a new era of development.

2. Design of Multi-channel data acquisition system based on Labview

B In many cases, traditional instruments have to rely on complex hardware circuits to accomplish some tasks, but because of the strong signal processing ability of computer data, these complex hardware circuits can be replaced. This is the biggest characteristic of virtual instrument. The premise of normal operation of data acquisition system is to choose an excellent computer platform. Often accompanied by strong vibration, noise, power line interference and electromagnetic interference. In order to ensure the normal operation of the recorder. When designing the system, the industrial computer is selected. Considering the reliable operation of the computer platform, the industrial computer usually takes anti-interference measures. On the other hand, the industrial computer usually has many kinds of interfaces. This is conducive to the further expansion of the function.

The sensor device can receive a signal from a measuring target and change the received message into an electrical signal or other form by changing the received message into an electrical signal or other
form through a set conversion ratio, thus completing the processing of the data signal. Storage, display, recording and control tasks. Sensors are the first step in system detection and control.

Most of the signals passed through the sensor can be received by the data acquisition equipment which can amplify, isolate, filter and stimulate the signals. Linearization and other processing. Because different types of sensors have different functions, in addition to considering some general functions. The special signal conditioning function should be realized according to the properties and requirements of different sensors. The general function of the signal conditioning circuit is as follows:

In order to improve the resolution of the system and reduce the noise interference, the weak signal must be amplified. The signal voltage after amplification is consistent with the voltage range of A / D conversion. After the signal passes through the sensor, the signal directly enters the signal conditioning mode for conditioning, so it is not easy to be affected by the external environment. Thus, the signal-to-noise ratio is further improved.

Isolation function isolation means to avoid direct electrical connection by means of light, interactive power supply or voltage transformer. The reasons for the use of isolation are as follows: first, for security reasons; The second is to ensure that the data collected will not be affected by other reasons [4].

Figure 1. Isolation function isolation means to avoid direct electrical connection by means of light

Filter filtering is to ensure the purity of the measured signal. Filter unwanted signals. Most signal conditioning modules have a low-pass filter that is used to filter noise. Usually anti-aliasing filters are also required. Filter the signal at all frequencies above the highest frequency of interest in the signal. 4) the excitation function signal conditioning module can provide the excitation signal for some sensors, and many signal conditioning modules provide the current source and the voltage source in order to provide the excitation to the sensor.

In order to compensate the sensor error, it is necessary to linearize the output signal. The data acquisition system can solve this problem by software.

In response to this situation, we used LABVIEW, a graphical programming language, to create a software app called the Health Wizard, which is designed to record the daily nutritional intake and accumulation of users and to form a specific diet path. And according to this diet track to give humanized sports advice, recommended to the user appropriate sports and exercise. The excess energy accumulated daily can be released through exercise, in order to achieve the purpose of a healthy life. Improve people's quality of life.

The characteristic of health elves is that they can give the optional exercise items and exercise time according to daily intake, which can avoid the drawbacks of daily quantitative exercise to some extent, and increase the interest of users to exercise. At the same time, the health wizard also serves as a reminder to the user to exercise in time.

In the material life and spiritual life are increasingly perfect in today's society, people's living conditions are good, their own health problems will be paid special attention to! We designed this app in the hope that we could help you with a little bit of your healthy life, especially for people who have been working at their desks for a long time to remind them of their health. Health Elf is a software that
serves people’s health. Starting with diet and exercise, it not only records the diet of users, but also provides users with reference to exercise [5].

LABVIEW has advantages in connecting with backstage database and interacting with users. We choose to use LABVIEW to program, which can facilitate the extension of subsequent programs and improve the comfort of users.

Labview is a program development environment, developed by the National instrument Company, similar to C and BASIC development environment. But the obvious difference between Labview and other computer languages is that other computer languages use text-based languages to generate code. Labview uses the graphical editing language G to write the program, and the generated program is in the form of block diagram.

![LabVIEW Block Diagram](image)

Figure2. Like C language and BASIC language, LabVIEW is also a general programming system.

Like C language and BASIC language, LabVIEW is also a general programming system. There is a huge function library. LabVIEW includes data acquisition. GPIB, serial port control, data analysis, data display and data storage. LabVIEW also has traditional debugging tools, such as setting breakpoints, displaying data and the results of its sub-programs in animation. Single-step execution and so on, easy to debug the program.

Labview is a graphical programming language that uses icons instead of text lines to create applications. Traditional text programming languages determine the order of program execution according to the order of statements and instructions. In Labview, the data flow direction between nodes in the program block diagram determines the execution order of VI and function. VI refers to virtual instrument, which is the program module of Labview.

Labview provides a number of controls that look similar to traditional instruments and can be used to easily create user interfaces. The user interface is called the front panel in Labview, using icons and wires. Objects on the front panel can be controlled by programming. This is the graphical source code, also known as G code. LabVIEW graphical source code in a way similar to the flow chart. Therefore, it is also called program block diagram code.

This semester through the study of Labview for the Labview has a certain understanding, on the basis of this, we according to the requirements of the teacher. The small device of sound and color lamp based on Labview is made. Through the combination of Labview and PCI6221 DAQ data acquisition card, the effect of collecting sound signal and controlling the flicker of color lamp is achieved.

The second major difference is that G code developed by LabVIEW follows the rule of data flow when executed. Rather than the more traditional procedural approach in most text-based programming languages, such as: C and C (that is, data flow languages such as executed command sequences, such as. G) (and Agilent VEE.). Microsoft Visual Programming Language. Apple Quartz composer uses data as the main concept to support various programs, and data stream execution patterns are data-driven. It is the flow of data between nodes in the program, not the order of the text, which determines the order of execution.

The difference may be small at first, but the impact is extraordinary, because it makes data paths between components of a program a focus for developers. Nodes in LabVIEW programs (I. e., functions,
loops, and so on). Subroutine.) gets the input data, processes the data and generates the output data. Once all the input of a given node contains valid data, the node executes its logic. The output data is generated and passed to the next node in the data flow path.

After the software of the voice acquisition system runs, it first enters the initialization state of the system. The initialization state of the system can mainly be used to NI ELVIS II data acquisition platform. The data acquisition channel and all the controls on the software interface are initialized. After the system is initialized, the software waits for other functions to be selected and run.

2.1. System wait
In the system waiting state, the user can select other functions and run. The system waiting state is required to be implemented with event-driven architecture.

2.2. Data acquisition
The system can be used for continuous real-time acquisition, analysis and display of speech signals. The sampling parameters can be set up including the physical channel and sampling rate of the NI ELVIS II data acquisition platform. Setting of parameters such as sampling points per channel. The waveform parameters in frequency domain can be set including waveform type in frequency domain, cutoff frequency (Hzn), and upper cutoff frequency (Hz.) [6]. The time domain waveform and other parameters are displayed in real time. The frequency spectrum of the signal is analyzed and the spectrum waveform is displayed.

3. Design of Multi-channel data acquisition system based on single Chip Microcomputer
The data acquisition system is to collect the analog signal output from the sensor and convert it into digital signal, and analyze, process, transmit, display, store and display. It started in the middle of 20th century. In the past few decades, with the development of various technologies in the field of information, the technology of data acquisition has also made great progress. The information of collecting data is the mainstream direction of the society at present. Data acquisition is used in various fields and has been applied in the fields of petroleum exploration, scientific experiment, airplane flight and seismic data acquisition.

![Figure 3. TDE-124C type TDE-224C seismic data acquisition](image)

TDE-124C type TDE-224C seismic data acquisition system is mainly used in the digital seismic observation system in China. In recent years, the dynamic range is larger and the linearity is higher. A more compatible, low-power and reliable TDE-324C seismic data acquisition system, which uses simultaneous sampling for analog amplification of electrical signals from the seismograph to the A / D digitized A / R D. The sampling data is processed by DSP digital filter and becomes digital seismic signal. The data acquisition system has 24 bits A / D conversion bits and the sampling rate is 50 HZ / 100HZ / 200HZ.

Science Studio is produced by PASCO Company, is a new system to apply data acquisition to physical experiments. It is composed of three parts: the sensor can collect the data of physical quantities in real time by using advanced sensing technology [7]. Computer interface: the data signal from the sensor is input to the computer, the sampling rate is up to 250,000 times / s; Software: Chinese and English applications.
Driven by demand. The new generation of airborne data acquisition system is also developing rapidly to meet the requirements of flight experiment. For example, the new generation of KAM500 airborne data acquisition system developed by Irish ACRA company in 2000 has reached 200.6 years. The system uses 16 bits (A/D) analog-to-digital transformation. The total sampling rate is 500 K/S and the synchronization time is between 250 ns, which can be used to form a large capacity distributed acquisition system with up to 1000 channels.

The concept of Virtual Instruments. National Instruments Corp of is the United States. In 1986, NI Company also put forward the slogan of "Software is instrument". Completely broke the traditional instrument can only be defined by manufacturers, users can not change the situation, thus causing a revolution in the instrument and automation industry. With the rapid development of hardware and software technology. The intellectualization and virtualization of instruments have become the development direction of laboratories and research institutions at all levels. Virtual instruments have the functions of traditional instruments. Different from other traditional instruments, it can make full use of the advanced computer technology and make the testing and measurement of instruments and the system testing and monitoring of automation industry extremely convenient and fast.

Virtual instrument is to combine the function module of computer, software and instrument hardware through application program. Users can use friendly graphical interface (usually called virtual front panel). To operate the computer is like operating a personal instrument defined by itself, so as to complete the acquisition, analysis, judgment and display of the signals to be tested. Digital storage and so on. Virtual instrument in a transparent way, through the analysis of data processing, expression and graphical user interface, computer resources (such as microprocessor). Display, etc.) and instrument hardware (such as A/D, D/A, digital I/O, timer. The test ability and control ability of signal conditioning are combined. Virtual breakthrough of the traditional instrument with hardware as the main mode, in fact, the user is operating the electronic computer with test software to measure. It is like operating a virtual electronic instrument.

We need to know that the data set collected by the signal is different from that of the system performance. Only when we know the nature of the measured signal, can we choose the right acquisition system accurately.

An arbitrary signal is a change in a physical quantity in time. In general, the signal carrying information is very extensive, such as: state, rate, level, form, frequency and so on. According to the signal carrying information of the signal can be divided into digital signal or analog digital signal. Including the signal pulse signal and switch signal. Two types of analog signals including DC signal, time domain signal, frequency domain signal.

![Figure4. The first kind of digital signal is a switch quantity signal](image)

The first kind of digital signal is a switch quantity signal, as shown in Figure 3. A switch signal carries the instantaneous state of information signal. If the voltage of a switching signal is between 0 and 0.8V, it is called logic low level, if 2.0V to 5.0V, it is called logic high level.

The hardware platform of virtual instrument consists of two parts: A computer is generally a PC or workstation, it is the core of the hardware platform.
It mainly completes the acquisition, amplification, A/D conversion of the input signal under test. According to the different bus and its corresponding I/O interface hardware equipment. For example, using the data acquisition card/board of PC bus, the VXI bus instrument module, the serial bus instrument and so on, there are five types of virtual instrument.

4. Design of Multi-channel data acquisition system based on single Chip computer and LabVIEW

Like most people, engineers and scientists can learn by looking at and processing images without having to meditate consciously. Many engineers and scientists are also described as "visual thinkers." This means that they are particularly good at organizing information through visual processing. In other words, they are best at visualizing thinking. This is often reinforced in colleges and universities. Students there are encouraged to build problem-solving solutions in the form of process diagrams. However, most general-purpose programming languages require you to spend a lot of time learning specific text syntax related to that language. Then the structure of the language is mapped to the problem being solved. The graphical programming with G provides a more intuitive experience.

G code is usually easier for engineers and scientists to understand quickly, because they are very relevant to display. You can even model the processes and tasks of program block diagrams and flowcharts in schematic form (which also follows the data flow rules.) in addition, because of the data flow language, you need to base the program structure of the data flow. For example, a typical G program may first collect the temperature data of multiple channels and then transmit the data to the analysis function. Finally, the analyzed data is written to disk. In general, the data flow and the steps involved in the program are easily understood in the LabVIEW block diagram.

Report generation function can realize the continuous speech signal acquisition and analysis of relevant parameters in the process of including the use of NI ELVIS II data acquisition platform physical channel, voltage maximum value, minimum value, sampling rate, sampling points per channel, the time domain waveform, spectrum waveform parameters or waveform as the contents of the report were saved. Open the report function can save the report was opened for off-line analysis and processing. Press the "exit" button will exit the system software.

Requirements of friendly interface and convenient operation. The system software system software interface on the front panel must have a status bar, to display the current running state of the software.

(1) a preliminary understanding of the design steps of the control system, control system design methods, to deepen the understanding of professional knowledge, can learn the integrated use of the sensor principle and detection technology of < >, < > < virtual instrument technology, measurement and control circuit >, < > control system principle and design the design of measurement and control system of professional knowledge unit, and the composition of the system.

(2) through the establishment of system design scheme, reasonable selection of sensors and other components, the correct calculation, select the circuit and component parameters, determine the size and the choice of materials, and comprehensively considering the requirements of manufacturing process, use and maintenance, to understand and grasp the process of measuring and controlling system and method of comprehensive design.

(3) to design the training of basic skills. Such as: calculation, drawing, familiar with the design and use of data (manual, Atlas, standards and specifications etc.) and the use of empirical data, empirical estimation ability and data processing and computer application.
(4) understand the development frontier of modern instrument science and technology, learning and mastering the composition and working principle of measurement and control system based on virtual instrument technology; to further understand and debug the software design method of virtual instrument based on LabVIEW graphics techniques.

(5) to cultivate students' ability of access to information and knowledge; improve students' ability of writing and presentation of papers; train students on the proper design and strict scientific style; cultivate students' innovation ability and the ability of using knowledge.

Although the programmable data acquisition and processing technology with microcomputer as the core has been developed rapidly as the data acquisition technology. And the board card level data acquisition products which are suitable for general computer (such as IBM PC series) have appeared in large numbers. It is so simple to form a data acquisition system that only one data acquisition card is needed. Inserting it into the expansion slot of microcomputer and applying software can realize the function of data acquisition, but this will not affect the data acquisition system based on MCU, because the function of SCM is powerful. With the advantages of strong anti-interference ability, high reliability, good flexibility and easy development, the data acquisition system based on single-chip microcomputer has been widely used in many fields.

Because the traditional data acquisition system based on single chip computer does not have the support of upper computer, its storage capacity is limited, no matter what kind of data memory is used. Therefore, the stored historical data has to be overwritten and refreshed, which is not conducive to the overall analysis of the data by the user, and therefore cannot accurately grasp the status of the production process.

This system uses the lower computer to collect the analog data, and from the single chip computer to collect the eight channels of data, and to answer the command sent by the host. The host computer is responsible for processing and displaying the received digital quantity. The communication between the host computer and the slave computer is carried out by RS-232, so that the user can write various programs to query and analyze the data in the file effectively on the host computer. The system uses AT89S52 single chip microcomputer, which is powerful and can meet the design requirements.

5. Summary

The digital signal is output to the PCI6221 data acquisition card through the DAQ digital sampling system, the cyclic statement and the selection statement. After the program is executed, the output signal is selected by the remainder operation of the running times. When the number of times of operation is 1:00, the division cooperator selects to execute yt3, and when y#time1# operation outputs 8-bit binary high and low level to DAQ digital sampling system. The PCI port controls the first pair of lights to be lit by the LED lamp group. Similarly, when the number of runs is 2:00, the division remainder selects to execute the command y= 4:00. The 8-bit binary high and low level running at 4:00 is sent to the DAQ digital sampling system to control the second pair of lights of the LED lamp set, and so on, so as to achieve the predetermined experimental effect.

The program begins to execute the event structure and selects the output signal by the division operation of the number of runs. For example, when the number of times of operation is 1:00, the division remainder selects to execute y0. And when yr = 0:00 operation output 8-bit binary high and low level to DAQ digital sampling system DAQ port control LED lamp group 2 lights up the first pair of lights, similarly, when the number of times of operation is 2:00. The division subunit selects to execute the command y= 1:00, and sends the 8-bit binary high and low level running at y#time1# to the DAQ digital sampling system to control the second pair of lights of the LED lamp group 2. And so on, so as to achieve a predetermined experimental effect.

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