Design and Research of Signal Processing System for Multi-Channel Data Acquisition Instrument Based on Adaptive Vibration

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Abstract: in Order to Improve the Quality of Signal Processing, the Design of Signal Processing System for Multichannel Data Acquisition Instrument is Studied Based on Adaptive Vibration. This Paper First Introduces the Structure of the System and Emphasizes the Necessity of Optimizing the Design of the System. Secondly, the Software and Hardware Design Methods Are Summarized. Finally, the Application Value of Each Design Method is Confirmed by Observing the Test Results of the System Function.

1. Introduction

Vibration is a common phenomenon, vibration frequency, velocity and displacement information in the process of equipment operation, which is included in the vibration process. The collection and analysis of the above information is helpful to clarify the operation status of the mechanical equipment, so as to realize the fault analysis and prevention. It can be seen that in order to reduce the failure rate, it is important to design the signal processing system of multi-channel data acquisition instrument based on adaptive vibration.

2. Signal Processing System of Multi-Channel Data Acquisition Instrument Based on Adaptive Vibration

The so-called self-adaptation refers to the process of adjusting the processing method according to its characteristics in the process of analyzing and processing the data. The signal processing system of multi-channel data acquisition instrument based on adaptive vibration is mainly composed of hardware and software. The hardware in the system is composed of an analog signal conditioning module, a digital control module and the like, and is characterized in that the vibration signal is adjusted to ensure that the data analysis requirement can be met. The digital control module consists of a C8051F single-chip computer, a keyboard, a liquid crystal display and the like, and is characterized in that the digital signal is adjusted. in addition, in that hardware of the system, the same packet Including power supply, controller, USB interface and so on. The software of the system is mainly database, A / D and D / A conversion system. The above composition can effectively meet the design requirements of the system and ensure the stable performance of the system [1].

3. Design and Test of Signal Processing System of Multi-Channel Data Acquisition Instrument Based on Self-Adaptive Vibration

3.1 System Hardware Design

The signal control module is the main part of the system hardware. In the system designed in this paper, there are many channels under this module. Vibration sensors are often used to connect between channels. The function of signal control module needs to be realized by sensor. In order to ensure the accuracy of signal acquisition, the designer added the charge amplifier to the hardware, and created an AC / DC coupling circuit. After the operation of the mechanical equipment, the multi-channel analog electronic switch can be opened immediately, and the vibration signal can be

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selected automatically. Since then, the filter in the system can play a role in processing the signal so that it can be output in the form of voltage signal [2]. The above signal The design method of control module can improve the automation level of system signal acquisition, reduce the difficulty of manual operation and improve the effect of signal processing.

During the operation of mechanical equipment, the rotating speed is generally in a constant state. In the absence of human operation, if the speed is suddenly abnormal, it indicates that the equipment may have failed, and the maintenance personnel need to deal with it immediately to avoid the expansion of the fault. In order to achieve the above purpose, this paper optimizes the design of the circuit by isolating and adjusting the pulse width, and enhances the pulse signal strength to a certain extent. This design method can improve the stability and standardization of the speed signal output, so that the speed can be controlled at a stable level. In addition, this paper also connects the circuit with C8051F, which lays the foundation for the coordination of the functions of the two [3]. When the mechanical equipment is running, the system can compare the time interval between the two adjacent impulses through the C8051F comparator, and the mechanical speed value can be obtained and displayed on the LCD screen.

The digital control module in the system needs to realize its function by means of a microprocessor. In order to improve the performance of the system, an SoC-based single-chip microcomputer is used to design the microprocessor. The single chip of this type, the core is CIP-51, has the advantage of fast speed. Practical experience shows that the highest speed can even reach 100 MIPs, which can fully meet the requirements of system operation and signal acquisition. The resource of the port is rich, which is one of the main advantages of the single-chip computer, and the designer does not need to be extended, so that the requirements of the system can be met. The function of the terminal is to perform the filtering control. A rich port resource, which is used to improve the performance of the wiring. The improvement is also of positive significance. In the system designed in this paper, the control clock of the cut-off frequency of the filter should also be controlled by the single-chip computer [4].

The operation of mechanical equipment is high in the supply stability of power resources. If the parameters such as current, voltage, etc. fail to meet the operation demand of the equipment, it is extremely easy to cause the efficiency to be reduced, and the failure can even occur, and the smooth progress of the production process will be hindered [5]. In a multi-channel data acquisition instrument signal processing system based on adaptive vibration, each type of hardware also needs to be operated by means of a power supply. In order to ensure the performance of the system, the 220V AC power supply is connected to the system, and the power supply is realized. The 220V power supply can be converted into a DC power supply of 12 V by the AC-DC power supply module. warp After the above-mentioned processing, the system will immediately analyze the power supply requirements of each part of the machine, and then convert the power supply into DC form, and supply power to each part through 24V, 5V and 3.3V.

3.2 System Software Design

The design of the running process of the system is one of the key contents of the software design. The specific methods are as follows: (1) system initialization, power supply and switch on, mechanical equipment start to run, the system starts. (2) search the daughterboard and set each channel to ensure that all channels can be used. (3) select the configuration channel and use it as a reference to select the sensor to ensure that the data acquisition results are accurate and can truly reflect the vibration status and characteristics of the equipment. (4) select the amplification and coupling methods to improve the quality of vibration signal processing, and lay the foundation for fault detection and elimination. (5) adjust the anti mixing filter frequency, select the type of output waveform, set the standard signal frequency, and configure the corresponding channel. (6) after the above operations are completed, the system will operate circularly according to the process to collect the vibration signals of mechanical equipment..

The performance of the system is the main way to improve the operation efficiency and improve the data signal processing ability. In order to achieve the above objects, the performance is optimized from the following angle: (1) The 16-channel vibration sensor is applied to the system to provide convenience and support for BN terminal access. (2) In order to improve the data collection efficiency, the system shall appropriately increase the number of sensors (e.g., voltage accelerometer, ICP acceleration sensor, etc.). It is worth noting that, for example, the ICP acceleration sensor is selected, it shall be ensured that the DC 4 mA constant current source can be provided. (3) The system can be 0.1-fold, 0.2-fold,1-fold, The gain multiple is optimized on the basis of 2 times and 4 times. In addition, it is necessary to optimize the main structure to enhance the anti-interference ability of the equipment, improve the signal-to-noise ratio of the system, reduce the communication loss, and enhance the system performance.

3.3 System Function Test

In order to judge whether the signal processing system of the multi-channel data acquisition instrument designed in this paper can meet the requirements of signal processing, the performance of the multi-channel data acquisition instrument is tested after the design is completed. Take the acquisition board as an example: the function of the acquisition board in the system is mainly to evaluate the strength of the signal, if the signal is weak, it can be processed by amplification and filtering. During the test, the corresponding signal should be sent out first, so that the acquisition board can collect it. Then gradually weaken the signal strength, observe the operation of the acquisition board. The data to be recorded during the test are mainly the peak value of the original waveform, the peak value after amplification and filtering, and so on. In addition, there is a need for signal-to-noise. The ratio and other parameters were observed.

Through the observation of the test results, it is found that when the vibration signal of the mechanical equipment is reduced to the minimum, the peak value of the original waveform is 840 MV. After using the acquisition board to amplify the filter, the value is increased to 3.4 V. In addition, the signal-to-noise ratio (SNR) data have also been improved. The test results show that the multi-channel data acquisition instrument signal processing system based on adaptive vibration has good performance, and can ensure that the signal acquisition is correct, stable, accurate and reliable operation, and the application and popularization value is high

4. Conclusion

To sum up, the signal processing system of multi-channel data acquisition instrument designed in this paper can collect the running signal of mechanical equipment in real time, and has the advantages of high signal transmission rate, strong stability and strong anti-interference ability. The application of it to the corresponding field can effectively prolong the service life of the equipment. In the future, it is suggested that the system should be popularized and applied so that its advantages and value can be brought into full play.

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