Design and Data Processing of AD Acquisition Program Based on LabVIEW—Motor Speed Detection as an Example

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ABSTRACT

Using LabVIEW as the software platform, the Altai PCI8932 signal acquisition card is the hardware. According to the motor speed detection project, the design and data processing of the AD acquisition program are carrying out, and the test of the motor speed frequency is completed. Based on the PCI driver function, a complete AD processing program is designed. The arithmetic average filtering algorithm and scale conversion data processing scheme are programmed for graphics in data acquisition process. To achieve more accurate and stable sampling data, it provides the basis for the later application of motor speed data (PID, result output).

Keywords: labview, pci8932, arithmetic average filter, scale conversion

Introduction

Combined with LabVIEW+PCI8932 card, the motor speed detection is taken as an example to complete AD acquisition program design and data processing based on LabVIEW. As shown in Figure 1, The DC motor is used as an actuating element, and the Holzer sensor is used as the detection device, and the motor speed governor is used as the drive of the motor. through the AD acquisition program design and data processing of LabVIEW, Realize the motor speed can be measured, the motor is reversible can be sentenced, the motor PID controllable functional requirements.

Figure 1. Labview—Motor speed measurement module.

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**AD data acquisition**

This system uses the Altai PCI8932 multi-function signal acquisition card as the virtual instrument data acquisition platform. In the process of programming, the CreateDevice function is used to create a handle hDevice of a device object, rely on the handle to pass parameters to the appropriate driver function. InitDeviceAD can use the hDevice handler to initialize the device, and the ReadDeviceAD function can use the hDevice handle to realize the sampling and reading of AD data. AD data acquisition flow chart is shown in figure 2. AD data processing involves two aspects of arithmetic average filtering algorithm and scale conversion data in this project.

![AD data acquisition flow chart.](image)

**AD acquisition program design**

1. **create device object functions**

   The Create Device function is responsible for creating the device object and returning the handle to the device object. If the function succeeds, it returns the handle to the device object; if the function failed, it returns the wrong code. The device object handle is the only basis for accessing a device. Different Device ID creates device object handles for accessing different devices, and the device is available to the user only when the handle to the device is specified by the Device ID. In this project, the Device ID should set 0 when the device handle management and operation of the first PCI device is to be created[1]. As shown in figure 3.

![Create Device.](image)

2. **initialize the device object AD**

   The InitDeviceAD function is responsible for the AD parts in the device object, Start AD device to open AD acquisition. The hDevice is the Device object handle, which is created by the Create Device of the PCI Device. PADPara is the object parameter structure, which involves the various states and operation modes of the device object, including AD sampling channels, sampling frequencies, and so on. As shown in Figure 4, This design builds an array function named PAPA (0, 1, 3, 0, 0). The parameters are as follows: the first channel 0, the end channel 1, the analog input range 3, the place 0, and programmable gain 0.

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(3) read the device AD

The ReadDeviceAD function is used to read batch data on the device AD. It must be used before the InitDeviceAD function, after the ReleaseDeviceAD function. hDevice is the handle of the device. ADBuffer is the address of the user data buffer. As shown in Figure 5. For example, if we need 2 data channels in design, we only need to collect analog signals acquired by acquisition cards and 1FFF, then get the signals stored in 2 channel data, that is, the elements of the array are divided into two output arrays (AD, AD2).

(4) arithmetic average filtering

This system uses arithmetic average filtering to filter noise, the method is to add \( N \) continuous sampling value, and then take the average value as the filter value of this measurement. The filtering effect only depends on the number of samples, the more times, the better[2]. As shown in equation 1:

\[
\overline{X} = \frac{1}{N} \sum_{i=1}^{N} X_i
\]

(1)

The arithmetic average filtering method of graphical programming is shown in figure 6. The first 4000 data stored in the AD array are summed up to element, and then the element is divided by 4000 to find the average to complete the whole average filter algorithm.

(5) scale conversion

The electrical signals detected by the sensor need to be collected and converted into the corresponding digital quantity. According to the parameters of the signal acquisition card, the voltage range is determined to be 0-10V, the AD conversion resolution is 12 bits, corresponding to 0-4096 digital quantity[3], and the scale conversion is as shown in equation 2. The block diagram is shown in figure 7.

\[
A_0 + (A_n - A_0) \frac{N_v - N_0}{N_n - N_0} = 0 + (10 - 0) \frac{4096 - 0}{4096 - 0} = 0.002441406V \times X
\]

(2)
(6) release the A/D device and release the device object

   When the acquisition card is used up, the A/D device is released first and then the acquisition card is released, as shown in figure 8.

   ![Figure 8. ReleaseDeviceAD, ReleaseDevice.](image)

**graphical programming**

   Using the Altai PCI8932 multi-function signal acquisition card, the complete graphical programming of the AD acquisition process is shown in figure 9. Follow the PCI8932 card AD acquisition process, The entire programming using flat sequence structure, While loop structure, For loop structure, conditional structure and other graphics. The speed detection of the DC motor in the LabVIEW is completed, which provides accurate data for the future PID control and the positive and reverse judgment[4].

   ![Figure 9. Graphical programming of AD data acquisition and processing](image)

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References