Report of Project 2

【Group Members】

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【Experimental Objectives】

1. **Understanding the programming process of analog output and achieve required functions;**
2. **Implementing various functions of graphical user interface (GUI);**

【Experimental Apparatus】

1. **USB-4704；**
2. **DAQNavi Driver for USB-4704；**
3. **ELVIS II+;**
4. **Qt creator.**

【Experimental Procedures and Requirements】

Part 1. Select a language for programming using DAQ Navi SDK and write the user interface for display and user interaction. The program needs to realize the following functions:

➢ **Write the graphical user interface (GUI) for display and user interaction;**
➢ **Generate data for the output waveform (reading from existing files or manually written);**
➢ **The output waveform can be displayed on the graphical user interface (GUI) at the same time;**
➢ **The frequency and cycle of the output waveform output number can be changed;**
➢ **Realize output a fixed number of data at a time, and also output without interruption;**
➢ **Start, stop and continue of output signals can be realized;**

After the program coding, test and debug the program, record the problems encountered and how to deal with them; After passing the test, publish the executable file and display the function on another PC.

【Results and discussion】

Part 1. Select a language for programming using DAQ Navi SDK and write the graphical user interface (GUI) for display and user interaction.

2.1 The logic of program development

The program is mainly divided into two parts which respectively are "configuredialog.cpp" "staticao.cpp". We will introduce this two modules respectively as following.

The first part is the "configuredialog.cpp", which is responsible for the hardware selection and some parameter settings.
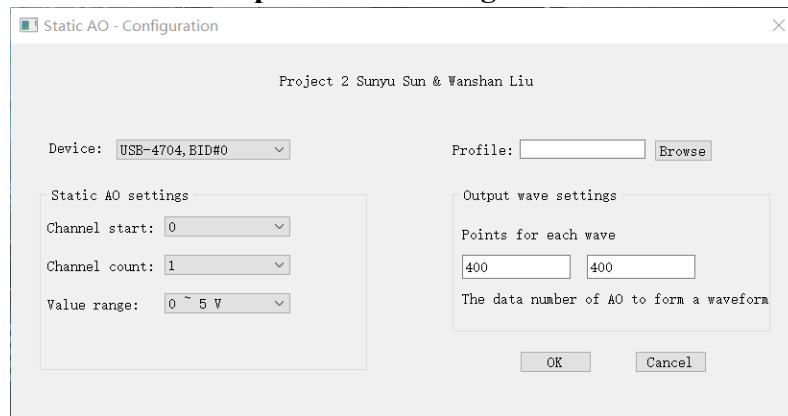

Figure. 1

Figure. 1 is the Graphical User Interface (GUI) of the "configuredialog.cpp" part. As we can see from the figure, we must select a specific equipment and its profile. Besides, we need to confirm the number of consecutive channels we have connected and other information such as channel start/channel count/value range/Points for each wave and so on. If we have confirmed all information of the configuration dialog and press the OK button, then we will enter into the main part of the program which is "staticao.cpp".

The second part which is also the most important part is the "staticao.cpp".
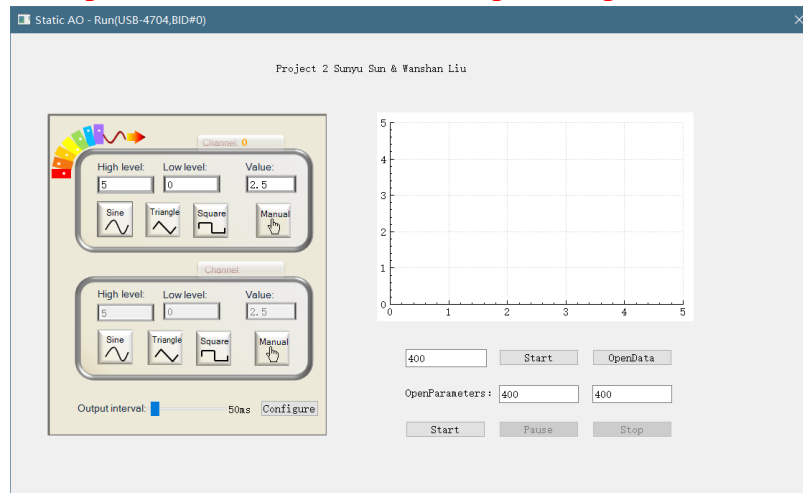

Figure. 2

The Figure. 2 above is the corresponding GUI interface. We will enter the interface after we confirm the information in the configuration dialog. In this part, we set a QTimer - Sample Interval (will be called clock below) and it will output one data of every channel when a sample interval passed by with the following code. Besides, we can output four kinds of waveforms including Sine wave, square wave, triangle wave, dc wave and so on.

We also have realized reading from existing files or manually written for the output waveforms.

```
errorCode = instantAoCtrl->Write(channelStart, channelCount, dataScaled);
```

Besides, we can switch to the configure dialog by clicking "Configure" button and reselect the device or channels. We also can read a CSV file and display it on the window.

【Analysis and discussion】

Part 1.   Periodic output point analysis

1.1   How to set appropriate cycle output points for signals of different frequencies

According to the test summary, it is more appropriate to set the periodic output points at different frequencies when the frequency × periodic output points are less than or equal to a certain constant.

1.2   Analyze the factors to be considered when setting cycle output points
  ➢ The output points of the cycle should correspond to the corresponding frequency.
  ➢ The number of points should not be too much, otherwise the frequency exceeding the Timer will appear distortion, unable to complete the output waveform.
  ➢ The number of points must not be too small, otherwise the complete waveform cannot be generated, and thus cannot be output.

Part 2.   Frequency analysis of analog output signal

2.1   Analyze the frequency range of USB-4704 analog output
  ➢ Through the test, when the output number of frequency × period is less than or equal to a certain constant, a relatively complete waveform can be output.
  ➢ Since the output cannot be too small, the maximum frequency is 5Hz.

2.2   If the output signal is outside this range, what problems will occur and explore possible solutions
  ➢ Problems: The signal distortion.
  ➢ Solutions: Reduce the frequency of the output signal; Appropriately reduce the number of output points per cycle; Switch to more advanced equipment.

Part 3.   Problems and solutions

Problems: Input can only accept positive voltage signal.
Solutions: Set a bias voltage on the output

Problems: We don't know how much data we need to collect before we collect the data. It is easy to cross the boundary with the traditional pointer method.
Solutions: Use STL-Vector in C++ to store data better.

Problems: There are a lot of unknown reasons for Qt development using VS, and a lot of time is wasted.
Solutions: Qt Designer is directly used for development with better compatibility.

Problems: In the process of real-time display, dynamic display cannot be achieved.
Solutions: Continuous refresh is adopted to achieve real-time dynamic display.

Problems: There is a conflict between reading in file and auto output
Solutions: Separate the read in file from the auto output.