Application of USB for Communication Verification Device in Theodolite

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Abstract. It is primary that difficult to verify the data for a long time in the data communication system of present theodolite. So take advantage of CY7C68013 to Designing the data communication verification device and composing the program for the test of the data communication verification. It is profitable to realize the data communication of theodolite and the realtime or later verificate data, and making the debugging more convenient. Meantime realize the high speed transmission.

1. Introduction
The photoelectric theodolite is the high precision photoelectric detection instrument of space mobile target tracking and positioning for the modernization in range, while the new weapons and equipment must achieve real-time, high precision, dynamic tracking and realize real-time image reproduction performance, which requires the communication system has good real-time and reliability.

2. System Structure

2.1. Data Communication System of Theodolite
The data communication system is the data exchange hub of the large photoelectric theodolite. According to different requirements, the theodolite subsystem adopts different MCU, so as to realize the communication function. If the real time, the transmission distance is not high and the transmission speed is high, the RS-422 interface can be discarded and the USB2.0 interface is used for data transmission.

2.2. USB Data Communication Verification Device of Hardware Development
The block diagram of the whole system is shown in figure 1. The system selects CY7C68013 as USB2.0 controller, which is responsible for USB transaction processing, and also as the USB external chip CPU. In order to give full play to the advantages of fast transmission speed of USB interface chip, the hardware design adopts the high speed 32 bit fixed point TMS320F2812.

2.2.1. Design of communication interface circuit
Asynchronous serial transmission mode is the most theodolite data communication methods, namely uses RS-422 transmission mode mostly, then before the serial data received by the DSP, the level requires interface conversion, while DSP is the standard TTL 3.3V, therefore should be level conversion for the serial data received.

2.2.2. Slave FIFOs hardware connection and working principle
In the whole communication system, the subsystem of SCM and DSP as the controller and the check device is connected, select Slave FIFOs mode as the work mode. The hardware connection is shown as figure 2.
3. Software of Data Communication Verification Device

All based on the MCU and its peripheral circuit of the normal work of functional devices are inseparable from the participation of software, USB devices are no exception.

In the process of data communication verification device, DSP is responsible for receiving serial data and sending the data to the host. In order to ensure the normal communication between DSP and USB controller, it is necessary to establish a standard communication protocol between them. DSP is responsible for continuously receiving external serial data and sends the data to the USB controller receiving end point of operation, it not only improves the transmission efficiency of USB, but also the DSP concentration to send data, thus increasing the transmission efficiency of DSP.

4. Test of the Data Communication Verification Device

The maximum transmission speed of up to 42.9Mbps USB interface between the data communication verification device and the main CPU, from the theoretical analysis, data check device can be extended ten serial experiments, and each serial communication baud rate can reach 4.1Mbps.

4.1. Functional Test of Data Communication Verification Device

The design of the system is as follows: the function of the communication system. The data communication verification device through the USB interface is connected with the notebook, data source is provided by
another TMS320F2812 port. This system chooses the highest baud rate of 4.1Mbps data source, the frequency is 100HZ, the contents of the packet is known, the experiment data are shown in table 1.

![Flow chart of DSP program](image)

**Figure 3.** The flow chart of DSP program

**Table 1.** The communication data of communication Verification Device and TMS320F2812

| baud rate  | Stop bit | Number of significant bits | Number of packets | Error percentage |
|------------|----------|----------------------------|-------------------|-----------------|
| 481.6 Kbps | 2 bits   | 8                          | 4159              | 0%              |
| 963.2 Kbps | 2 bits   | 8                          | 5050              | 0%              |
| 4.252 Mbps | 1 bit    | 8                          | 5332              | 0%              |

From the table 1, in the communication verification device and PC communication process, not only can flexibly set the baud rate, and transmission rate gradually increased, but also the right to transmit data.
4.2. Transmission Speed Test of the Data Communication Verification Device

TMS320F2812 as a data source, CY7C68013 provides read and write signal, the host selects various types of files for sending to DSP. DSP opens array reception, when the array is full and then returns the data to the USB controller, the host saves the receive data at the same time, finally compares the received files and the original file of the host, the test results are shown in table 2.

| file name  | file size  | transmission time | speed    | bit error |
|------------|------------|-------------------|----------|-----------|
| video.avi  | 30.64 MB   | 11.68 s           | 38.12 Mbps | 0         |
| text.txt   | 5.26 MB    | 1.98 s            | 38.64 Mbps | 0         |
| audio.mp3  | 4.52 MB    | 1.69 s            | 38.38 Mbps | 0         |

From the table 2, when the transmission bandwidth is 8, transmission speed is about 38Mbps, because TMS320F2812 external I/O read and write speed is slow, DSP read and write frequency is 4.46MHz in the working environment of the system, if using faster operating frequency, transmission speed will be increased.

5. Summary and Innovation

The data communication verification device used in the theodolite data communication verification, can receive and store data long time; real time check and post check combination, can accurately determine the time and number of errors occurred in the process of data communication, which greatly facilitates the system debugging, to ensure the stability of data communication in the process; can also be used for receiving video and image transmission speed higher requirements on the occasion.

6. Acknowledgement

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7. Reference

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