Design of Wireless GPIB Interface Module Based on Bluetooth

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Design of Wireless GPIB Interface Module Based on Bluetooth

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Abstract. GPIB interface is widely used in the testing and control field. In this paper a wireless GPIB interface module based on Bluetooth is developed. Programming with Verilog HDL language on the hardware of ROK 101 008 and a FPGA chip, the complicated logical design of GPIB interface and the Bluetooth data processing unit are implemented. On basis of Bluetooth specifications, the software for the control computer is developed. In order to provide a standard software interface for users, a VISA library that is compatible with the VPP specifications is also designed.

1. Introduction

In the automatic measurement and testing field, in order to construct a GPIB testing system, devices and equipments must have GPIB Interfaces to connect the GPIB cables. The wireless measurement instrument system has its advantage when the cable connection is not convenient or even impossible. In the past years, wireless measurement instrument system has not been widely applied due to its high cost and complexity. But now, Bluetooth with the advantage of small volume, low cost, low power consumption and strong reliability makes the popularizing of wireless measurement instrument possible. A design of wireless GPIB interface module based on Bluetooth is introduced in this paper, and a wireless GPIB automatic system can be constructed with this module.

2. Structure of wireless GPIB interface

The structure of the wireless GPIB interface is shown in Figure 1.

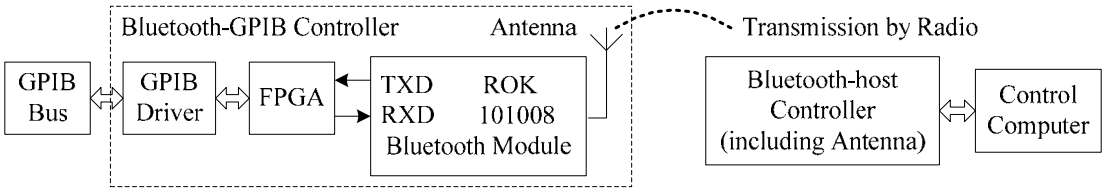

Figure 1. Structure of the wireless GPIB interface.

The interface consists of four parts: a GPIB driver, a radio unit, a data processing unit and systematic software. It works in the following procedures. Firstly, the control computer sends commands to the Bluetooth-GPIB controller through the Bluetooth-host controller. Then, the Bluetooth-GPIB controller processes the received commands and transfers them to GPIB-bus. At last, the Bluetooth-GPIB controller receives the data returned from GPIB Bus and transmits them to the control computer so that the computer can implement corresponding operations.

3. Hardware Design

CSR CSR01 is chosen as the Bluetooth-host Controller which makes the hardware design for the control computer simple, and this section focuses on the design of Bluetooth-GPIB controller. Bluetooth-GPIB controller that consists of a GPIB driver, an internal logic unit in a FPGA chip and a radio unit is the most important part of wireless GPIB interface module.

3.1. GPIB Driver

The GPIB driver adopts SN75160B and SN75162B made by TI Company. SN75160B/SN75162B is an 8-channel bus transceiver that is a single integrated, high speed and low power consumption device. The two chips can be linked to form an interface driver for GPIB, and the protecting function of their internal circuits can remove the impulse noises produced by power on/off.

3.2. Radio unit

Bluetooth module is the foundation to realize wireless communication. Erisson's ROK101008 and CSR's CSR01 (including USB interface) are two popular Bluetooth modules, because they integrate with radio unit and baseband controller, provide many kinds of interfaces of HCI transport layer, and supply an interface circuit board and an antenna for experiment. ROK101008 is chosen for Bluetooth-GPIB controller because it could satisfy the need of serial communication. CSR01 is chosen for Bluetooth-host controller, because the control computer must be connected with Bluetooth module by USB interface.

3.3. Internal logic unit of FPGA

The internal logic of FPGA is key and difficulty for design of Bluetooth-GPIB controller. Bluetooth data processing unit and GPIB interface function have been designed respectively in FPGA with Verilog HDL language. The frame diagram of internal logic of FPGA is shown in Figure 2.

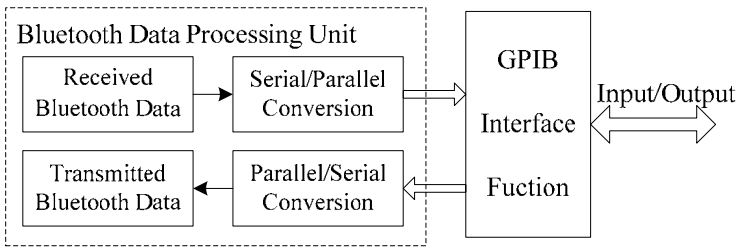

Figure 2. Frame diagram of internal logic of FPGA.

3.3.1. Bluetooth data processing unit. In the Bluetooth data processing unit, the serial data received from ROK101008 are converted into parallel data from which the valid data is picked up according to the format of data package described by Bluetooth specifications. Meanwhile, the valid data from GPIB-bus are packed according to the same format and converted between parallel/serial conversions. Then, Bluetooth Module will receive and transmit them to the control computer. The related specification of HCI_UART transport layer are used to the chosen UART interface.

3.3.2. Design of GPIB interface. GPIB interface includes device function and interface function. The former is deeply related with its own characteristics and the latter is the general part of the interface. Therefore, the interface function is the principal part of general purpose interface. As it is necessary to link equipments with GPIB-bus through transceiver circuit and encoding circuit, the GPIB interface can be divided into the following parts: a local/remote encoder, an interface function, a transceiver, etc. The block diagram of GPIB interface is shown in Figure 3.

The GPIB Interface are designed with top-down approach and divided into two major parts: a register unit and an interface function unit.

In the register unit, the control logic for reading/writing and 16 registers (8 read-only registers and 8 write-only registers) are designed. By setting flag bits, the related local messages can be sent out to the back interface function so that we can start the state machine of interface function and make sure whether the interface function works correctly. At the same time, control computer can get the bus state and send out command punctually to control the data transmission on the bus by reading certain flag bits of registers.

According to the selected function subsets, the interface function unit also can be divided into several small function units: control function, listening and talking function, etc. Though these small function units are independent to each other, they are connected by some crossed states and given commands from computer through local messages. In addition to selected function subsets, the time limit required by Bluetooth specifications is necessary to ensure the reliability of the communication between control computer and GPIB equipments.

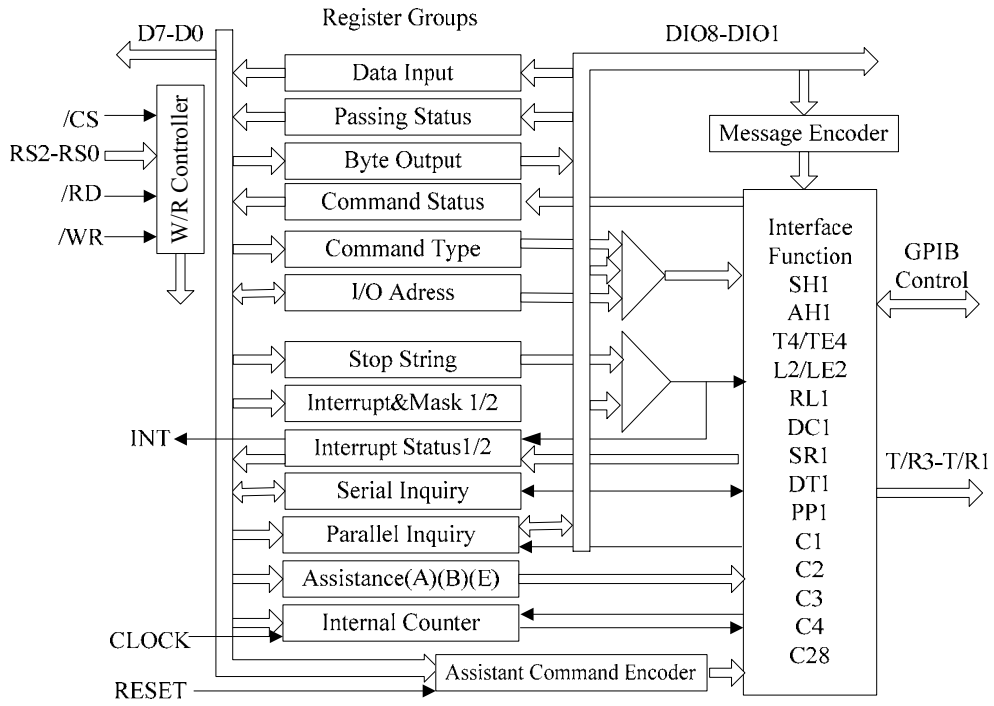

Figure 3. Block diagram of GPIB interface.

4. Software Design

The architecture of general software design is shown in Figure 4. It consists of four major parts.

4.1. Resource manager

The resource manager is applied to achieve the system configuration, supply overall document and interface configuration information for VISA32.DLL. VISA library can be used successfully by user program only when resource manager runs normally. Here it is developed by Borland C++ Builder5.0.

4.2. VISA library

VISA library is provided to users in a form of 32 bit DLL which is the most important part of the software and an indispensable part of VPP specifications. Users can adopt different program languages to call the function in VISA library and program related module driver. We choose Visual C++6.0 as development tool for VISA library. The key is to program for Bluetooth communication according to the Bluetooth specifications. The data communication between two Bluetooth devices is realized by HCL groups including command groups, event groups and data groups. Generally, the flow of ACL

(Asynchronous Connection Less) data communication includes 6 steps: Opening Bluetooth module, initializing Bluetooth module, inquiring, creating connection, transmitting data and cancelling connection.

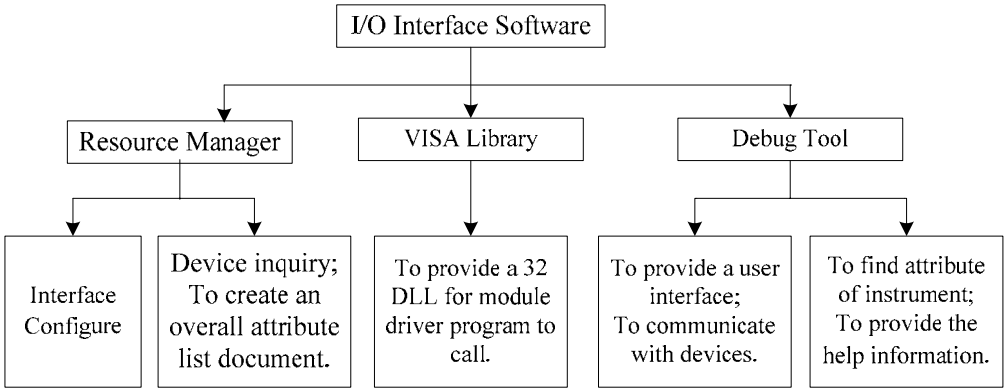

Figure 4. Architecture of I/O Interface Software.

4.3. Debug tool HIT-VISA

A communication device with a user-friendly interface is supplied by the visible and other characteristics of Borland C++ Builder5.0. HIT-VLSA can search and show different devices by calling VISA library functions. In addition, it also can communicate with any device in this system.

4.4. Help and install program

Help and install program provides users the installation and help information during programming. The disc for installing is made by Installshield, a tool developed by Visual Studio.

5. Wireless GPIB automatic testing system

A wirelss GPIB automatic testing system can be realized by the wireless GPIB interface module developed in this paper. The structure is shown in Figure 5.

Bluetooth-host controller connects with control computer through USB interface as the Master of the bluetooth micronet, while the bluetooth-GPIB controller connects with all kinds of measurement and testing instruments through GPIB interface as the Slave of the bluetooth micronet. In this system, each bluetooth device has a unique address to distinguish different devices.

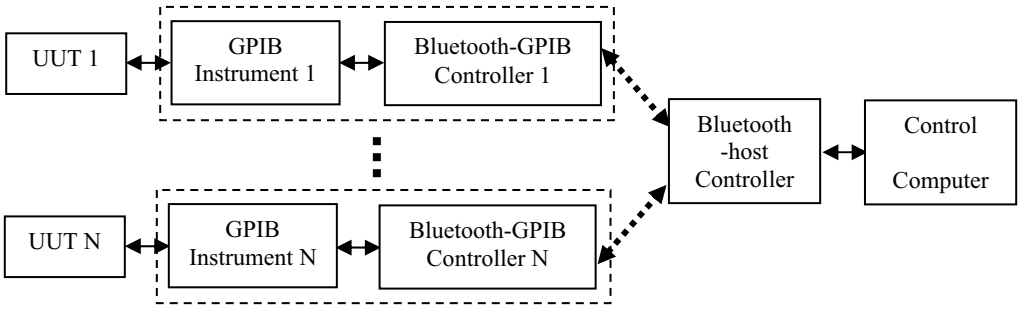

Figure 5. Principle of Wireless GPIB Testing System.

6. Conclusion

In this paper, a wireless GPIB interface module based on Bluetooth is developed. It adopts Verilog HDL language and FPGA device to implement complicated logic of GPIB interface and the Bluetooth data processing unit, which brings low cost, high integration, reliability, flexibility and expansibility of the system function. In order to provide a standard function interface for users, the VISA library that is

compatible with VPP specifications is designed. The wireless GPIB interface module can be widely applied in manufacture and research fields especially in those systems that need remote operations.

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