

The Designing of Serial Communication Based on RS232

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Abstract—This Paper discussed the principle of serial communication mainly, proposed the design method based on RS232, designed the hard circuit of serial communication, and realized the programming to PC Microcomputer and single chip microcomputer by using assembly language and C++ Builder separately.

Keywords—serial communication; single chip microcomputer; program design

I. INTRODUCTION

During working in the control system, the PC microcomputer sends instructions for step-by-step motor to collect the image information. Therefore the communication between the PC microcomputer and the driving system is needed for the communication system. In general, a complete communication system consists of transmitter, receiver, converting the data interface and transmitting data channel. The control of the step-by-step motor is realized through the pulse distribution by single chip microcomputer. On the motor control system, the PC microcomputer is called as upper computer, and the single chip microcomputer for driving step-by-step motor is called as lower computer. The communication between the upper computer and the lower computer has two methods, that is to say the parallel communication and serial communication. Parallel interface can transmit much data at the same time and has the fast speed, but when the transmission distance is far and the number of data is much, it needs more the number of transmission lines. In addition, the voltage level may be changed by the transmission line factor and electromagnetic interference. Serial communication is a one way that the data is transmitted by a bit in order, in which two transition lines is needed to realize bidirectional communication. It is taken into consideration that the data is much and the transmutation number is little, the serial communication is utilized in the control system so as to simplify the hardware and save the cost.

II. THE BRIEF DESCRIPTION OF SERIAL PORT COMMUNICATION

There are more serial communication standard interfaces, such as RS-232, RS-485, USB Interface, IEEE-1394, which has itself good features and also has focused on areas of application. RS-485 has a anti-noise

capacity transmitting data, so it is commonly used in industrial production. USB interface and IEEE-1394 have fast speed, but some computers and operating systems do not support such interfaces. RS-232 is most widely used as a serial interface in a PC computer and communications industries [1]-[2]. RS-232 is defined as the single-ended standards, which has much characteristic, such as more communication distance in a low-speed serial communications, moderate price and good practicality of the system, so it is most appropriate to be a communication port.

RS-232 is an essential modern computer interface, it includes ports COM1 and COM2, the port COM1 has 9-pin connector. The new generation computer has a 9-pin connector (DB9) so as to connect with the RS-232 communication port. In order to achieve reliable and real-time transmission, the system adopt a three-wire connection method, that is to say that the GND pin, RXD pin and TXD pin of RS-232 port is connected with the external port, it is shown in Figure 1.

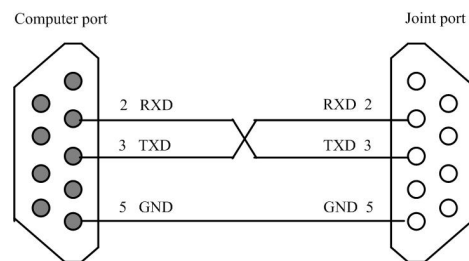


Figure 1. The RS-232 port

III. THE HARDWARE DESIGN OF SERIAL PORT COMMUNICATION

The in-out level of single chip computer is TTL level, while the RS-232 serial interface of a PC computer is standard serial interface, so both the electrical specifications are inconsistent. In order to communicate with the upper and lower computer, it is needed that the out level of single chip computer is changed to the TTL level [3] - [6]. The common level converter chip between TTL and RS-232 level is MCI1488 and MCI1489. The MCI1488 converts TTL level to RS-232 level, it needs the supply voltage of $\pm 12V$, and that the MCI1489 converts the RS-232 standard level TTL level, it needs power supply voltage of $+5V$. Due to three power supply voltage, the circuit will be complicated, so

this circuit adopts the standard RS-232 chip MAX232.

MAX232 is the product of the MAXIM company, it is the road receiver and driver IC chip. MAX232 chip has a voltage converter which can transform the voltage of +5 V to the required voltage. Therefore, it adapts to the serial communication interface, moreover it has much characteristic, such as moderate price, the hardware simple, so it is used to be a voltage converter. The hardware circuit of serial communication module is shown in Figure 2.

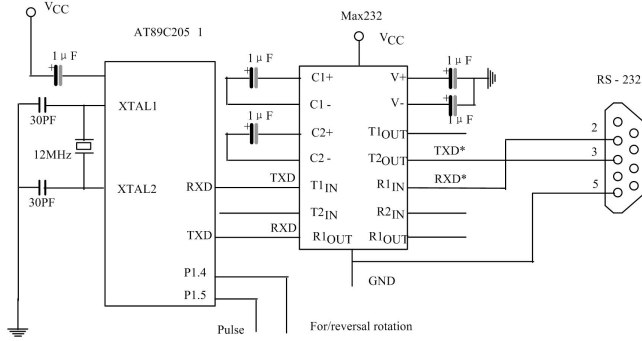


Figure 2. The hardware circuit of serial communication module

IV. THE SOFTWARE DESIGN OF SERIAL PORT COMMUNICATION

The communication program of the single chip microcomputer communicates with PC computer by interrupt and PC computer is called as main controller. When the single chip computer receives the data signals sent by PC computer, then it calls interrupt service program. The flowchart of the interrupt service main subprogram is shown in Figure 3. In order to fully exploit the efficiency of single chip computer to minimize CPU 'time occupied by communication, the control program will be we will promptly respond to and control objects. The communication program will be optimized. The subprogram of serial port interrupt for receiving data, the subprogram for sending step-by-step impulse, the subprogram for judging instruction and the subprogram for sending data.

A. The subprogram of serial port interrupts for receiving data

The subprogram of serial port interrupts for receiving data is mainly responsible for receiving data sent by PC microcomputer and storing the data into allocated memory (it does not deal with data so as to reduce the time taken up by interruptions). The data received by the single chip microcomputer includes little information, such as speed, steps and on/off instructions, and the buffer is large enough to send the computer, so the software shake hands protocol is omit so as to raises the CPU utilization. When the program of serial port interrupt receives the specified data, it exits the serial port interrupt.

B. The subprogram of sending the step-by-step impulse

Using counter-timer of the single chip microcontroller timer 0, as the fixed times complete, the p1.5 port is negated so as to periodically generate the driving pulses. The timer 0 begins to count from initial value to 65535, then the interrupt sub-program of timer 0 is called, in which the p1.5 port is negated to generate a driving pulse. Meanwhile, the single chip microcomputer loads again the initial value which is sent by the PC microcomputer by serial communication.

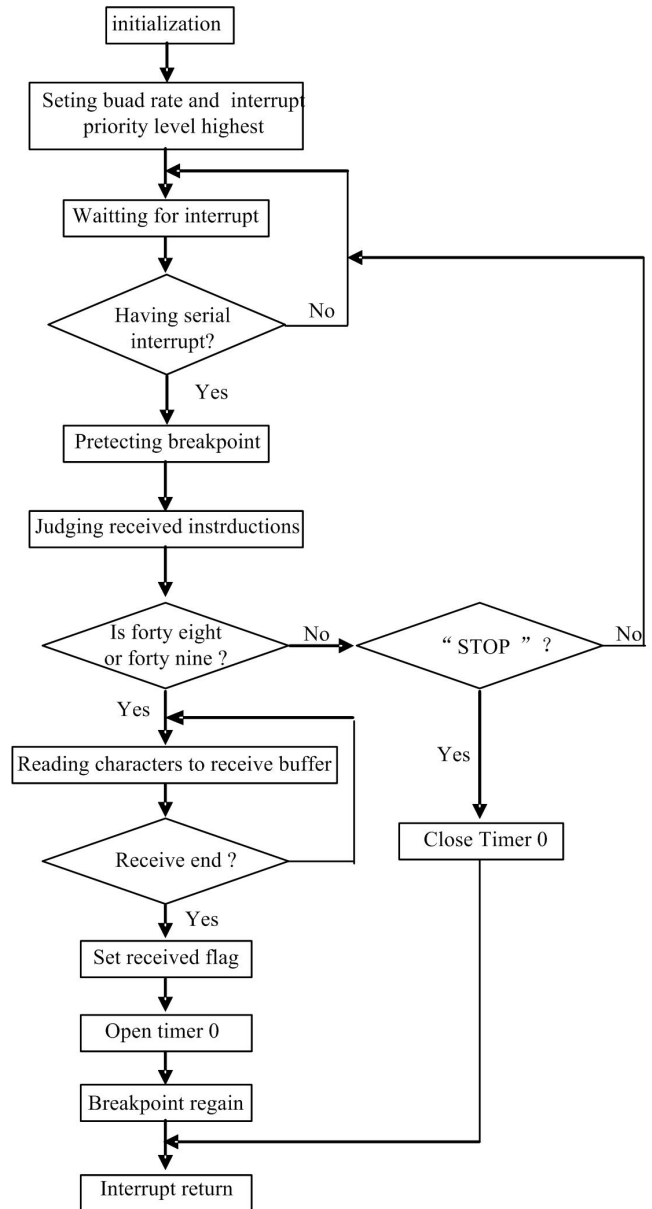


Figure 3. The flowchart of the interrupt service main subprogram

C. The subprograms of judging instruction

The program of judging instruction is set on the serial port interrupt program to be called. The PC microcomputer sends data to the single chip microcomputer. After the single chip microcomputer receives data, it sets the RI higher and called the serial port interrupt sub-program, in which the first data is processed. If the first data is a digital symbol "48", the serial port interrupt sub-program sets P1.4 higher, then the next five bytes data is used to ensure the step-by-step motor' speed and steps. If the first data is a digital symbol "49", it means that the step-by-step motor reverses, then the single chip microcomputer receives the speed and steps information. Otherwise the single chip microcomputer judges that the received data is not "STOP" instruction, if so, it sends "stop" instruction to the drive system; if not, it quits the interrupt.

D. The processing subprogram of send interrupts

The processing subprogram of send interrupts is responsible to send data to the computer, sending interrupt state is off in the general. When the communication program completely deals with data sent by PC microcomputer, the symbol "1" can be written to send buffer. As the computer receives the symbol "1", it is said that single chip computer executes completely the introduction sent by PC microcomputer. Therefore the serial port interrupt is set as "off" state by the single chip microcontroller and it is set "on" state again after the data are sent. So the single chip microcomputer returns to main program and waits for receiving instructions.

V. THE DESIGN OF COMMUNICATION PROGRAM OF PC MICROCOMPUTER AND SINGLE CHIP MICROCOMPUTER

In order to realize the system software easily grafted and uniformity, the program of upper computer is designed using the Boland C++ Builder 5.0 as a programming tool in the control system s the Boland C++ Builder 5.0 as a programming tool for PC programming. The serial port communication can be utilized in two ways: First, register components, C++ Builder does not in itself provide a separate serial communication component, but it can be obtained through registered Microsoft MSComm32 components, in which it is relatively simple for VB, VC in this way. The second method is called Windows API (Application Program Interface) function, in which this function is provided by the operating system in order to provide a lot

of executive function. The program steps is followed:

- (1) Setting by communication protocol and opening the serial port, which is called initialization, then blocking the other programs to use the serial port.
- (2) Configuring the serial port.
- (3) Transmitting data by the serial port to and fro, verifying data during transmission.
- (4) Closing the serial port as no needing it so that other program uses.

The sub-interface is simple, in which the setting on sub-interface parameters are defaults, such as baud rate that single chip communication module has been set to 2400Bps and that the baud rate is set to 2400Bps in the computer settings on the ports. The PC microcomputer has two ports called as serial port COM1 and COM2 generally, so the program can automatically identify serial port so that it can send and receive data and instructions successfully.

VI. CONCLUSION

The hardware of serial port communication are designed based on RS232, and the software of communication module between PC microcomputer and single chip microcomputer were programmed by using C++ Build and assembly language. The control system runs well on industry field, and controls the stepping motor' Start/Stop and Forward/Reversal rotation by controlling single microcomputer. The PC microcomputer sends out control instruction to the single microcomputer by friendly user interface.

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