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April 28, 2021

# Research and simulation of communication between MCU and MCGS based on Proteus

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**Abstract**—In view of the electronic information engineering major student carries out the single chip microcomputer innovation practice weak present situation, Proteus virtual simulation software is introduced to carry out the second classroom practice teaching, AT89C51 MCU, DS18B20 digital temperature sensor, communication interface circuit, virtual serial port driver software and MCGS system design. The system uses the standard ModbusRTU protocol to collect real-time data from the DS18B20 temperature sensor and upload it to the MCGS configuration interface. At the same time, the button in MCGS controls the 8 LED indicators in the P1 port of the MCU accordingly. Through Proteus simulation, the normal communication between MCGS and MicroController is achieved, which overcomes the problem that students cannot be debug due to hardware design errors in the process of innovative practice, which is conducive to the cultivation of students' innovative thinking and provides ideas for students to carry out innovative practice activities.

**Keywords**—MCU; MCGS. Communication; Simulation

## I. INTRODUCTION

MCU technology is widely used in instruments, industrial automation, intelligent household appliances and other fields, MCU course has become a required course of colleges and universities electrical engineering and its automation, electronic information engineering, automation, new energy science and engineering and other majors. At present, the MCU teaching is basically only teaching the knowledge of the subject, without breaking the structural barriers of the discipline system, and integrating the knowledge system of other disciplines related to the MCU course, which makes the students' innovation is not strong and the knowledge structure system is out of step when carrying out innovative practice activities. Aiming at the above problems, combining with the characteristics of applied undergraduate talents training, in addition to the single chip computer in the process of classroom teaching for limited introduction "project drive type" teaching method, improve the students' practical ability and application ability, also should develop the second classroom teaching to enrich students' extracurricular innovation practice activity, in order to develop the students' knowledge

system, cultivation of students innovative thinking and innovative ability. Therefore, this paper introduces the "research and simulation of MCU and MCGS communication based on Proteus" to enrich the second classroom content.

## II. MCU AND MCGS COMMUNICATION SYSTEM DESIGN

The whole system by the digital DC regulator output 24V and 5V DC two channels respectively for MCGS touch screen and MCU control system. Part of the hardware of the MCU control system in the lower computer is composed of AT89C51 MCU, DS18B20 temperature sensor, RS232 communication circuit module and LED group. The upper computer uses Kunlun configuration MCGS touch screen to design the interface. The whole system carries on the data transmission through the standard ModbusRTU protocol, that is, the real-time data collected by the DS18B20 digital temperature sensor is processed by the 51 MCU and then sent to the MCGS configuration interface. At the same time, the button switch in the MCGS interface controls the 8 LED light emitting diodes at the P1 port of 51 MCU. The overall block diagram of communication between MCU and MCGS is shown in Fig 1.

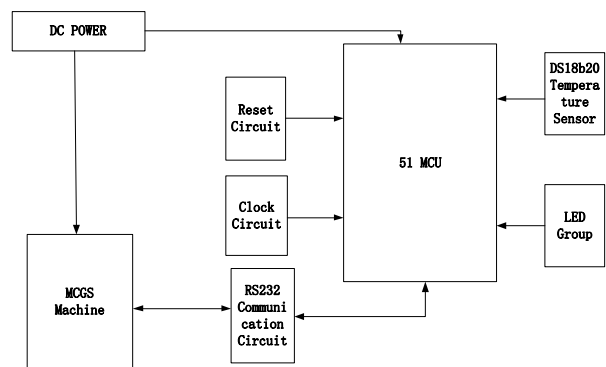


Fig. 1. general block diagram of communication between MCU and MCGS

## III. SYSTEM HARDWARE CIRCUIT DESIGN

AT89C51 MCU TXD, RXD two pin is a full duplex serial communication interface, through this full duplex serial communication interface, MCU set the correct communication parameters and MCGS touch screen can

be serial communication. MCGS touchscreen, mainly using RS232 and MCU communication, but both in the serial communication also need to meet certain conditions, mainly use level in different ways, both the MCGS touchscreen using RS232 serial port level, the use of single-chip microcomputer is TTL level, so when the single chip microcomputer and the MCGS touch screen objects for communication, both need special MAX232 chip to convert the level, this paper only based on Proteus simulation, ignores the integrity of the circuit design. Port1 mouth of MCU is connected with 8 LED light emitting diodes, using low level drive light emitting diodes on and off. The monitoring system based on MCU is shown in the Fig 2.

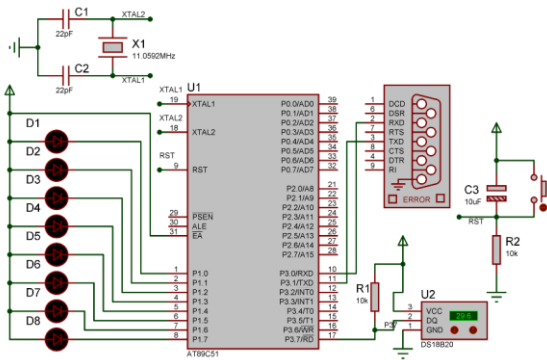


Fig. 2. MCU monitoring system

In Fig 2, P3.7 pin of single chip microcomputer is connected with DQ input and output pin of DS18B20. DS18B20 is a digital temperature sensor produced by Dallas Company in the United States, which has small size, low power consumption and strong anti-interference ability. The temperature can be directly converted into digital signals through A single bus directly transmitted to the MCU processing, thus eliminating the need for traditional signal amplification, A/D conversion and other peripheral circuits. And the DS18B20 measurement temperature range  $-55 \sim +128^{\circ}\text{C}$ , in the range of  $-10 \sim +85^{\circ}\text{C}$ , the measurement accuracy can reach  $\pm 0.5^{\circ}\text{C}$ , very suitable for harsh environment of the field temperature measurement.

#### IV. SYSTEM SOFTWARE DESIGN AND CONFIGURATION

In industrial control, it is often necessary to observe the running state of the system or modify the running parameters. MCGS touch screen can intuitively and vividly display operating parameters and status, and the system operating parameters can be directly modified through the screen of MCGS touch screen, and the man-machine interaction is good. MCU is widely used in the field of industrial control. With the cooperation of MCGS touch screen, it can form a good human-computer interaction environment. To communicate with MCGS touch screen and MCU, it is necessary to write corresponding communication program for MCU according to the communication protocol adopted by MCGS touch screen.

#### A. MCGS touch screen interface design

First of all, a new window 0 is created in the user window, and then the indicator light 3 is selected from the object component library as the indicator light of the MCU and MCGS communication simulation debugging system, and two standard buttons "on and off" are placed for each indicator light. At the same time, place the live curve and label in the toolbox. Finally, select the appropriate variable for each object element. The interface of MCU and MCGS communication simulation debugging system is shown in Fig 3.

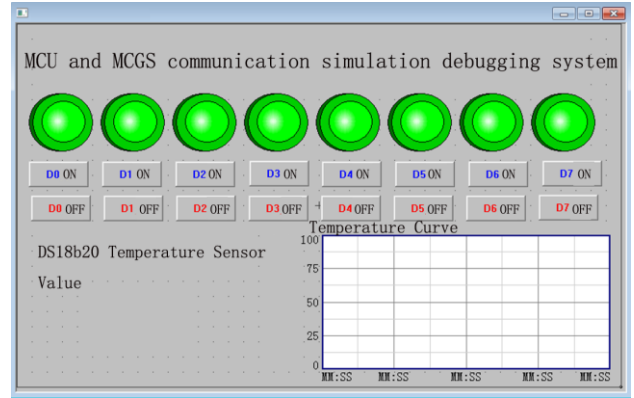


Fig. 3. Fig. 3 Interface of MCU and MCGS communication simulation debugging system

#### B. MCGS touch screen system configuration

Edit the general serial port device properties in the device window, and set the serial port number as COM1, because this system is based on RS232 communication, if it is based on RS485, the secondary serial port number needs to be set as COM2. The baud rate is 9600bps, the check bit is NONE, the data bit is 8, and the stop bit is 1. The general serial port device property parameters are set.

As ModbusRTU protocol is an effective communication protocol between controllers and between controllers and other devices launched by Modicon Company in the United States, the standard ModbusRTU protocol is selected for the MCU and MCGS communication. This driver component can support the ModbusRTU register type. When setting ModbusRTU channel properties in this system, the data type of the 4-block output register is mainly WUB, and the operation mode is read and write. The switching quantity in the MCGS interface is written into the address corresponding to the MCU for the corresponding coil to obtain the state value, so as to light and extinguish the 8 LED light emitting diodes corresponding to the P1 port. At the same time, the DS18B20 is read and collected in real time, processed by the MCU, and stored in the register for the MCU to send it to the MCGS touch screen display on a regular basis. Specific DS18B20 temperature sensor reading process and LED light emitting diode on or off.

### C. Communication module configuration in Proteus simulation circuit

First, configuration the component properties of the RS232 communication module interface, open the property dialog box of the serial port COM, select COM2 after Physical Port, the baud rate is 9600bps, the check bit is NONE, the data bit is 8, and the stop bit is 1. The communication parameter configuration here needs to be consistent with the MCGS touch screen, otherwise there will be no communication, and the communication simulation debugging function between MCU and MCGS cannot be realized. The configuration of properties for the specific COMPIN is shown in Fig 4.

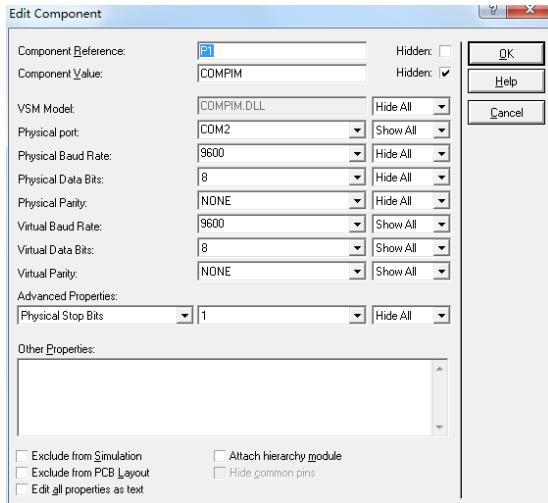


Fig. 4. Compim properties configuration

Because the COMPIM component in Proteus software is no specific simulation model, so it needs to be configured through the script code to simulate. The script code for the COMPIM component properties is shown in Fig 5.

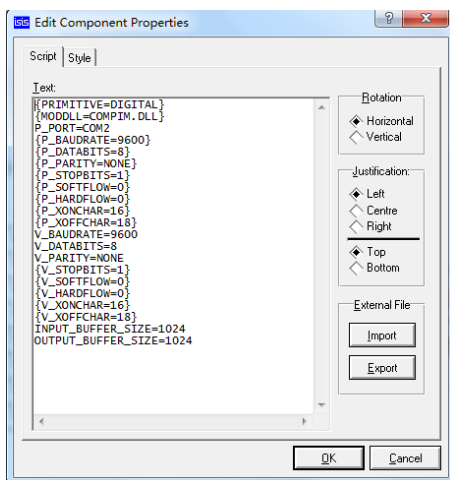


Fig. 5. Script code for the COMPIM component properties

### D. MCU baud rate program design

Timer 1 is used as the baud rate generator during the development of the serial port function of the single chip microcomputer, and the baud rate of the single chip communication is configured as 9600bps. The specific initialization procedure for the serial port is as follows:

```
void Initial(void)
{
    SCON=0x50;
    TMOD=0x20;
    TL1=0xfd;
    TH1=0xfd;
    EA=1;
    TR1=1;
}
```

### V. SOFTWARE AND HARDWARE COMBINED MODULATION

First of all, in the communication between MCU and MCGS, virtual Serial port software Virtual Serial Ports Driver needs to be installed. The main function of virtual Serial port software is to connect the MCGS general Serial port COM1 mentioned above with COMPIM configuration COM2 in Proteus simulation software for virtual Serial port. Special attention should be paid to the serial port setting here. When adding a serial port, make sure that the computer COM port does not have a physical serial port. If there is a physical serial port connection, it cannot be set as a virtual serial port.

Secondly, in Keil4 software, C language is used to write the source program of the MCU control system, and HEX file is generated and loaded into the MCU. The D2, D4, D6, D8 light-emitting diodes and the D1, D3, D5, D7 light-emitting diodes in the Fig are all controlled by the corresponding switches in MCGS. The 48°C degrees currently simulated by the DS18B20 temperature sensor are sent to MCGS by the single-chip microcomputer through the serial port. The operation effect of the MCU control system is shown in Fig 6.

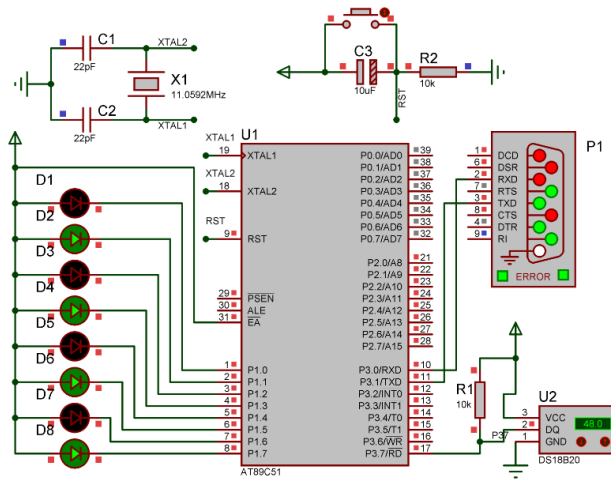


Fig. 6. MCU control system operation effect diagram

Finally, after downloading and configuring the user window 0, click Start and run, and the running effect is shown in Fig 7. By clicking the switch button on and off, the green light and red light indicate respectively. The green indicator light in the interface represents that the LED in the control system of the corresponding single chip microcomputer is on, and the red indicator light represents that the LED in the control system of the corresponding single chip microcomputer is off. The 48 and curve in the interface are all detected by the DS18B20 temperature sensor in the control system of the single chip microcomputer.

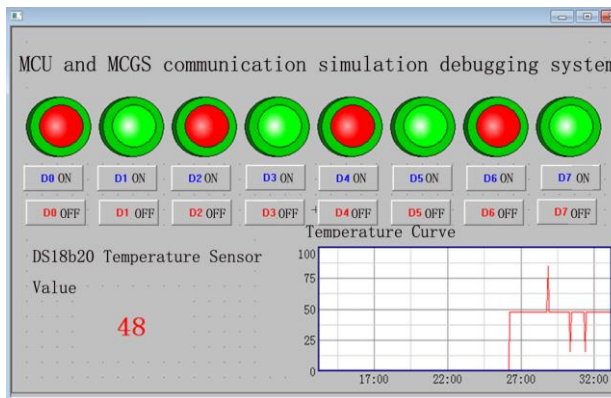


Fig. 7. MCGS operation rendering

This design is based on the ModbusRTU communication protocol, MCGS as the Master, MCU as the slave (Slave), MCGS itself supports ModbusRTU communication protocol, as long as the MCU in accordance with the ModbusRTU protocol for the preparation of data transceiver program, using RS232 standard interface can be directly connected to the communication. After comprehensive debugging, the interaction between MCU and MCGS communication simulation debugging system is very friendly.

## VI. CONCLUSIONS

Through introducing in the second classroom MCU and the MCGS communication based on Proteus simulation teaching cases, students have to carry out the innovative practice, subject have achieved good results in the competition, and raised the students embedded independent design and engineering practice ability, is conducive to the cultivation of students' innovative thinking, compared with the traditional practice teaching introduction of virtual simulation technology has obvious advantages.

## ACKNOWLEDGMENT

This work was supported by the Younger and Middle-aged Research Backbone Training Program of Nantong Institute of Technology Grant No.ZQNGG306 and Key Laboratory of Intelligent Control and Intelligent Computing of Nantong City.

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