Research on Modelling and Analysis of Electrical Virtual Simulation SCM Experimental Platform

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Abstract. The thesis establishes a single-chip virtual simulation experiment platform, which mainly completes the related experiments of the single-chip principal course, and can be used for single-chip curriculum teaching, curriculum design, graduation design and related competition training for college students. The simulation platform has the characteristics of friendly interface and high degree of simulation, which truly breaks through the limitations of geography and time. The policy modelling platform realizes a teaching development model that centres on cultivating students' application ability and takes teacher construction and laboratory construction as two wings. At the same time, a project-based driving form is adopted to encourage students to participate in a variety of after-school practice links to achieve the unity of classroom theory and experimental teaching.

Key words. Virtual simulation, electrical, single chip microcomputer, experimental platform.

1. Introduction
The single-chip microcomputer is a theoretical and practical course, and practice is an essential and important link. The traditional teaching method is to first give theory lessons in the classroom, and then go to the laboratory to do experiments or practical training after finishing the theory lessons. The result is often that the theory lessons are boring and empty, and students cannot recall the knowledge of the theory lessons in practice, that is, theory. Disconnected from practice. At present, a new teaching method is used in the teaching of single-chip microcomputer courses in many higher vocational colleges, namely the project-based teaching method [1]. This teaching method combines theory and practice courses into one, and moves theory courses to the laboratory, "doing while teaching", "learning while doing", this kind of project-based teaching is mostly done in the experiment box. Since the hardware circuit of the traditional experiment box has been completed and the wiring has been fixed, students can only perform simple wiring during the implementation of project-based teaching. Often students have a vague understanding of the system hardware principles after writing the program, let alone Students design the microcontroller hardware circuit by themselves. In addition, a problem that should not be ignored is that in higher vocational colleges dominated by engineering, many majors offer single-chip microcomputer courses. Implementing project-based teaching methods together will cause laboratory resources to be strained and the damage rate of hardware experimental equipment will increase. It is unrealistic for every student to make real objects. This article introduces the use of Proteus software to build a single-chip
virtual simulation experiment platform. The practical teaching effect shows that this is a new way to improve the teaching effect.

2. Construction of virtual experiment simulation platform

The virtual experiment simulation platform is mainly composed of computer and simulation software. Software the "hardware experiment box" and "software debugging environment", install the simulation software on the computer, you can write programs, design circuits, and optimize the design through real-time simulation.

2.1. KeilC51 programming software

KeilC51 software provides a wealth of library functions, powerful integrated development and debugging tools, and a full Windows interface. KeilC51 adopts a project management mode, all files are established under the project, unified management, used to compile C source code, assembly source program, link and relocate object files and library files, create HEX files and debug target programs, etc., in the simulation of KeilC51 in the function, there are two simulation models: software simulation mode and target board simulation debugging mode.

2.2. Proteus simulation software

With the rapid development of computer technology and multimedia technology, virtual simulation experiment technology has risen rapidly as a new technology. Simulation technology has gradually become an important tool for circuit analysis and auxiliary design in the field of electronic engineering. Proteus simulation software is a typical representative of it. Proteus software is a circuit simulation tool software published by Lab centre electronics in the UK. It runs on the Windows operating system [2]. It can not only realize the design and simulation of digital-electric, analogy-electric, and digital-analogy hybrid circuits, but also supports the simulation of mainstream single-chip microcomputer systems. The latter is the most distinctive feature of proteus.

3. Single-chip virtual experiment system design

3.1. System flow

As shown in Figure 1, the developed remote single-chip virtual experiment system includes client, server and virtual experiment server. The client can display the experiment page provided by the server on any smart device (including smart phones, computers, tablets, etc.). The user can input the experiment information on the experiment page and send it to the server; the server will use this experiment information and simulation tasks again Sent to the idle virtual experiment server; the working state of the virtual experiment server is in the automatic control state, it receives experimental information and simulation tasks, starts video recording and virtual simulation software, assigns the received experimental information to the simulated single-chip computer model, and uses the virtual mouse and key operation to complete the interactive operation of the simulation process, recording a specified time video, stopping the simulation and other tasks.
3. The server is used to receive client data, perform simulation experiment task scheduling, and allocate simulation tasks to idle virtual experiment servers. If there is no idle virtual experiment server, the client will be prompted that the simulation task is busy and the waiting time is estimated. The virtual experiment server completes the simulation and generates a video, and feeds it back to the task scheduling server. The server records the above information and feeds it back to the client [3]. The user can see the simulation result video on the client. The experiment information recorded by the server can be used for subsequent experiment statistics and analysis. According to the above ideas, the system software was compiled, and after debugging and simulation, satisfactory results were obtained. The specific workflow is shown in Figure 2.

3.2. The hardware simulation realization method of the joint single-chip system

The specific implementation method of hardware simulation based on Proteus and CV combined single-chip microcomputer system is as follows: first analyse the problem, determine the design plan, draw the schematic circuit diagram in the Proteus software, and then write the control program in the C language in the CV software, and compile the HEX file. Subsequently, the software and hardware co-simulation and debugging are carried out, that is, the Proteus hardware development environment and the CV software development environment are combined on the computer to achieve a perfect microcontroller simulation development process [4]. There are two ways to use this combination of software and hardware development environments, one is static combination and the other is dynamic combination. Static combined simulation is to embed the HEX file generated under CV software into Proteus software
for software and hardware simulation; dynamic combined simulation is to use Proteus software to support third-party software compilation and debugging environment characteristics, and to dynamically connect Proteus software and CV software, Realize the dynamic real-time simulation of both. For simplicity, a static combination method is generally used in practical applications. Finally observe the experimental results, click the execute button in Proteus to start the simulation, if the experiment does not achieve the expected results, you can easily modify the hardware circuit or software program to re-experiment until the control requirements are fully met.

4. Microcontroller experiment mode

The use of integrated project teaching of theory and experiment is helpful to overcome the difficulties caused by the traditional teaching mode of chapter-ordered, theory-oriented and practice-oriented. As a kind of teaching method with the characteristics of vocational education, the integrated project-based teaching of theory and practice is helpful to carry out systemic course development based on the work process, optimize the teaching process, and improve the quality and efficiency of teaching, changing the traditional theory of verification The purpose of the single-chip experiment teaching enables higher vocational colleges to organize teaching according to post needs and economic development [5]. The single-chip microcomputer experiment model based on virtual simulation and ISP online download technology proposed in the paper provides technical support for the teaching of integrated theoretical experiments, and is more conducive to improving students' comprehensive development capabilities and cultivating innovation capabilities.

4.1. Schematic drawing

Take the single-chip microcomputer experiment "A/D conversion experiment" as an example to introduce how to use the computer and simulation software to virtualize the experiment. Open the Proteus software and draw the design schematic diagram as shown in Figure 3. This experiment is implemented by using AT89C52 and ADC0808. Note that some components in the Proteus component library have no simulation models, such as ADC0809, ADC0809 can be replaced by ADC0808.

![A/D conversion simulation schematic](image)

**Figure 3. A/D conversion simulation schematic**
4.2. Examples of experimental mode implementation
In this article, the "LED dot matrix real-time temperature display system" project is taken as an example to introduce the implementation process of the single-chip experiment mode based on virtual simulation and ISP online download.

4.2.1 Overall system implementation plan. The design goal of this system is to be able to collect the field temperature in real time and display the temperature value on the LED dot matrix display. The main control chip selects the 8-bit microprocessor ATMEGA16 with high performance and low power consumption. Because DS18B20's unique single-bus interface has obvious advantages in multi-point temperature measurement, it occupies less I/O pin resources of MCU, and the communication protocol with MCU is relatively simple, the cost is low, and the transmission distance is long, so DS18B20 is selected as Sensor for temperature measurement [6]. The LED dot matrix chooses 4 pieces of 8×8 dot matrix modules to form a 16×16 dot matrix module. When using, it is necessary to connect the corresponding row and column lines in parallel, and use multiple character time-sharing display methods to display more for more information, the display code corresponding to each character is generated by special font fetching software.

4.2.2 Download the target program to the control chip to realize the conversion from virtual to reality. The target program generated in the CV is downloaded to the control chip on the universal board through the self-made USBISP programmer, and on-site debugging is carried out to realize the conversion from virtual to reality. Some technical parameters, such as the drive capability of the I/O port, can only be observed when the board is running. The on-site commissioning operation effect is shown in Figure 4, which shows that the project design has reached the expected goal and completed the design task. If problems are found during commissioning, they should be transferred to the corresponding stage for modification until the control requirements are fully met.

![Figure 4. The effect of on-site debugging](image)

The correctness of the analysis data can be visually analysed through the display module. Record the observed test results as shown in Table 1. According to Table 1, it can be seen that machine A sends the character ‘0’ to machine B. After receiving it, the digital tube will display the result as ‘0’, indicating that the data sent is correct. Then machine B sends back the character ‘1’ to machine A. After receiving
it, the digital tube will display the result as ‘1’, indicating that the received data is correct. Observe the result visually through the display module of the serial communication teaching system, indicating that the data transmission is correct. Finally, analyse the communication data format and observe the start bit, stop bit and data bit. Finally, observe the communication sequence.

Table 1. Test results of the serial communication teaching system

| Number of measurements | Characters sent by machine A | Characters received by machine B | Characters sent by machine B | Characters received by machine A |
|------------------------|-----------------------------|---------------------------------|-----------------------------|---------------------------------|
| 1                      | 0                           | 0                               | 1                           | 1                               |
| 2                      | 2                           | 2                               | 3                           | 3                               |
| 3                      | 4                           | 4                               | 5                           | 5                               |
| 4                      | 6                           | 6                               | 7                           | 7                               |
| 5                      | 8                           | 8                               | 9                           | 9                               |
| 6                      | A                           | A                               | B                           | B                               |
| 7                      | C                           | C                               | D                           | D                               |
| 8                      | E                           | E                               | F                           | F                               |

5. Conclusion

By using the Proteus simulation software to design the hardware circuit, combined with the Keil software design program, a single-chip serial communication teaching system is finally formed. The teaching system can not only complete the explanation of serial communication with relatively difficult content, but also display the teaching content to students intuitively during the teaching process, but also teach students the method of communication protocol, so that students have the ability to use serial communication; It can also complete the expansion of multiple communication protocols, and it is not limited to the types of single-chip computers, nor is it limited to hardware circuits and use sites. It is beneficial for students to further study multiple communication protocols and enable students to have the ability to expand the communication interface of single-chip computers.

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