The Design of Multifunctional Single Chip Microcomputer Virtual Experiment Box Applied to Project Teaching

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Abstract: At present, the single chip virtual experiment box with high utilization rate has the problem of slow data transmission, and therefore this paper proposes a multifunctional single chip virtual experiment box applied to project teaching. Multi-functional SCM virtual experiment box is composed of three modules including logic circuit module, run module and message module. Of which, logic module introduces MVC design ideas, realizing the unity and universality of the platform. The run module adopts the form of pseudo-compilation to judge the right and wrong of assembly language instruction. Message module adds a component processing structure, which is used to sense the direction of the circuit operation and store the queue message package into the system. The design of the multifunctional single-chip virtual experiment box is completed by combining the three modules. The experiment shows that when the user opens the multifunctional SCM virtual experiment box, the virtual experiment can be carried out without tedious links, indicating that the system has a fast processing speed.

Keywords: Multi-function single chip microcomputer ; Virtual experimental box ; Project teaching ; Data processing

1. Introduction

Project teaching enlightens the labor education thought in Europe, and after a long period of development, it gradually becomes perfect in the late 20th century. Project teaching is an important theoretical trend of thought and a modern educational form based on industrial society and information society. With the content of sociality as the main part, educatee socialization and educatee adapts contemporary productivity as development target, it cultivate practical talents for society. Such talent-training mode has been recognized by the society, which can not only solve problems, but also help the educated to accept new knowledge, especially in the process of cooperation with others and project cooperation, which can fully reflect the individual's operational ability. Teachers can use different ways to transfer knowledge and skills to students. They do not simply let students get a result according to the arrangement of teachers, but seek the way to get the result under the guidance of teachers [1].

SCM virtual experiment box is a very important specialized course in electronic information and automatic control. In practical teaching, the single-chip teaching platform only pursues function, which is limited by price, so it cannot carry out pioneering experiments. Single-chip microcomputer experimental platform produced by many enterprises is fixed, and enterprises cannot fully disclose all the technical data, which is not conducive to students to master the hardware principle, so students can only do some experimental projects but innovative experimental projects. Therefore, multi-function single chip microcomputer is proposed. The device can complete the download experiment and step tracking, and it is fully open multifunctional SCM virtual experiment box. A variety of modules are used to make the virtual components. The components in the virtual experimental system are divided into two types, one is simple logic components, and the other is complex single-chip microcomputer. Simple components are composed of multiple logic gates, and combine them into specific components and then introduce them into a virtual component library. In addition, this experiment box replaces the single simulation software, and uses a variety of mixed technologies to realize the multifunctional experiment system, which solves the problem of slow data processing and effectively improves the speed of the single-chip virtual experiment box.

2 Multi-function Single Chip Microcomputer Virtual Experiment Box Design

2.1. Logic circuit

In this project teaching, it has introduced the design idea of MVC for the overall software design, and the structure pattern is simple, realizing the interaction between data access logic and display logic [2]. The interactive approach only adds a complex design to the application, which completes the design of the overall software inter-

face and makes it more general. From a functional point of view, the software interface can effectively meet the user's experimental needs. The design of the virtual experiment software interface of logic circuit and single chip microcomputer is arranged according to the MVC concept, and it can continue the user's usage habit and it can be used without changing the application program. The purpose of the design is to achieve the universality of the platform and the unity of the experiment, even in a complex environment, and it can complete the single-chip experiment from the beginning to the end. In the experiment, devices are divided into two types, one is placed on the test table, and the other is placed on the device. The virtual experiment platform of the logic circuit is shown as below.
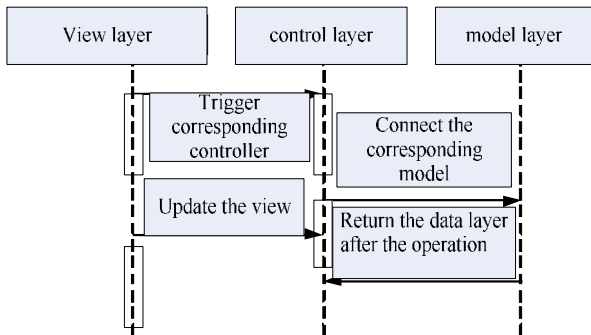

Figure 1. The virtual experiment platform of the logic circuit

It can be seen from the virtual experiment platform of the logic circuit in figure 1 that the software design of this platform adopts the classic MVC structure, which separates data from view and provides a convenient way for system development.

2.2. Run module

Run module is the core part of the multifunctional SCM virtual experiment box. Figure 2 is the structure diagram of the run module, and it is as shown below.
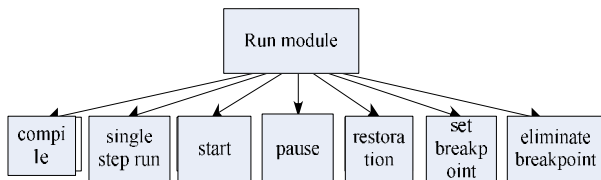

Figure 2. Run module

Run module in figure 2 can be divided into 7 parts, including compile, single step run, start, pause, restoration, set breakpoint and eliminate breakpoint. The form of pseudo-compilation is used to judge the assembly language instruction and conduct segmentation process. Separate the assembly language source program into a series of instructions, eliminate invalid characters accord-

ing to the statement label and operands, and store the effective characters into the data file [3]. In addition, the statement sequence number is used to identify the statement's location. Compilation refers to the translation of the source program into the language of the application program. After processing, the assembly language is converted into machine language according to the corresponding relationship. If there is no compilation, it needs to carry out syntax analysis, after confirming the instruction, save it in the document. This compilation method can filter the wrong characters, avoid program running errors caused by the occurrence of non-standard input. If there is an error in the opcode, it will affect the final use effect.

Before running the command, it is similar to the principle of single-step operation, and in this segment, the system needs to use the TIMER control in the original program. Using the properties of the internet, the TDBGtird control pointer is moved at regular intervals [4]. The principle of single-step operation is to simulate various assembly language program instructions in single - chip microcomputer, before running, the pointer direction of the program counter needs to be monitored in real time. If the pointer points to the address where the command is about to be executed, the system needs to calculate the program counter before compilation to provide a convenient way for the operation of the program.

2.3. Message module

Before the simulation experiment, the added components should be carried out the structure processing on the test stand. In addition, the components require registration information, so that the user can know the direction of the circuit at any time. Some upstream and downstream components of the circuit are connected. Once the relationship is known, the system reorders the order in which messages are delivered and stores the updated messages in the document [5]. As shown in figure 3.
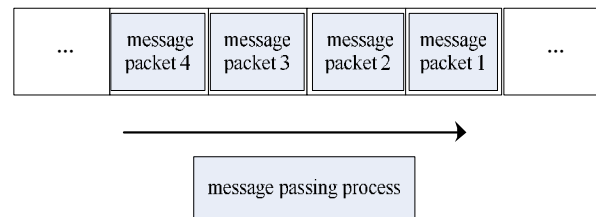

Figure 3. The structure of message module

Figure 3 is the structure of message module, the update message is packaged and stored in the message queue, and the stored output pin in each message packet displays the updated value [6]. The active element of the circuit will input the circuit signal sequence at the first moment, so that the active element can output the updated output value in time. When a queue message packet is sent, and

the system will automatically fetches a message packet, after the analysis, the new value is sent to the other components. Finally, each component receives a new input value and the entire circuit will be completely updated as the procedure is repeated, however, this method has a disadvantage that it cannot accurately determine the output value of all components of the whole circuit, nor can it detect when the circuit is in a stable state [7]. If there are messages transmitting in the message queue, then the message of the whole circuit will be reduced, if the circuit is very large, it needs to send many messages, seriously slowing down the simulation speed of the whole system.

In order to solve the above problem, it is necessary to connect each component pin into a message queue at the time of design [8]. Once the message queue is updated, and it will be sent to the downstream controller, which can effectively solve the problem of out-of-sync circuit pins. With the increase of the number of circuit components, the number of message queues will also increase, which takes up many resources. In the further study, it is found that to obtain the circuit at a certain moment, and the circuit must be updated synchronously, if not, it will block the pin value of the entire circuit. Therefore, number each message queue where the user created the circuit, and connect all the circuits according to the serial number and sequence to ensure that the value of other nodes remains unchanged when the active component is updated. At this point, the design of multi-functional single-chip virtual experiment box applied in project teaching is finished.

3. Experimental Analysis

In order to highlight the practical operation effect of the design of multi-functional single-chip virtual experiment box applied in project teaching, the following comparative experiment is designed. The three modules including logic circuit, run module and message module are integrated into software for the overall test. Due to this system is the multifunctional monolithic integrated circuit virtual experiment system that used in the project teaching, and the project teaching system is used to test its usability in the experiment. Two common single chip microcomputer and digital circuit are selected for experimental test. Finally, the application value of the system is verified by numerical comparison, of which, the experimental group is a multifunctional SCM virtual experiment box applied to project teaching, while the control group is the traditional SCM virtual experiment box. The experimental results are shown as below.
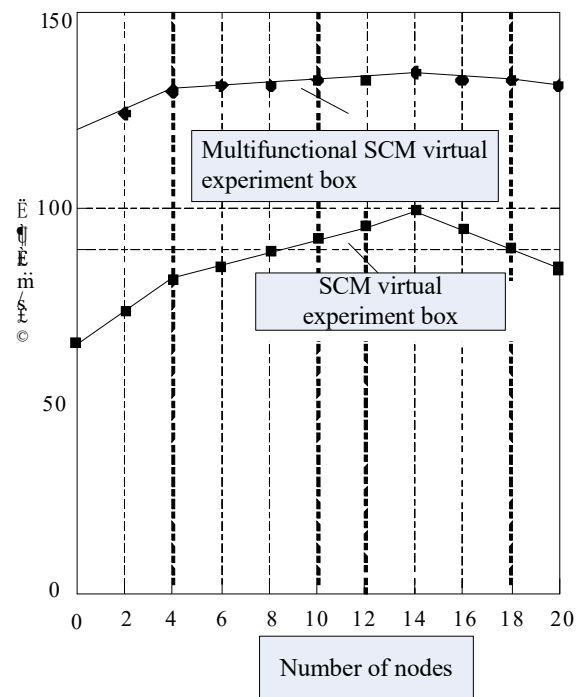

Figure 4. The result of comparative test

As can be seen from the experimental results in figure 4, when adopting the traditional single-chip virtual experiment box, the user needs to process each virtual device one by one, in particular, there will be wrong information when collecting project experiments, which seriously affects the speed of data processing in the background. When the user opens the multifunctional SCM virtual experiment box, the virtual experiment can be carried out without tedious links, and it indicates that the speed of system background processing data is faster.

4. Conclusions

In the experiment, we can found that there is still some room for improvement in the multifunctional SCM virtual experiment box. In the future experimental development, further research is needed to make the experimental course of project teaching more efficient.

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