Application for Emu8086 and Proteus in Microcomputer Principle Teaching

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Abstract. Combined with the teaching of Microcomputer Principle and interface technology in electrical engineering and automation, the authors proposes a new teaching method. Firstly, the authors analyzed the teaching and learning situation of Microcomputer Principle and interface technology. Secondly, in the theory and practice teaching process, the authors put forward a new designing scheme that through the Emu8086 and Proteus software for assembly program writing, hardware circuit design and simulation design. The simulation example of frequency divider circuit is constructed by 8086 and 8253A. The experimental results show that the constructed frequency divider circuit can be realized by 8086 simulation. Finally, the authors summarizes the teaching methods of virtual simulation for Emu8086 and Proteus software, and obtains very good teaching results. In this paper, this innovation mode (that is, through the vivid simulation effect) arouse the student's study enthusiasm and provides a new method for embedded curriculum teaching reform.

The Present Situation of Course Teaching and Learning

Basic core courses of engineering major require the support of microcomputer principle and interface technology course, these basic specialized include the electrical engineering and automation, mechanical engineering, vehicle engineering, new energy science and engineering and others. The course mainly contains the basic composition, 8086/8088 of the work principle, instruction system, assembly program design, storage system and microcomputer interface circuit design. With the computer hardware related technology developing rapidly in recent years, the microcomputer principle and interface technology course teaching content is abstract, complex and practical very strong, as the same time the practice teaching link is very weak, the resources of experiment equipment are limited. These cases have led to teaching effects that are not optimistic in most universities in the country, the students are not interest in learning this course as well.

With the rapid development of computer software technology, the authors adopted teaching reform for the above problems. Such as the microcomputer principle and interface technology course of Nantong institute of technology uses Emu8086 for assembler programming theory teaching in the process of teaching reform, and Proteus 7.10 for 8086 experiments simulation in practice teaching. The teaching reform has obtained the very good teaching effect [1]. This paper presents a new method to solve the problems of microcomputer principle and interface technology theory teaching and practice teaching, and the problems of the lack of experimental equipment was solved.

Overview of the Emu8086 & Proteus Software

Emu8086 Software

Emu8086 is the essential tools of learning assembly language programming, it is a combination of an advanced original editor, the assembler, the set of translation, with the function of debugging the software simulation, and a step-by-step guidance tool. The software contains all the content of the assembly language program design. Emu8086 also set the source code editor, assembly/disassembly
tool, and can be run the debug of the simulator, the debug of the simulator is very suitable for teachers and students in the instruction set and assembler programming part of the theory of teaching and learning, Emu8086 can intuitively reflects the change of the relevant register process and assembly steps of program execution.

**Proteus Software**

Proteus software is the EDA tool software that was published by Lab Center Electronics. It not only has the simulation function of other EDA tool software, but also can simulate single chip microcomputer and peripheral devices. It is a good simulation of single chip microcomputer and peripheral devices. Although the domestic promotion has just started, it has been favored by the single-chip computer enthusiasts, teachers who are engaged in single-chip microcomputer teaching, and devoted to the development and application of single-chip microcomputers. From schematic diagram, code debugging to single chip microcomputer and peripheral circuit coordination simulation, one key switch to PCB design, Proteus software truly realized the complete design from concept to product. It is currently the world's only the circuit simulation software, PCB design software and virtual models simulation software platform for the design. It supports 8051,DSP,ARM,8086,MSP430 processor model of architecture. At the compile of program, it also supports the IAR, Keil compiler.

**Frequency Division Circuit Experiment**

The frequency division circuit is an electronic circuit, which the output signal frequency is one of the input signal frequency integer times. Many electronic devices(such as electronic clock, frequency meter) are need to all sorts of different frequency signal to work together. The common methods is based on the quartz crystal oscillator of high stability as the main vibration source, related equipment require various frequency components through a variety of transformation. The frequency division circuit is main transformation means.

![Schematic diagram of frequency division circuit system.](image)

The experiment mainly uses Proteus circuit simulation software to realize the fractional frequency circuit design of 8086 microprocessor and 8253A timing/counting chip. Since 8086 is a two-way signal line multiplexed by 20 data and address, three 74HC373 chips are selected in the circuit, which has the function of 74LS244 three-state gate function and 74LS273 data lock. Circuit also chose special decoding chip 74LS138 for decoding circuit. The figure show that the A12 to A15 pin on the address bus as address decoder input and enable control. Because of not all address bus as input of decoding circuit, this is a form of partial address decoding. When the 74LS138 of IO2 pin output low level signal, the 8253A is selected [2]. The A0 and A1 of 8253A chip are controlled by four ports on the system address bus A1 and A2 pin. The counter0 is input by external clock, the external clock input
pulse of 100HZ. When he gate0 sets high level signal, the counter0 start counting. Through the output port out0 of counter0 show external virtual oscilloscope to observe the input and output waveforms. the fractional frequency circuit principle diagram of the hardware system is shown in figure 1.

The 8253A timer/counter mainly compose of three counters, a logic circuit control register, data bus buffer and logic circuit of reading and writing. The authors suggest students must understand the content of counter, include the selection of timer/counter, working modes set to determine the port address and control word, counting finally calculate the initial value. According to the schematic diagram of the frequency division circuit system, a list of 8086 system address bus assignment is listed as shown in table 1.

Table 1. System address bus assignment.

<table>
<thead>
<tr>
<th>8086 Address pin</th>
<th>A1</th>
<th>A1</th>
<th>A1</th>
<th>A1</th>
<th>A1-A4</th>
<th>A3</th>
<th>A2</th>
<th>A1</th>
<th>A0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Circuit Chip</td>
<td>74HC138</td>
<td>E1</td>
<td>C</td>
<td>B</td>
<td>A</td>
<td>X</td>
<td>X</td>
<td>A1</td>
<td>A0</td>
</tr>
<tr>
<td>Port</td>
<td>CNT0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>0</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>CNT1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>X</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>CNT2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>X</td>
<td>1</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Control Register</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>X</td>
<td>0</td>
<td>0</td>
<td>X</td>
</tr>
</tbody>
</table>

Experiments require using the counter0 of 8253A, working in the mode three (square wave generator), the input clock CLK0 is 100HZ, the output OUT0 require for 10HZ square-wave, these can realize the function of fractional frequency. We can observe the output waveform from the oscilloscope. Therefore, according to the fixed format of 8253A control word, the control word of 8253A is calculated as 16H, and the initial value of the counting is 100HZ/10HZ = 10, according to the input clock pulse and output frequency. As shown in table I, the address of the counter 0 is A000H, and the address of the control word register is A006H.

According to the above calculation, the initial value is based on the programming algorithm of 8253A, and the software of Emu 8086 assembler programming software is used to write the control word of the counter0 first, and then the counting initial value of the counter0 is written.

The assembly language source program is saved as the format of asm file by click save button. The source program can be used for single step debugging through EMU8086. By click compile button, the EMU8086 software will generate a com file. The interface of the software is also very friendly, and the change state of the register is displayed on the left side. The single step debugging environment for the source program is shown in figure 2.

The source program is saved in the .asm format, and the source program is compiled. The Com file can be well combined with Proteus software for simulation. Specific loading process for com file, right-click the 8086 chip select edit properties pop-up as shown in figure 3, 8086 chip properties...
dialog window, in the program file, select the EMU8086 generated com file, set the clock frequency is 1.5 MHZ, the most important is must in the Advanced properties of choosing Internal Memory Size is set to 0x10000, click OK in the end\[4\].

At this point, by clicking on the running function in Proteus, the fractional frequency circuit can simulate the simulation using the 8086 chip. By observing the virtual oscilloscope, we are obtained the input and output waveforms of the frequency division circuit. Frequency division circuit input and output waveform diagram is shown in figure 3.

The experimental results show that the built frequency division circuit can be realized through the simulation of 8086. Students can understand the link between the theory of knowledge and master the practice teaching, by through the fractional frequency circuit experiment of microcomputer principle and interface technology curriculum. At the same time, the students can also master the complete development process that the hardware development process in detail is how to do joint software simulation and hardware debugging\[5\]. It has enhanced students' interest in learning microcomputer principles and interface technology, so that students are not restricted by hardware resources and time and space in learning microcomputer principles and interface technology course, it also provides the following specialized courses, such as DSP, ARM, RX23T, FPGA, etc., to lay a solid foundation for further research.

**Conclusion**

Microcomputer principle and interface technology is a very professional course. In the course of engineering teaching of applied undergraduate, it has a very important position. Using EMU8086 and Proteus virtual simulation teaching method, it obtains very good teaching effect. Through vivid simulation effect stimulate student's study enthusiasm. The problems of weak practical teaching links and limited laboratory resources have been solved. This innovation mode provides a practice method for cultivating the students' independent ability and innovation ability, also provides a new method for the reform of course teaching.

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**References**


