Research on the Reform of Teaching for MCU based on C-Language

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Abstract: The two courses of C language programming and single-chip microcomputer are almost required courses for all the colleges and universities in the fields of electrical and electronic automation. The two courses are closely related. According to the author's years of experience in teaching experience and teaching methods of "Single-Chip" and "C-Language", a teaching method combining "Single-Chip" and "C-Language" was proposed. This new teaching method can fully stimulate students' enthusiasm for learning and deepen students' understanding and mastery of the knowledge of C language and MCU.

1. Introduction

The traditional course is set up as C language as a professional basic course is generally set up in the next semester, and the SCM as a professional limited selection course will be set up in the second semester of the second year or the last semester of junior year. The longer time interval has led to a serious disconnect between the two closely related courses and the "C language" learned by junior year has almost been forgotten, and has to learn from scratch. In particular, the "C Language Programming" course is aimed at freshmen. The vast majority of students are initially exposed to computer language learning. It is generally believed that the course has complex concepts and many rules, and it is very difficult to learn. Moreover, freshmen have not involved related knowledge of SCM. Therefore, students are not very interested in learning C language and have low interest. The learning effect is not ideal.

2. Teaching reform goals

Through the reform of teaching methods, students' interest in programming is fully mobilized so that most students can master the basic knowledge of C programming and have certain programming and debugging capabilities. At the same time, students can master basic knowledge of microcontrollers and related interface circuit knowledge. Can use C language to carry on the design of some simple one-chip computer program control, thus have profound understanding and experience to C language how to control the hardware. At the same time, it also lays a solid foundation for students' curriculum design, graduation design, and participation in college students' electronic design competitions.

3. Teaching reform content

At present, the MCU teaching in most colleges and universities mainly uses assembly language, but the assembly language is abstract and the readability is poor, and students are difficult to understand. The programming efficiency is low, and the students' learning is difficult. The code structure is complex and difficult to maintain and update. In engineering practice, there are few assembly language applications, and the application of C language is more and more extensive. "Single-Chip Microcontroller C Language" is characterized by its rapid development and high readability. It has gradually replaced assembly language in the development of single-chip

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microcomputers, and the electronic design competition and graduation design for college students participated in by our students have also adopted the C language for single-chip microcomputers. Design and development. Therefore, in order to adapt to the needs of undergraduate education for application, our microcontrollers have adopted a C language instead of assembly language.

For the students to learn C language difficulty, interest is not high, and the microcontroller is using C programming language this status, we boldly reform, the "microcontroller" and "C language" combined, two courses combined into one. The course is scheduled for the fourth semester. Two courses are combined into one course. The total class time is 96 hours. The course is completely arranged in a computer room equipped with multimedia, and each computer is equipped with Preoteus software and Keil software, so as to combine practice and practice while speaking. Through several years of educational practice, we have selected the appropriate content and the appropriate experiment to teach, formed a perfect exercise test library, and revised the experimental instruction book. Teaching tools to make full use of multimedia courseware and on-site program design and debugging, supplemented by Predictus software hardware circuit design and SCM learning board on-site demonstration, the reform of monotonous teaching methods before, so that students no longer boring learning, so that the classroom becomes Fun and vibrant.

In the teaching process, we put the interest of cultivating students in the first link, allowing students to personally experience the joy of programming. In the first lesson of the course, we will send a SCM teaching experiment board to each student. When the machine is on board, it will carry the experiment and can practice it after class. In the course of teaching, the use of SCM development board to demonstrate the programming effect of C language, allowing students to clearly understand the entire process of the C language to control the microcontroller, and further deepen students' understanding of the "C language" and master.

4. Introducing Proteus MCU simulation software in teaching

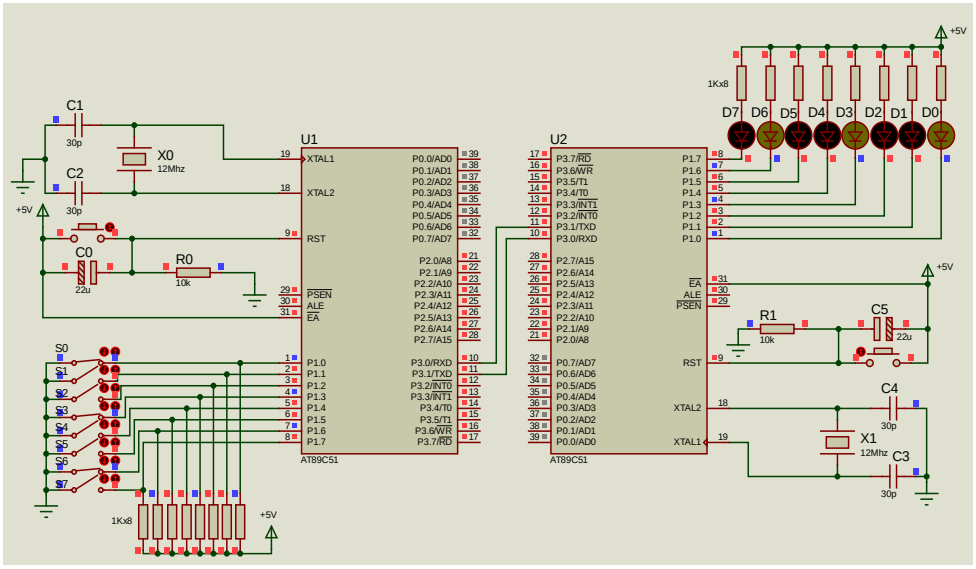

Fig. 1 Lantern remote control simulation diagram.

Protens is an excellent microcontroller development platform developed by Lalxenter Electronics in the United Kingdom. It can be used to simulate the design of the SCM and its peripheral circuits. Secondly, under the condition of no single-chip hardware, the use of a PC can make the virtual SCM system soft. Cooperative design of hardware. Teachers use Protens software to integrate teaching content into the design and development process of a specific project. This enables the mutual penetration of theoretical teaching and practical teaching. Students can intuitively see the process of system design and system operation during the learning process. The effect can help students understand the theory. Second, students can use Protens software to use the computer to design and develop the single-chip microcomputer system under the condition of not being limited by the

experimental conditions. Protens software covers a variety of single-chip microcomputer models ranging from 8-bit microcontroller 8051 up to 32-bit microcontroller ARM7 system. It can make use of it to make up for the inability of experimental equipment to be updated in time due to financial and material constraints. Fig. 1 is a remote control simulation effect diagram of a lantern developed and developed using Protens software.

5. Teaching case design

The teacher formulates a reasonable syllabus and teaching schedule according to the content system and curriculum characteristics of the SCM and C language. The combination of microcontroller and C language is mainly reflected in the basic part of C language and SCM, such as:

(1)Introduction to the introduction of knowledge (SCM includes the basic knowledge of the microcontroller power supply and ground pin, reset pin, PO port - P3 port specific location and arrangement order, so that students have a preliminary understanding of the structure of the microcontroller; C language The C51 part includes data types, commonly used header files, operators, and basic sentence descriptions. Under the guidance of the teacher, some basic rules and techniques for programming the SCM are preliminarily mastered.)

(2)Introduce the use of Proteus software and Keil software; Live demonstration using Proteus software to draw a minimum single-chip system, programming to achieve a LED light lighting control, both to deepen students' understanding of the principles of the microcontroller, but also exercise the students to carry out comprehensive design of hardware and software ability.

(3) Through the LED flashing and blinking program design, students can grasp the use of while statements, do-while statements, for statements, and other loop statements. By designing delay subroutines at different times, they can grasp the knowledge of the microcontroller's crystal oscillator and timing. For example, in the teaching process, the teacher uses the light-emitting diode on the experiment board to perform a live demonstration, and the LED light's brightening and extinguishing conditions are explained in correspondence with each program instruction. Because each instruction of the program corresponds to the specific phenomenon of the LED light, it is intuitive and inspiring to stimulate students' interest in learning.

The program case is as follows: Using a loop statement nested to write a simple LED flashing flash program, LED light interval 10ms light off, the microcontroller used by the crystal frequency is 11. 0592MHz, LED lamp cathode connected P0.1 pin. The control of time is achieved by means of time delay.

The main program is as follows:

```
main()
  sbit LED=P0^1;
  LED =1;
   While(1)
   {  LED=0;
      Delay(100);
      LED=0;
     Delay(100);
   }
   Delay(ms)
   { unsigned int ms;
     unsigned char n;
     for(ms=0;ms--<=125;ms++)
     for(n=0;n<=125;n++);
    }
```

The teacher instructs the student to modify the program, and the LED lamp can have different effects, such as modifying the delay time, nesting the for statement and the while statement, and so on. This greatly enhances the enthusiasm of the students. In order to make satisfactory experimental

results, they will certainly listen carefully in their studies. In addition to using the experimental board design verification, students are also required to use Proteus software to design their own circuits, and simulations, and better grasp the hardware circuit connection method.

(4) Through the water lamp circuit design, so that students master the use of the choice of statements, and further proficient in the use of loop statements. Use a loop statement nested to write a water lamp program, LED lights in turn, the time interval is 50ms, 10 cycles of the program, the microcontroller used in the crystal frequency is 11.0592MHz, 8 LED cathodes are connected to P0 pin. The control of time is achieved by means of time delay. The main program is as follows:

```
 void main (void)
{ unsigned char a,n;
  a=0xfe;
 for(n=0;n<10;n++);
{
  P2=a;
  Delay(500);
       a = a << 1;
                if(P2 == 0x00 )
{a = 0xfe;  }
  }
 }
```

(5) The neon control circuit design allows students to master the application of arrays. Use 51 single-chip control light-emitting diodes to achieve a variety of actions: a bright spot left flow; a bright spot to move water; the middle two bright spots move to the side; both bright spots move to the middle; 8 lights flash once. In this way, a variety of control state changes achieve neon effect.

(6) Through the circuit design of traffic lights, students can grasp the application of timer/counter, interrupt system and the application of digital tube and keyboard interface technology. The program will not repeat them here.

(7) The remote control design of the lantern enables students to master the serial interface technology of the microcontroller. A lantern remote control system is designed. A port of a single-chip computer (a machine) is connected to a group of independent buttons. The machine A reads the button status and sends it to the B machine; another piece of SCM (B machine) receives the data sent by the A machine. It is displayed on the 8-bit LED signal connected to the P1 port to achieve remote control of the lantern.

(8) Curriculum design is conducted through the independent practice week at the end of the semester, and the understanding of knowledge is further enhanced in practice. Temperature measurement using temperature sensor DS18B2, and then through the LCD display ambient temperature value, microcontroller temperature control simulation. 3 to 5 people make up the production team to complete the physical production and operation debugging (including simulation in the Proteus environment), and submit the teacher acceptance and evaluation.

6. Summary

This article proposes a teaching method combining "single-chip microcomputer" and "C language". When students understand some of the major structure and function of the SCM and master the basic knowledge of the "Single-Chip Microcontroller C language", the teacher demonstrates through examples and strengthens students' "C language" understanding and mastery. At the same time using Proteus software design circuit, the microcontroller's commonly used peripheral circuit design and resistance, capacitor values, etc. to explain clearly, so that students fully grasp the microcontroller's C language programming and microcontroller peripheral circuit design ideas.

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References

[1] Hu Zunmei. Discussion on the reform of C language programming experimental teaching [J]. Fujian Computer, 2010, 1; 202-203.

[2] Su Bo. "Single-chip microcomputer" and "C language" teaching and research [J]. Beijing Optical Technology, 2010. 108-109.

[3] Chen Yuanyuan, Chen et al. Discussion and research on experimental teaching based on Proteus and Keil MCU [J]. Electronic World, 2016, No.495 09:28-29..

[4] Xiangju C. Construction and Improvement of College English Flipped Classroom Teaching Mode Based on Network Teaching Platform[J]. Journal of Applied Science and Engineering Innovation, 2018, 5(2): 37-41.

[5] Chen Wenhui, Cai Qizhong, Yan Yongxin. Reform and Practice of "Single Chip Microcomputer Principle and Application" Curriculum System [J]. China Science and Technology Information, 2006, 19: 250-253.