Research on the Teaching Reform of Mcu Course Based on Virtual Simulation Technology in Junior College

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Abstract: MCU course plays an important role in the curriculum system of mechanical and electrical specialty. This paper introduces the current teaching situation of MCU course in junior college, and puts forward corresponding reform measures in teaching objectives, teaching content and teaching means. The teaching objectives and teaching contents that are more in line with the learning situation of junior college students. The project-driven teaching method is used, the virtual simulation technology is introduced into the teaching, and the order of "do it first, teach it and then do it again" is adopted in classroom teaching, so that students can learn with questions. The practice has showed that this new teaching mode has achieved good results in junior college teaching.

1. Introduction

MCU is a professional required course for mechanical and electrical majors. It is a theoretical and practical course. It has the characteristics of abstract theoretical knowledge but strong applicability. The teaching of MCU course is usually oriented to undergraduate students in universities, so there is rarely teaching mode specially designed for junior college students. However, undergraduate students and junior college students have different learning conditions. Junior college students' knowledge base and learning habits are relatively poor, and their self-control is not strong, so it is obviously impossible to generalize. At the same time, the ability training of college students is more emphasis on practical application. Therefore, it is necessary to study the teaching reform of MCU for junior college students, so as to effectively improve the teaching effect and enhance the applicability and practicability.

2. Analysis of Teaching Situation of Mcu Course in Junior College

2.1 Lack of Clear and Definite Teaching Objectives of the Course

It is difficult to find a MCU textbook specially prepared for junior college students at present. Most of the teaching materials are based on the ability to develop MCU after learning. However, such requirements are not appropriate and difficult to achieve for junior college students.

2.2 The Inappropriate Proportion of the Theory and Practice Part in the Textbook

The content of the teaching material emphasizes theory but ignores practice, which is not in line with the learning situation of college students. The traditional MCU course is based on the order of hardware, instructions, programming and external expansion. Most of the time is spent on the explanation of obscure theoretical knowledge, and only the last few weeks are reserved for students to carry out practical operation. In this way, students can only passively receive knowledge according to the content taught by the teacher. However, such a teaching method can not effectively stimulate the interest of college students with poor knowledge foundation and poor learning ability. Obviously, the teaching effect can not be guaranteed naturally. Therefore, for college students, we

should focus on the cultivation of their practical application ability[1].

2.3 The Programming is Difficult and the Language is Not Suitable for Practical Application

In order to help students better understand the hardware structure of MCU, the traditional teaching of MCU course mainly uses assembly language which is closely connected with hardware. Therefore, students need to understand and memorize 111 assembly instructions and be able to skillfully use them in MCU system. This is a relatively difficult requirement for junior college students. In addition, students usually participate in projects with many requirements while the development cycle is short. The simple assembly language can not meet the requirements of the project, so this low-level language has been seldom used in actual work environment. Therefore, there is a problem that the theory learning is divorced from the practical application.

2.4 Insufficient Experimental Equipment and Insufficient Student Participation

The single-chip development boards are usually used in the traditional practice of MCU teaching, which requires a lot of teaching cost to purchase and maintain these hardware equipment. The laboratory investment is large and the maintenance cost is high. There are also some limitations such as fixed experimental content, poor flexibility, lack of innovation and openness[2]. In addition, due to the lack of single-chip development board, as well as the weak self-control of college students, some students' participation is not high. In the group training, there is usually only one student to operate, and other members seldom participate in it.

3. Measures of Curriculum Reform

3.1 Reference to the Aim of Cultivating Talents and Learning Situation to Formulate Clear Curriculum Teaching Objectives

Considering that the aim of cultivating talents of junior college students is to improve their operational skills rather than the development ability, and most of the students have poor knowledge base, so it is unrealistic to ask them to develop MCU. Therefore, the teaching objectives of this course can be divided into two levels: primary and advanced.

Primary goal: to understand the use of common function modules of MCU and circuit schematic diagram of MCU system, to have preliminary imitation programming ability, and to master common fault detection methods and troubleshooting methods of MCU system.

Advanced goal: master the working principle of common function modules of MCU, be able to design hardware, have certain ability of independent programming and debugging program, and be able to assist engineers in on-site debugging.

If the junior college students can achieve the primary goal through classroom listening, they can be regarded as qualified. If some students like this technology very much and are willing to spend more time on it, we can help these students achieve their advanced goals through after-school counseling and interest groups.

3.2 Refine the Theoretical Teaching Content and Use Project-Driven Method in Teaching

College students should pay more attention to the application of MCU, so some complicated and difficult knowledge about the internal structure of MCU in tradional courses could be removed. The teacher only explains the internal resources of MCU that users of MCU will use, that is, focusing on the three internal resources of MCU: program memory(ROM) and data storage Device (RAM) and special function register (SFR).

Secondly, break the original knowledge system, divide the knowledge structure according to the project task[3], integrate the knowledge points into the project, and make the abstract and complex theoretical knowledge more vivid. Students learn around the task and effectively absorb knowledge

in the process of project implementation. For example, the following items can be set up for this course to lead teaching and learning, as shown in Table 1.

Table 1 Projectized Instructional Desigh of the Course

Numbers	Project tasks of teaching	Knowledge points
1	Light a LED light	MCU Minimum System, I / O port, MCU internal resources
2	flowing water lights	Conversion between hexadecimal and binary, C programming foundation(variable type, basic operators, for loop statement, while statement, if statement)
3	Auto flashing LED lights	Common delay Time Method of MCU, the principle of the timer, C programming foundation(logic operation)
4	Static display of digital tube	The principle of static display of digital tube, C programming foundation(array, function call)
5	Dynamic display of digital tube	The principle of dynamic display of digital tube, the principle of interruption, C programming foundation(while statement)
6	Control the display of digital tube with key-press	The principle of key-press input circuit, elimination buffeting of keystroke
7	Control the buzzer with serial communication	The principle and classification of serial communication
8	Design of digital voltmeter	Basic concepts of A / D conversion, A / D conversion interface chip and its application
9	Design of Waveform Generators	Basic concepts of D / A conversion, D / A conversion interface chip and its application
10	Multifunctional electronic clock	comprehensive design

3.3 Using C Language as Mcu Programming Language

After changing the programming language to C language, students do not need to do in-depth study of the underlying principles of MCU. As a high-level language used more and more in project development, C language has become an important language gradually replacing assembly language. Therefore, it is more appropriate to use C language in the teaching of MCU for junior college students, and it can play a important role in training students' practical ability.

3.4 Applying Virtual Simulation Technology to Class Teaching

The application of virtual simulation technology in classroom teaching can realize the real-time operation and verification of teaching examples and after class topics. In the process of theory teaching, students can intuitively see the operation process and results of the system through the virtual simulation experimental platform, so that they can better understand the knowledge points and stimulate their interest in learning. In addition, the virtual simulation experiment platform is easy to build and can be realized with only one computer. A student with a computer, so that each student's practical ability can be trained.

3.4.1 Selection of Virtual Simulation Experiment Platform

Proteus Software[4] is selected as hardware circuit platform. Proteus Software is a kind of simulation software developed by Labcenter electronics company in UK. It has abundant simulation resources. It can design circuit schematic diagram, PCB layout, simulate and analyze various analog devices and integrated circuits.

Keil C51 was selected as the software platform. Keil c51 is a development software for 51 MCU produced by keil software company of the United States. The programming language is C language. C51 can operate the hardware of MCU directly, and the development of application program is convenient and fast.

3.4.2 Teaching Process Design Based on Virtual Simulation Platform

Due to the characteristics of College Students' learning situation, their interest and effect will be greatly reduced without intuitive and specific cognition. Therefore, this course has made some reforms in the teaching form and reaching order. The course takes practice as the main line, adopts the sequence of "do it first, teach it and then do it again". The purpose of the course is to make students have questions in the process of practice, and students take questions to learn the theoretical knowledge so that the teaching effect will be better. After learning the theoretical knowledge, the students try to complete the project tasks independently without looking up the answers.

The specific implementation process is as follows:

Step 1: stimulate students' questions. Students build the hardware circuit in Proteus according to the circuit diagram and program code given by the teacher, write program code and compile the program in Keil C51, generate the hex file and load it into Proteus to output the simulation results;

Step 2: students learn theoretical knowledge. The teacher explains the theoretical knowledge involved in the project;

Step 3: students use what they have learned to complete the task independently, including building hardware circuit and writing program code independently, and output simulation results at last;

Step 4: Expand and upgrade the requirements of the project task, and students can try to do some imitative coding after independent thinking.

4. Teaching Case Analysis Based on Virtual Simulation Platform

This case is to control a LED light flashing by MCU.

4.1 Hardware Circuit Design

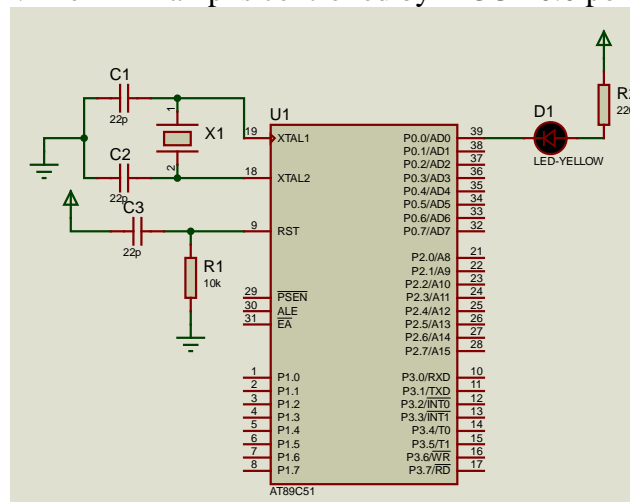As shown in the figure 1. The LED lamp is controlled by MCU P0.0 port.

Fig.1 Hardware Circuit of Led Light Flashing.

4.2 Software Design

The software part is divided into two levels. The primary goal is to achieve the inaccurate timing flicker of LED lights, and the advanced goal is to achieve accurate timing flicker of LED lights. In the primary target, the delay program of LED flashing uses the for loop statement, and the code of delay program is: for (i = 0; i < 30000; i + +). In the advanced target, the timer is used to make the LED light flash accurately every 1 second. The flow chart of the program is shown in figure 2 and figure 3.

4.2.1 Implementation of Primary Goal

As mentioned above, the teaching implementation process to achieve the primary goal is as follows:

Step 1: stimulate students' questions. Students run the simulation results in Proteus according to the circuit diagram and program code given by the teacher;

Step 2: the teacher explains the theoretical knowledge in this case to answer questions, including common delay methods, C programming basis;

Step 3: the students independently completed the hardware circuit construction and programming;

Step 4: thinking after project simulation practice. The teacher asked the students the question: if you change 30000 to 70000 or 200 in the for loop statement, will the LED still flash? After rewriting the code, students observe the simulation results, think about and discuss the causes of this phenomenon. Finally, we can draw a conclusion: the type of variable I has an impact on the running results of the system.

Step 5: the teacher puts forward the advanced goal: how to achieve accurate timing? With the question raised, we naturally enter into the study and implementation of the advanced goal of this case.

4.2.2 Implementation of Advanced Goal

The timer is a very important knowledge point in the course of MCU. The use of virtual simulation technology can help teachers to explain this part of the content well. The teaching steps to achieve the advanced goal are similar to the five steps in the primary goal. In the last step, the project task requirements can be expanded and upgraded. Students are required to try to use the timer to achieve 1 second precise timing to control the water lamp program through the knowledge learned in class, and students can have a better understanding of the knowledge through this kind of imitative programming.
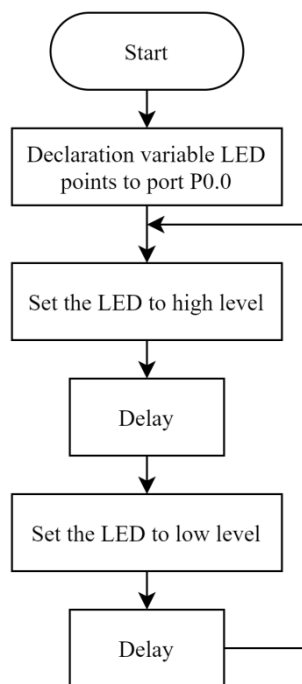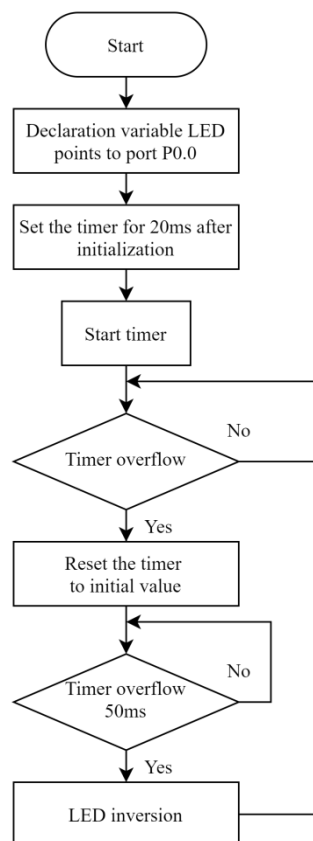
Fig.2 Ccurate Timing.   Figure 3 Accurate Timing with Timer.

5. Conclusion

Combining with the learning situation of junior college students and focusing on the cultivation of students' practical application ability, this paper expounds the reform of teaching purpose, teaching content, teaching means and programming language of SCM course, clarifies the teaching purpose, refines the teaching content, introduces the virtual simulation platform into the teaching, and adopts the order of "do it first, teach it and then do it again" in teaching means. In the process of realizing the project, the knowledge points are gradually integrated and used flexibly. This teaching mode has carried out pilot teaching for industrial robot specialty in our college. It has achieved good results in attracting students' interest and improving students' practical ability at present.

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