Improving the teaching effectiveness of an SCM course

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ABSTRACT: An SCM (single chip microcomputer) course is an important specialised course that is both technical and practical. However, SCM technical knowledge is abstract and difficult for most students to master. They often feel that the content of an SCM course is complicated, dull and confusing. So, students are not enthusiastic about learning and the classroom atmosphere is passive. Therefore, the teaching is not ideal. Proposed in this article are several measures to improve the teaching effectiveness of SCM courses in order to stimulate the enthusiasm of students, and to improve their practical ability and theoretical knowledge.

INTRODUCTION

At present, the SCM (single chip microcomputer) teaching methods at most colleges and universities are based on the structure of the SCM itself. First, the SCM hardware architecture is introduced; second, the instructions and software programming are covered; third, the application of a variety of peripheral devices and the expansion of the SCM system are examined; and, finally, several examples are put forward. Students generally feel that it is difficult to learn through this teaching method. It is not easy for students to understand the internal structure of the SCM, since many have not been exposed to computer architecture and they have just come into contact with digital circuits.

It is difficult for students to understand the concept of a bus or an address as mentioned in many books, no matter the clever analogy used. Most students feel daunted and begin to give up. Therefore, the pass rate of the MCU (microcontroller unit) course is not high. In order to change the above factors, it is necessary to improve the SCM curriculum and teaching methods.

TEACHING BY WAY OF *BLACKBOARD + MULTIMEDIA + PHYSICAL DEMONSTRATION*

In teaching SCM, the teacher guides students to take an interest in the course. Mainly, the teacher introduces the application of SCM to all students and shows them several designs. The teacher can use multimedia technology to demonstrate SCM applications; hence, making SCM no longer mysterious [1]. The teaching method can bring teachers and students closer together and combines theory with practice.

A teacher just talking to a class is inferior as compared with bringing physical objects into the classroom, such as an SCM chip, memory, programmer, experiment board and communication cable. These all can be demonstrated using multimedia or studied by students after class. At the same time, the teacher should make full use of multimedia. The teacher can use animation, audio and video to increase the students' interest. Using Proteus software (from Labcenter Electronics) in the SCM class can enhance the teaching and improve students' intuitive understanding [2].

An SCM contains many registers and memory. The knowledge of SCMs is tedious and it is not easy to understand. Metaphors are useful in associating SCMs with the real world and are a good way to introduce knowledge to the students. By such methods, twice the result can be obtained, with half the effort [3].

For example, the SCM priority interrupt system must deal with several interrupts. That can be likened to a person who is having dinner, while the doorbell rings, the telephone rings and, at the same time, water is boiling in the kitchen [4]. The diner must prioritise answering the door and looking after the boiling water.

When multiple machines communicate with each other, the host first must send the address and, then, the data [5]. That can be likened to the teacher who asks students to answer questions in class; first a student stands up and, then, the questions are asked. The timer/counter can be compared to an alarm clock [6]. If people are compared to a single chip microcomputer, the on-chip RAM is the clothes and pocket and the external RAM is the luggage or bags. Their capacities are different and their access speeds are also different. If the teacher carefully and appropriately uses metaphors and examples, esoteric knowledge, previously boring for students, can be vividly introduced. In this way, students can like to learn, teachers can easily teach and students can grasp difficult concepts [7].

IMPROVED EXPERIMENTAL TEACHING IN THE FORM OF *PROTEUS + EXPERIMENT BOARD*

Scheduled classes can increase the time needed to do an experiment. Students should be able to do an experiment anytime and anywhere. Increasing or extending the laboratory opening time can allow students to have more opportunities for contact with SCMs [8].

Proteus software is introduced to demonstrate examples, and to make the SCM teaching more vivid and intuitive. For example, teachers can demonstrate some typical applications, such as the water lights experiment, the digital display, traffic lights and the digital clock. Students develop a strong feeling for SCM applications and can understand the role and status of an SCM application in a complete system.

It can also help students to understand how to use a Directive (a special instruction in Proteus) to change procedures or instructions. Students, then, can observe the operating results and; hence grasp the meaning of the statement.

Illustrative Example

Here, as an illustrative example, is an experiment of the dynamic display of a digital tube.

Using the dynamic display mode, the data to be displayed were stored in 7 Eh ~ 79 h (corresponding to the space position from right to left) and the internal number, which is stored, is 0 ~ 9 (or 0 ~ FH); see Figure 1 below.
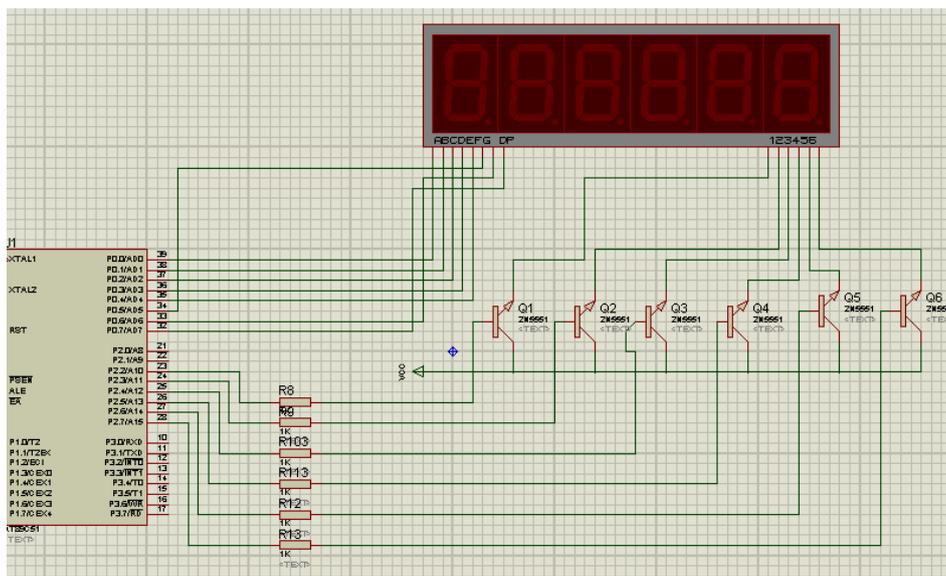

Figure 1: The hardware design for the dynamic display of a digital tube.

Hardware Analysis

In the above figure, P0 port outputs the segment-selected code, and P2 outputs the bit-selected code. The line number of the bit-selected code occupied by the P2 port depends on the number of display digits. For example, six digits to display must account for 6 lines.

An LED digital tube is an anode of the digital tube. The triodes (Q1 to Q7) are looked at as the bit-selected code driver. For example, when the pin of P2.2 outputs at a low level, there is a potential difference between the base pole (B pole) of the triode (Q1) and the collector pole (C pole) of the triode (Q1). When the voltage reaches the triode (Q1) working voltage, the triode (Q1) is in a saturated state. There is, then, conduction between the collector pole (C pole) of the triode (Q1) and the emitting electrode (C pole) of the triode (Q1). The first one of the LED digital tubes then lights up.

Software Analysis

The following procedure applies:

1. To display the data, which are stored in 7 eh ~ 79 h (corresponding to the space position from right to left).

2. The internal number, which is stored, is 0 ~ 9 (or 0 ~ FH).

3. The method is shown in Table 1. The selected subject should be output at low level. Set the initial value to f 7 h by shifting to the right.

Table 1: Choice code table.

Data to be displayed	(79H)	(7AH)	(7BH)	(7CH)	(7DH)	(7EH)
Segment code	Look-up table to obtain					
Choice code	FBH	F7H	EFH	DFH	BFH	7FH

4. Each bit-LED is lit up in turn. Every bit-LED has a 1 ms delay and within 10 to 20 ms, the LED lights up again. So, with a human's persistence of vision, it is as if the six bit-LEDs are lit up at the same time.

5. The software flow chart and, finally, the experimental results are as follows:
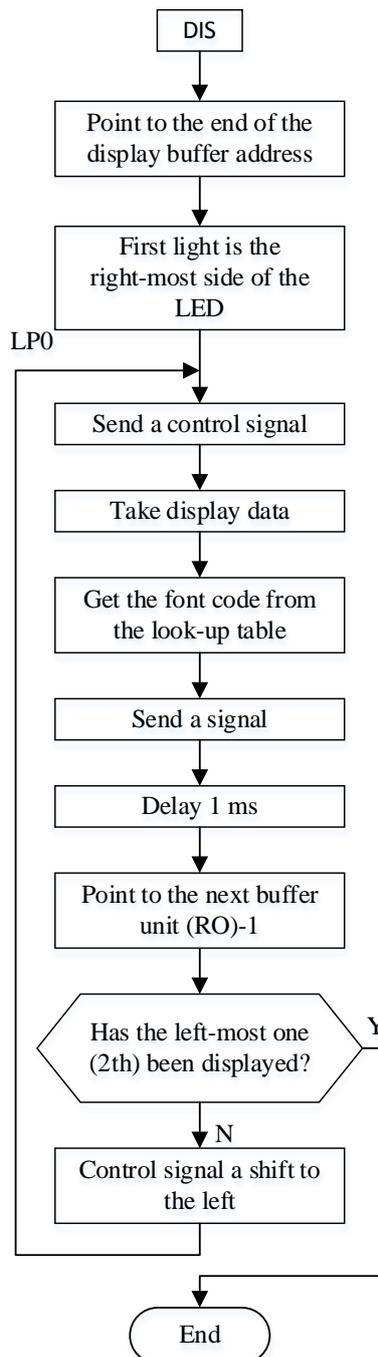

Figure 2: The software design.

IMPROVE STUDENTS' INITIATIVE THROUGH A VARIETY OF WAYS

Students are the main focus of SCM teaching and if students do not actively participate in class, the teaching will be ineffective. The teaching can be used to maximise students' initiative in various ways. For example, relevant instances are first introduced to establish a framework for the lecture. Or a student may modify a program, and other students observe a demonstration of the modified program. The experiments and curriculum further develop a student's practical ability.

Also, through electronic competitions and the graduation project design, the innovative abilities of students are brought into play. Students' learning initiative is enhanced and students develop a positive attitude to attending class. Hence, the teaching effectiveness of the SCM course will be increased.

Figure 3 and Figure 4 show the code, and the output from the experiment.

```
ORG 0000H
MAIN:MOV 7EH,#1
MOV 7DH,#2
MOV 7CH,#0AH
MOV 7BH,#0FH
MOV 7AH,#8
MOV 79H,#0CH
DIS:    MOV R0,#7EH
MOV     R2,#07FH
MOV     A,R2
MOV     DPTR,#TAB
LP0:
MOV     P2,A
MOV     A,@R0
MOVC    A,@A+DPTR
MOV     P0,A
ACALL   D1MS
DEC     R0
MOV     A,R2
JNB     ACC.2,LP1
RR      A
MOV     R2,A
AJMP    LP0
LP1:    SJMP MAIN
TAB:    DB 0c0H,0f9H,0a4H,0b0H,99H,92H,82H,0f8H
        DB 80H,90H,88H,83H,0c6H,0a1H,86H,8eH

D1MS:   MOV     R7,#02H
DL:     MOV     R6,#0FFH
DL1:    DJNZ    R6,DL1
                DJNZ    R7,DL
                RET
                  END
```

Figure 3: The code for the example.
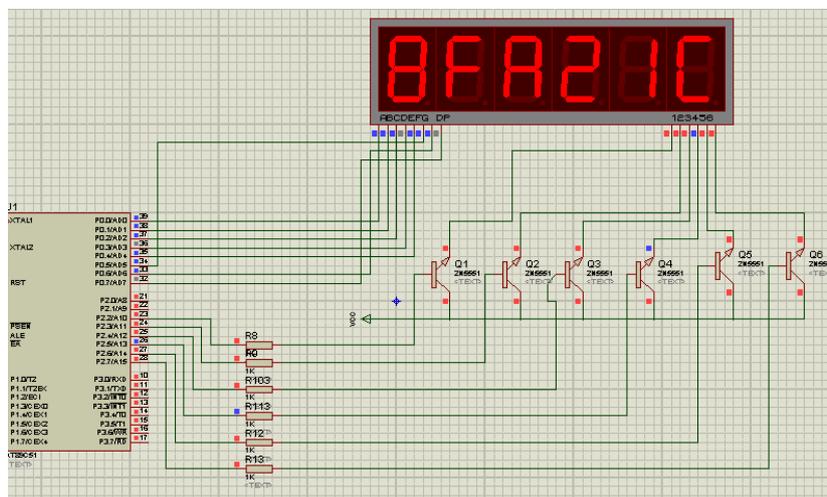
Figure 4: The experimental result.

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CONCLUSIONS

Three methods to improve the teaching of an SCM class, viz. to improve the teaching of experiments, to improve students' initiative to learn and to improve the quality of SCM teaching are outlined in this article. Practice has shown that improved SCM teaching methods improve students' interest in the SCM course, increase students' initiative, broaden students' knowledge, improve students' practical abilities, enrich the teaching and improve teaching effectiveness and, finally, provide a good foundation of learning and learning methodologies for follow-on professional courses and professional practice.

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