Modernization Innovation on MCU Education

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Abstract—Because of the unique characteristics of Single-Chip Microcomputer, some students find it is very hard to learn it well at the first sight. Especially the materials and books used nowadays are often focusing too much on the structure, system and function of the Micro-Controller Unit (MCU for short). However, there exists an extremely shortage on the experiment content and technique. Some suggestions on the MCU virtual laboratory are put forward in this essay, trying to solve the problems on the experiment modernization and innovation.

Keywords—virtual laboratory; MCU education; experiment innovation

I. INTRODUCTION

Micro-Controller Unit, also named Single-Chip Microcomputer, is called MCU for short in this article. Followed with the development of computer, MCU has been widely used in intelligence instrument, intelligence sensors, data collection and processing, electronic appliance, computer control, and so on. From this point of view, there is enough importance for student to learn and master MCU, who is major in electronic and information engineering.

There is no doubt to see so many books about MCU education in the markets. However, the main content and the arrangement of those materials are on the introduction of the principle and structure of MCU, usually not systemic. Students always find it very hard at the first sight. Sometimes they cannot even form a vivid concept for the whole system of MCU, and they can’t master the basic design using MCU, nevertheless the application in engineering and creation. The shortage in experiment capability affects directly the lessons followed, finally affects the bachelor graduation design. So how to inspire the students and encourage them to foster the experimental habit is an emergency.

This article explores the ways to build a virtual lab through the integrated development environment using Keil and Proteus software. The function of the lab was illustrated with examples to verify the feasibility of the virtual lab, which can solve the problems of fund shortage, backward equipment, and slow renewal of the functions. This virtual lab owns good popularization value in the long run.

II. EXPERIMENT EDUCATION

In the traditional arrangement, MCU is taught as the sequence of framework, instruction, interface and programming, and so on. During the most class time, teachers speak a lot about the theory; they cannot receive some feedback from students. Only approaching the end of the semester, students have the opportunity to contact some basic MCU suite and do some simple operation. Before that, educates struggle to find a clarified target to follow, so one of the critical problems mentioned are losing interesting and confidence. Using of compile language is another question. To conquer these difficulties faced by students, some optimizations are used in the framework, at the same time, C language is reloaded for a main language since its easy going; at last, and the application on real operation becomes the masterstroke over the whole semester.

For example, the first lesson of my class is “Illumine a light-emitting diode”. It is simple enough, but the knowledge used here is comprehensive. Students could understand the flow chart using C language and MCU development suite, with desire for the knowledge extremely inspired and immediate understanding studying target.

During the lessons followed, Keil as a compiler is taught all the time, from the beginning of C function “MAIN”. The complex structure of MCU is overleaped at first; on the contrary the application is the main topic. Actually the function of every MCU appliance is introduced during the lessons needed.

Near the ending of the course, a comprehensive experiment system should be designed by students, part of knowledge of MCU used at least. For example, the design of an electronic clock with the function of time adjustment or singing, the technique used here including timer, interruption, key, bell, LED, and so on.

This method complied human’s realization process of the nature, from basic to complexity, from superficial to mechanism. More important, students come to use the MCU at the first sight without knowing the structure, which is newly experience for them. Actually that’s enough for the training of a amateur engineer.

III. EDUCATION SOLUTION MODERNIZATION

Time of information has brought out some new technologies, especially the emergency of computer and
internet on the education field. MCU is a production of information technology, so its education should enjoy the modernization fruit, not following the track of blackboard writing any more. On the contrary, some education solutions themselves rely on MCU technology, the using of them also inspire students from the other side.

Our modernized education system includes three parts: virtual laboratory, multimedia solution and net classroom.

A. Construction of Virtual Laboratory

Virtual laboratory is one production of modernization. The construction of virtual lab can be achieved in two ways\(^5\). One is based on the Internet or local area network, the main function is teaching experiment knowledge. The other relies on the simulation platform built by professional software.

As shown in Figure 1, our online virtual lab developed on the Windows operation system, using Visual C++ and SQL server technology, the man-machine interface designed using Dreamweaver.

The main functions include introduction, guideline, modeling and simulation, self-examination system, message board and frequently ask questions (FAQ). The part of simulation and self-examination are developed by us, which can demonstrate the important experiments of MCU. Though some clicks and other mouse operation, users can do some simple experiments.

Anyway, online virtual lab can only supply some basic demonstrations, a better solution for simulation should use other professional platform such as Keil and Proteus.

(b)Keil

Figure 2. Integrated development environment of Keil and Proteus software

Proteus is from Labcenter electronics, England. It is a comprehensive solution for electronic modeling and simulation\(^{2,3}\). Its revolutionary function is integrating the circuit and micro processor simulation, direct compile on MCU; display them from instruments such as LED, LCD, making it a real-time simulation.

Another part of our integrated development environment is Keil software from Germany. Keil has become a important development suite for MCU users because of its powerful capability on the language compiler\(^4\). It also supplies some program debug function before its combination with Proteus.

An example of the integrated development environment is shown in Figure 2. An electronic calculator with a LCD monitor is made using 51 MCU. The program is completed using Keil for sure.

B. Multi-media Education

Nowadays, electronic education has been carried out in most colleges. However, it isn’t in the round to see the electronic education as a combination of computer, projector systems and microphones. Actually an interactive platform should be constructed to encourage students’ participation.

From that point of view, a lot of modern media products are used here, as shown in Figure 3. The centre of the platform is a general computer, digital camera as a video sensor, microphone as an audio sensor (including the software installed on computer). The output instruments include a series of sound boxes and a projector. A comprehensive experiment box is an interactive tool, on which teachers can operate immediately after theory education.

The outstanding characteristic in this system is the interaction between teacher and student. Experiment box and digital camera’s using make the classroom become a workshop, and directly show the students the complete operations letting them feel like on the real manufacture exploitation.
C. Internet Classroom

If experiment lesson taught in the laboratory, with a unique computer for every student at the same time, then another solution called Multimedia Internet Classroom can be an assistant for the teachers.

Internet classroom is usually software installed on the computers in the lab, based on the Client/Server system (Figure 4). Teachers can control students’ computer through operations on the server to accomplish the class. This system takes full advantage of modernization, making it a class formally at the same time.

Multimedia Internet Classroom we used here can operate in the lab as well as the campus local area network (LAN). The interface of Multi-media Internet Classroom is shown in Figure 5. The prominent function is its simulation for the real classroom and optimization on the operation. Students will feel like in a real classroom, even they can raise their “electronic hands” to raise a question for the teachers. While the teachers can broad his content, voice education, real time display monitor, long-distance shutdown and assignment dispatch, and so on.

Without any question, the efficiency of the education will improve dramatically using so many modern solutions. At the same time, the education itself will become a easy-going business.

IV. Layer for the Students

The education target in Chinese engineering college is to raise designer and engineer. There is no more study for a test like in high school; on the contrary, students find it very hard to find an interaction of their career and interesting. One of the teacher’s task is to show them that they shouldn’t study for an examination any more, but for their career.

A. To the primer

However, Chinese Confucius ever said “to teach students according with their aptitude”. There is difference between students, especially when there is a very small elimination rate in Chinese colleges. The teachers should distinguish his students’ intelligence and set different target for them. For a common student, the mission is to learn the thought but not the technology, they will fall back on the teachers if really needed after graduation.

B. Superior with some competition

Actually, MCU is a course full of practice, is tightly associated with kinds of competition. For the superior students, the lesson and experiment on the class is far from enough. In this situation, teachers should shoulder the responsibility to offer them opportunity as many as possible.

For example, National electronic competition (Sony Cup early, now is Philips Cup) is good chance for students to practice roundly [5]. As a comprehensive competition, it comprises digital circuits, analog circuits, non-linear circuits and some EDU technologies. Using MCU as a controller almost takes half the questions, becoming more and more popular and conveniently. In fact, the students ever engaging in the competition become familiar with the development of project. During the competition, the relationships of the competitors become more harmony. The team work and creation spirit are practiced drastically.

And, others competition such as “Challenge Cup” and “Creation Cup” can be a good opportunity as well.

V. Conclusion

Finally, the slogan of our education is “finish the education in experiments, promote the education with competition”. In our hope, these innovations will change
students’ attitude for the MCU education even the electronic domain.

REFERENCES


