The discussion about teaching of embedded system experiments

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Abstract—The embedded technology in the 21st century is one of the most viable high-tech, highly practical, comprehensive and applied. Embedded system is a relatively new course, but also have a strong application background, this is the need for the University's undergraduate curriculum. In this paper, combining the embedded system experiments planning and construction of the base of Computer Science and Technology department in our school, around embedded system experiment course, as well as the existing problems carry out the research and exploration, with the goal of enhancing student training in basic skills, training and improving the students hands-on innovation.

Keywords—embedded software; practical; platform; RTOS teching experiments;

I. INTRODUCTION

Embedded system is the IT industry's hot spots, at present, embedded technology and embedded products have penetrated into industrial control systems, information appliances, communications equipment, instrumentation, military technology and daily life in all areas of society. The demand for a large number of technical personnel, making embedded software and hardware engineers become the most popular professions over the next few years. As a result, as a new technology research and exploration of the most active groups, Institutions of higher learning should advise their students how to learn embedded systems? especially the application of embedded system software development.

Experimental teaching is an important way to train students have the ability to engage in scientific experiments and have the rigorous and realistic scientific quality[1] Embedded laboratory should put the personnel training on the primacy of development planning[2]. In computer science subject to open the embedded systems courses, setting up the embedded systems experiment base has become an important issues that the computer science subject of colleges and universities are facing.

II. CHARACTERISTICS AND THE ROLE OF EMBEDDED SYSTEM TEACHING

A. Embedded teaching features

Basis: as the basis class platform for computers, electronics and information, automation, communications and so on other professionals, students can further strengthen the basic knowledge of computers so that make students understand the current development and dynamic of computer technology, and promoting the embedded technology application in the above-related subjects.

Comprehensive: Embedded system is the perfect combination of software, hardware design, can be combined with different professional knowledge(such as electronics, computers, automatic control and so on many areas such as professional knowledge), using the embedded technology to solve related disciplines problems, training students the comprehensive ability effectively.

Practical: Embedded technology is a very practical technology, experiment is an important part of embedded system teaching. If there is no necessary link in the experiment, a simple and boring teaching process, students are not interested in, It would not serve any purpose to open the course. Students from the beginning of the problem needs to learn how to design their own systems, how to debug the system, the master of the embedded system design, to achieve the initial application of a number of small embedded system technology.

B. The status and role of embedded system experiment in the computer

With the technology developing, embedded technology reflect the incomparable advantages that the original technology have, such as the development of the system in good human-computer interaction and multi-platform, cross-language compiler environment, providing designers a lot of free space to develop; with the original single-chip system, portable operating system such as Linux, Win2dows CE and so on ,making embedded systems support more peripherals, such as communications networks, GPS systems, USB devices and so on. At the same time, embedded systems also provide users with a convenient operating environment, such as mobile phones are now used by the operating platform, It is an important symbol that embedded technology are different from the traditional control . As the embedded technology more and more, The personnel that master the embedded technology are increasingly favored by the community. As a result, culture the talents that master embedded technology is the current needs. The embedded experimental course is matched to theory curriculum of embedded system, realizing the theoretical simulation,
system verification and an important link in the development of creativity.

III. THE EXPERIMENTAL TEACHING BUILDING OF EMBEDDED SYSTEM

A. Hardware platform choice

The experiment aims to developing students practical design capability of embedded software and hardware. The embedded system using host / target as the development method typically, requiring special hardware and software development tools and environment, so the embedded experiment also need to choose the mainstream development tools and environment of embedded software hardware. Our experimental platform selected BoChuang Beijing Company UP-NETARM3000 platform, modular design, greater emphasis on the application transplanting the current most popular real-time, open-source operating system, the uc/os-II and uclinux, the realizing the different requirements of the teaching profession-wide coverage is more mature ARM7 embedded system teaching and scientific research experiments.

B. The choice of operating system

At present, real-time embedded operating system is divided into two categories: commercial and free. One typical type of commercial RTOS are: Windows CE4.0 (suitable for consumer electronics); Vxwork (suitable for network switching equipment, etc.); Palaos (suitable for PDA products). The free RTOS are Linux and uc / os-II. Teaching students must from the actual situation, making the teaching plans and choose experimental device, not just pursuing of "high" and "pop" that neglecting of teaching the most critical link in the "students accept capacity " The teachers should do according to ability , capitalize on the trend in order to achieve the best teaching results.

The UP-NETARM3000 and UP-NETARM300 teaching platform that belongs to BoChuang take the above teaching characteristics into full consideration, that is, in the case of Linux is unpopular for most professionals, The best choice is Ucos that using of source operating system, ucos source code classic simple, easy to learn and accept, Under the Windows environment, easy to understand and learn. Through the 30-40 hours of teaching and experiments, students can master the main points of embedded development.

C. The content setting of experiment teaching

UP-NETARM3000 experimental box provides 23 experimental projects that the BoChuang company developed, and BoChuang also offers the 23 source code of test cases. Wide coverage of these experiments, involving the main function of embedded development board, but the contents is single, interrelated nature of the weak, the expansion of the weak, if students do these experiments only, it is difficult to show initiative.

1) For the first level the basis experiment

This part experiments using the method of theoretical instruction and hands-on experiments combining to enable students understand the development environment, the development process, and master the usage of development tools, familiar with the software programming environment, in accordance with the guidance of experiments to test the contents of debugging, read experimental source operating procedures and processes, and can be modified, supplemented application programming portfolio.

2) The second level comprehensive design experiment

This part experiments are on the basis of basic type, proof-of-experiments, integrating the knowledge of entire course, making use of the experimental system resources as much as possible, constructing of a practical application of embedded system, so that is a much more complicated experiment.

3) The third level research experiment

This part experiments are provided to the students in-depth study who have a better basis, in order to enable them grasp the theory of embedded system knowledge better, and have more opportunity to practice the subject of a comprehensive design, so as to nurture students in scientific research capacity , innovation and engineering capability[3]

IV. THE STATUS AND EXPERIMENTAL TEACHING REFORM OF EMBEDDED SYSTEM

A. The present status quo and problems of embedded teaching

At present, The embedded technology teaching status quo of colleges and universities is: vague concept of embedded technology, complex content, How to determine the mainstream chips and operating systems and so on teaching content, for the teachers who initial contact with embedded system, it will be difficult. Embedded system are often present as a teaching elective courses, shorter hours, whether the students achieve the purpose of learning the embedded technological knowledge, mastering the basic development method and application, It need to be the test of practice.[4]

1) Lack sufficient knowledge of hardware experimental courses

As the hardware experiment itself have a certain degree of difficulty, the students who belong to the computer professional have a certain degree of bias or lack of sufficient knowledge of the hardware courses, Therefore, the students lack of adequate concern to the theory of knowledge and experiment, the investing time and energy are lagging far behind of software investment, resulting in students have poor application ability.

2) Experimental courses out line of theory

Experimental course does not match with the theoretical curriculum. such as the theory curriculum has not yet been reached regular content, and the experimental courses have been conducted; or theoretical courses have been completed, while the corresponding experiment can not keep up; The situation is not conducive to the students receive the knowledge and master the system, as well as practical applications, so that the experiment has become a form courses also can not receive the desired results.

3) Undue reliance on the existing experimental platform
This shows lacking of intermediate links, that are replaced by most of the experimental platform, so students lack of entire understanding of the whole experiment process, has seriously affected the students in creation. With the experimental platform enrich and improve, many of the original parts need students completed are replaced by some of the experimental module, so in the course of the experiment a lot of steps without the students hands-on, as long as students do the experiment in accordance with the steps that provided. And student in turning a deaf ear to some of the experiment principles. This obviously reduces the difficulty of the experiment, with the result that the understanding to entire body of knowledge only have to stay on the surface, is difficult to understand the details of the knowledge and use.

4) Lack of independent innovation experiment

In the embedded experimental system, most experiments are provided by the manual, and completed in accordance with a certain order, Rarely developed the experiments that has its own characteristics using simulation development platform, the whole experimental system formal and too rigid. Embedded simulation system is not only an experimental system, but also the simulation development system, which should make full use of existing hardware resources and teacher resources, developing the embedded system experiments that has its own characteristics and direction.

B. Solutions to the problem

1) From the perspective of knowledge to explain the important role that hardware experimental course plays in the entire computer system.

Hardware support as a platform for software running. This occupies an important position in the computer knowledge system. Fully understanding and mastering the computer's hardware structure and working principle is critical importance for the computer systems. The hardware experiment as a access to hardware platform is an important platform, the whole experimental system formal and too rigid. Embedded simulation system is not only an experimental system, but also the simulation development system, which should make full use of existing hardware resources and teacher resources, developing the embedded system experiments that has its own characteristics and direction.

2) Must be made hardware experimental courses link up with each other

Some embedded experiments are not arranged very reasonable, So we can not copy mechanically. The experimental curriculum should include instruction for teachers and teachers in the experimental ideas. The experimental curriculum should include instruction for teachers and teachers in the experimental ideas. The embedded experiment process should be conducted by the following principles: First, the easy-to-digest. Second, realizing the partial modular test. Third :the realization of the system experiment.

3) Kowwing the status of hardware courses and practical applications explicitly , so as to enhance the students ' desire to learn

In the process of hardware experiment course, first of all, is a clear about such knowledge applications, so that students can understand the specific needs of society of this knowledge field and the value of the application, stimulating students to learn psychologically ; followed by, clear about the important role that the knowledge plays in the curriculum system.So as to make students understand the important position; Once more make students clear about the specific application of each hardware module.

4) Increase the strength of independent innovation to the experiment

In the course of the entire experimental system, independent innovation is a weak link in the experiment, If want to make students learn the embedded knowledge and apply easily in the practice ,The independent innovative experiment is the best way for this purpose.

5) Provide a relaxed experiment environment

As the embedded hardware laboratory, we must make full use of existing laboratory hardware resources, time and place for those students who interested in embedded experiments, providing with good facilities, making it a truly open experiment room to students. This will play a laboratory resources, so that the experimental device will not idle for a long time; on the other hand, through long-term effects of subtle influence, so that make more students participate the study of embedded system and development design.

C. The practical teaching system building of embedded System

The practical teaching link, for training the high-quality personnel who have the innovative spirit plays an important role. In this regard, we will combine the experiment, curriculum design, graduate design and technology practice activities of extra-curricular , as a whole, constructing the practice teaching system, that is the confirmatory test — the design and comprehensive test — the innovative and comprehensive training projects three levels. The three levels of experiment projects are distributed in different practical teaching links, the role and nature are different.

V. Summary

In this paper, combined with our actual situation, make the discussion regarding the embedded experiment building and the construction of the experimental practical teaching system, made clear about strengthening the importance of teachers. Proposed a number of issues that should be paid attention to the construction of the experimental teaching, particularly in the aspect of the practical teaching building, proposing combine the experiment, curriculum design, graduate design and technology practice activities of extra-curricular, Constructing of a " the confirmatory test — the design and comprehensive test — the innovative and comprehensive training projects " three-level system of teaching practice.

REFERENCES


