

## Project-driven Teaching Reform of Embedded System Course

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### Abstract

**Aiming at the current problems of embedded teaching and personnel training, we put forward the case teaching as the main body, the driven process assessment mechanism, project implementation as innovation practice teaching carrier. In order to actively explore the way of teaching, we will discuss on the aspects of teaching content reform and project driven platform and project integrated teaching mode. Practice has proved that the implementation of the teaching model has improved the students' practical ability and creativity, and can help improve the quality of teaching better.**

### Keywords

**Embedded, procedurization, project implementation, case teaching.**

### 1. Introduction

With the progress of Information Technology, research of embedded system become current hot spot. However, it is related to computer courses as well as electronics, communications and automation[1]. Supported by the basic courses such as C language program, digital/analog electronic technology, the embedded Linux operating system and embedded application courses, combine with the design of the PCB circuit in the specific application, also involves the application of background knowledge. Basically, there is urgent need for embedded related technology talent. From the point of view of training embedded system application development talent, the current teaching content and teaching mode and practice can not meet the requirements of employers in the embedded professional skills, practical ability, innovation consciousness, Lack of standard engineering methods to build system capabilities that meet application requirements, a longer period of adaptation is required as new employees. Therefore, how to adapt to the change and development of the Employment situation, to eliminate the gap between schools and enterprises, it is an urgent task presently for us to improve the teaching quality of embedded system course, Train high-quality embedded system application development talents for social needs. Northwest Agriculture and Forestry University offered a course of embedded curriculum since 2011, and we gradually explore a diversified teaching development mode after 6 years of efforts, gain the recognition from the students, however, embedded courses involve a wide range of knowledge, teaching difficulty is still greater. Based on the characteristics of embedded course and some problems existing in embedded teaching are analyzed, and the improvement of teaching practice in recent years are summarized, through the establishment of the project of embedded teaching system, Explore a suitable for our own professional teaching mode which called "hand and soft power, high and low mutually, heavy practice ", so better result is gained.

### 2. The reform of teaching contents of multi-courses

The embedded curriculum is practical and the construction of the curriculum hierarchy is based on the ARM1156T2-S processor as the experimental development platform, laying special stress on the teaching platform and the processor characteristics, extended interface board development technology, operating system kernel streamline optimization technology and other system software development optimization technology, application development technology etc[2]. At the same time, embedded development engineers should not only stay in an application or a module, but should try to fully learn or grasp the whole system, although the code achieved for each module is not

understood again, the basic process and the basic level of development are all from low to high including start, drive, operation system, API, middleware, UI application. Therefore, project driven curriculum will focus more on developing students' self-learning ability, team collaboration ability and system regulation ability. New curriculum planning requires students to develop a habit, that is, actively find related books, find information, learn to pay attention to the development of science and technology, keep up with the trend of the times. In order to improve students' team cooperation ability, the new curriculum plan highlights more team design, raises students' practical ability, and embodies the core concept of "conceive-design- experiment-operation" in practice[3]. According to the characteristics of embedded curriculum, the new curriculum around the "engaging in project" mode, they need to perform design work from low to high stages, hierarchically according to the relevance of the curriculum and software levels, and each stage of knowledge is consolidated through the application stage of the project, the end of the course through the comprehensive application of the project to make improve in practice. This will greatly improve students the ability of controlling the system.

### **3. Construction of professional project platform**

Embedded system involves a wide range of knowledge, direction of multidisciplinary, multifunctional and specialization, including hardware development and design, software coding, testing, maintenance, etc., the establishment of specialized courses cannot be exhaustive. Through analysis of the demand for different positions of embedded talents in society, we locate our embedded professional direction in software coding, testing and maintenance at different levels of institutional development, equipped with the embedded practical training room, used the development design mode of ARM+Linux and advanced technical architecture and development mode, easy to expand development. The hardware based on S3C2410 experimental box, Tiny6410 development board as the target machine, equipped with MDK software integrated development environment, virtual Linux operating system, Qt graphical interface development environment and Eclipse integrated development environment. The platform can complete BootLoader programming, kernel transplanted, the foundation root file system, the establishment of C and assembly programming and debugging based on C++ of graphical interface program development, Android system based on Java project development.

### **4. Project integration teaching mode**

To stimulate student interest in learning, we introduce students specific project introducing into the learning situation, transformed from the center of the original textbooks into the project center, According to the needs of knowledge, combined with the needs of the project to explain the basic concepts and technical points, to encourage students to explore actively and learn ahead of time. Through the analysis of project needs, review students how much knowledge you have in the area of the project design requirement, explain in detail the project background knowledge. What is task driven, namely, breaking down a specific project into a number of tasks, follow the order from simple to integrated, from simple to complex, step by step. According to the design requirements of the project and the cultivation of students' comprehensive ability, the project teaching be carried on the project implementation by the grouping form, team members complement each other and promote each other between the complementary advantages, the problems encountered in the project design can be carried out in the form of team communication and discussion, complex project design can be taken the team cooperation to complete the project together.

The research work completed a total of 5 works including Tetris design, the snake game based on wireless control, ARM music device design based on Bluetooth control car, ARM board based on bluetooth. These projects are carried out for the characteristics of computer science, with strong interest and knowledge. For example, according to the Linux operating system and ARM board, we designed ARM control system based on Bluetooth, including "opening motor module", "adjusting motor module", "turnning off the motor module, video module", "video monitoring module" etc. To

simplify the effectiveness of communication between the mobile communication terminal equipment with Bluetooth. The feedback not only feed on the development board, also connect to the mobile phone, or to the fast developing Internet, which stimulates the students' enthusiasm and creativity in learning embedded technology. Tetris use the LED display and keyboard driver structure in the development board, the 8X8 array is used to simulate the LED lattice. When array block shows 1, not to 0, the shape of the block is stored in the array according to the coordinates CX and CY, then delete the current block from the array, after changing the coordinates value, put the block in the array, and add two threads in the main method respectively, Move the boxes down each other at regular intervals; Another thread receive characters entered by the keyboard in accordance with the character value transform square coordinate or shape, the values in the array transform to a 16 hexadecimal number according to the column, the number 8 were sent to the LED display, finally the host computer will write C program compiled into the development board implementation procedures, debugging and running to get the job done. The completion of the work helps prevent PTSD and interferes with the ability of the brain to store visual memory, which greatly enhances students the interest in learning.

### **5. Concise experimental content and process**

In order to Improving the interest of computer majors in learning embedded technology, aim at the characteristics of embedded system "heavy practice, heavy experience accumulation" the experimental contents and method are also made the corresponding adjustment, each experiment is adjusted to three parts: basic verification, function expansion, summarization and evaluation[6]. The basic verification part is mainly the functional components involved in this experimental test, such as serial port, timer component parts, this part of the experiment content generally provides reference routines, allowing students to master quickly the approaches and characteristics of the component, it take us generally 30 to 40 minutes. On the comprehensive expansion stage, it requires students to expand function based on the validation routines, do not provide reference routines, taking time is 40~50 minutes, more features will be required comprehensive application or Synthesized the previous several experimental content, further improve the function of the existing procedure etc. For example, the first experiment for students is a variety of light water controlled buttons, the second experiments is serial communication, then the extension requires the students to control the water lights and buttons for monitoring serial communication, the third experiment is the liquid crystal display, it requires students not only display characters, but also integrate the first two experimental contents as a whole. As a result, as the experiment continues to increase, the students' comprehensive application ability is also increasing. In the third stage, each student was required to sum up the experiment, and the teacher grade the experiment results as the basis for the evaluation of credit score[7-9]. it will fully arouse enthusiasm of the students and achieve good experimental results.

### **6. Case teaching and edutainment**

If we just inculcate to the students dull theory knowledge such as registers, frequency, the timer registers, etc. students often cannot be aroused the initiative, the classroom atmosphere will be more boring[10-11]. Especially for electronic and information students in agriculture and forestry universities, it is generally believed that the curriculum is more difficult, the concept is more abstract, and cannot be combined with the reality, it is easy to cause learning interest low. Therefore, according to the teaching experience on embedded system recent years, through the introduction of case teaching in the classroom, we connect to the boring theoretical knowledge to daily life, to enhance the enthusiasm and initiative of students' participation in classroom teaching. Students' interest in the course is critical, with interest in learning, students will take the initiative in seeking knowledge, which is conducive to the harmonious relationship between teachers and students, but also conducive to the smooth progress of classroom teaching. For example, when we the teach the GPIO interface, the teaching case "marquee" is introduced, student will not feel boring through the case study of hardware connection diagram, register and programming knowledge theory, but funny in the process of active code, such learning is twice as much can be accomplished with half the effort. In addition,

when we teach "PWM timer" and "watchdog", they can combine the concepts of register and frequency through designing a music controlled buzzer by programming to achieve music playback. The Students enthusiasm has been improved in the design process, but also edutainment. Such study and experience happy helps to cultivate students' interest in learning, to cultivate their positive and optimistic qualities, to improve their overall quality, and to help them grow and develop their minds [12-13].

## 7. Process assessment mechanism

Embedded courses is very practical, and the traditional theoretical examinations cannot reflect the practical ability, and computer evaluation cannot fully measure students' learning effects. Procedural assessment mechanism is adopted, the whole teaching process is included in the assessment category, increasing students' daily accumulation of knowledge, learning assessment, focusing on assessment of students practical ability, analysis of encoding and problem solving ability, so as to make the curriculum assessment process, regular and enterprise. In order to encourage students' occupation quality, the content of the examination will be diversified, do not confine themselves book knowledge assessment, but also innovative design, students' career ability and the open source philosophy are all put into the scope of examination, so as to achieve the comprehensive assessment and fair evaluation of students' knowledge, ability and quality[14-15].

The assessment process includes daily attendance, written assignments, practice report, speech in class, project training, and teamwork and enhance. The project practice assessment is mainly covered the whole process of project tasks which includes technical ability and occupation accomplishment. The completion time, quality, innovation and development of each project should be evaluated. In project acceptance stage, each team is required to perform production demonstration, team members must be participated, and examined, recorded becoming a part of the total mark.

## 8. Conclusion

In a word, the embedded system of project driven are always changing on the way, by constructing the project of embedded teaching system, strengthening the curriculum design to improve the teaching effect, enhancing students' practical ability. The implementation of project based embedded teaching system and process assessment mechanism will stimulate students' interest in learning, improve students' learning initiative and creativity, increase the team cooperation spirit, but also to strengthen the communication and interaction between teachers and students, so that learning process in class will change from passive learning to active learning, the students' creativity and desire for knowledge will be stimulated, and finally achieve cultivating students' comprehensive quality. Practice teaching also accumulated rich experience for the students to develop the embedded project, students can not only improve the learning interest, enhance the practical ability of embedded system design and lay a good foundation for the future employment.

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