Teaching Reform and Practice Research of DSP Technology Curriculum

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Abstract. DSP technology is a highly technical and engineering course. If students master this course effectively, they will greatly improve their engineering practice ability. Therefore, we should develop the students' DSP technology application development ability. Considering the development of DSP technology course, course features, teaching status and existing problems, the teaching contents, theoretical teaching and experimental teaching are discussed. According to the principle of cognition, this paper puts forward the idea of curriculum reform, puts emphasis on practice, and develops the students' hands-on ability, thus achieving the goal of cultivating the applied talents.

1. Introduction

With the development of society and technology, embedded system has become the main force of the information age, more and more companies and research institutes have developed and applied embedded system as a new direction of its development\cite{1}. Therefore, these companies and research institutes need to introduce a large number of embedded technology professionals. Digital Signal Processing (DSP) is one of the important branches of embedded systems. It is widely used in communication, remote sensing, image processing, computer network, medical equipment, TV technology, control theory, bio-medical and instrument Instrumentation and other fields. The "DSP technology" course is a required course for students majoring in electronics and information, and also a broad and theoretical subject. "DSP technology" is characterized by a wide variety of algorithms, abstract content and difficult to understand. Coupled with less time, students can only get to the level of entry through shorter periods of study. At the same time, DSP course requirements are students in the study of analog circuits, digital circuits, c language, 51 single-chip, signal and systems, communication principles and other courses under the premise. For undergraduates majoring in electronic information, the DSP experiment is an important part of their course in learning DSP technology.

The "DSP technology" course itself is characterized by many concepts, difficulty and high flexibility. Students in the learning process often due to the profound theory and programming cumbersome and lose interest in learning. At the same time, the "DSP technology" course includes hardware, software, development environment, application platform, basic algorithms, programming and so on, and DSP technology update is very fast. It is impossible for students to fully understand the essence and connotation of the course through theoretical teaching and homework in class. Therefore, the problem of the teaching of the course is analyzed, and the existing teaching methods and modes are explored. To develop effective theory and experimental teaching to deepen students' knowledge of theory and practice, this is necessary to improve the teaching of the course.

2. Current Situation of DSP Technology Teaching and Curriculum Characteristics

At present, the institute of electronic engineering of the university has the course of DSP technology in telecommunications, communications, microelectronics and applied electronics. Among them, the first three majors were 36 sessions, of which 12 experimental hours; should be professional hours of 48, of which 20 experimental times. The main contents are as follows: Overview, system hardware structure, DSP instruction system, program design, DSP chip peripherals and DSP engineering development examples introduced; mainly involved in the experiment: Code
Composer Studio entry, the preparation of link control file, data access, Fixed-point division, I / O port and I / O control module experiments.

For a long time, based on the importance and particularity of DSP professional information training, the teaching of this course has been pay more attention in the whole course system[1][2]. But look at the current situation of DSP teaching, which also exist in varying degrees, some of the problems and some of the following characteristics.

2.1 Less experienced teachers are scarce.

Most of the colleges and universities have the "DSP technology" course, mainly to meet the University for the Community to cultivate the application of undergraduate talent goals. Therefore, the teachers taught in this course not only need to have a solid theoretical knowledge, but also have a good engineering practice experience. However, most of the colleges and universities currently offering this course are lack of engineering experience. For example, in the FIR digital filter design, many teachers will explain to the students FIR digital filter principle and method, and let students familiar with the characteristics of phase FIR filter[3]. But due to lack of engineering practice experience with FIR filters, some of the applications of FIR filters in engineering are not mentioned in the course.

2.2 Curriculum development fast, content, application of strong.

DSP technology curriculum itself has the content and application of strong and so on, from the content structure, including DSP hardware structure, DSP programming, DSP program development and debugging tools, digital signal processing algorithms, the course content has a certain degree of difficulty, is not easy to understand[4]. In particular, in recent years, DSP and embedded technology has developed very rapidly, the old model chips have been eliminated, the new model chips have emerged. New knowledge, new technologies, new tools continue to emerge to the teacher's knowledge update and put forward higher requirements. At present, first of all, different schools due to different professional, the choice of different DSP chips, DSP technology teaching materials are different, so the teaching content is not the same. Second, the DSP course content is numerous, the hardware function is complex, and the time assignments are few, how in the limited time to make the students grasp the DSP key technology and has the certain application ability is a problem for every DSP technical teacher.

3. Research on the Teaching of DSP Technology Course Theory

DSP technology courses are more abstract. Students understand and learn the difficulty coefficient is relatively large, therefore, in order to promote students' enthusiasm for learning, must consider the recent development of DSP technology, application and students of professional knowledge background, theory and practice, to set up a reasonable theoretical teaching plan and the appropriate practical tasks. According to the experience of developing DSP in these years, set up a set of theoretical teaching methods with their own characteristics, mainly in the following:

3.1 Arrange the teaching content reasonably

At present, our institute for electronic information undergraduate students to set up DSP technology courses, the theoretical hours of 32 hours, the experimental hours for 12 hours. In general, the lesson is limited and the teaching task is heavy. Therefore, in the arrangement of teaching content must be refined, reasonable teaching content arrangements can better stimulate students' interest in learning.

DSP technology course content includes introduction (DSP technology overview, features and DSP chip development and application), DSP chip hardware structure (including the bus structure, the central processing unit and control components, central memory, on-chip peripherals, reset circuit, etc.), instruction system, assembly language programming, DSP integrated development environment CCS, application development examples [5]. As the DSP chip types, the different DSP hardware with the different software, TM320C54x series of chips in various fields of application
more. So in the classroom teaching will focus on the chip hardware and software. The specific classroom teaching hours are shown in Table 1.

<table>
<thead>
<tr>
<th>Course content</th>
<th>class hour</th>
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<tbody>
<tr>
<td>The introduction</td>
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<td>DSP system development</td>
<td>2</td>
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<td>Hardware structure</td>
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<td>Assembly language programming</td>
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<td>DSP peripherals and applications</td>
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<tr>
<td>Examples of application</td>
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</table>

Table 1. The scheduling of classroom instruction.

3.2 Compare with relevant courses

DSP technology course needs the basis of the previous semester courses. In order to make the students better master the DSP technology and enhance the students' interest in the course within the limited class hour. So in comparison method is adopted in the teaching, from the DSP technology courses to find out with the previous "single-chip" and "embedded system" courses similar content, coupled with the classroom video and animation display, avoids the course learning boring and abstract, make it easier for students to accept the DSP technology course.

3.3 More examples of research projects in the classroom

In order to broaden the students' knowledge on DSP, arouse their interest in learning, combining with the Tianjin University of Technology and Education's teachers some military and applied topics such as: "The research on the application of GPS integrated navigation system" and "Hardware implementation of the new filter", etc. Introduce these research projects about DSP to students in the form of cases. Introduce software programming and hardware circuit board design skills to students, while also presenting scientific results to students. Problems at the same time also in view of the subject development of DSP and solutions throughout the course of teaching, students for future work in the related technology development to provide some experience.

4. Research on Experimental Teaching of DSP Technology Course

In order to enable students to understand and consolidate the theoretical knowledge of the classroom, combining theoretic studies with hands-on training to achieve all-round development, experimental teaching done a lot of detailed work. The college has a DSP laboratory, experimental teaching for the 12-20 hours. In order to keep track of the development of science and technology, the college will order a certain number of new experimental boxes each year and provide the students with a good experimental environment. DSP laboratory of the college is an open laboratory, students use their spare time can undertake related experiment study, at the same time college experimental training center has designed more than 20 kinds of experimental courses, and matched with the experiment instruction. Excellent students can improve themselves by curriculum experiment of the DSP technology.

4.1 Reasonable design of experimental content

The experimental content consists of basic verification experiment and design comprehensive experiment, which from easy to difficult. Basic experimental teaching is designed to reduce the difficulty of entry, and beginners should master the construction of the project as soon as possible and
the use of the software development environment, which is familiar with DSP[6]. The design comprehensive experiment is to require the students to complete the programming, the building of the project, the program code to debug and run. Students can choose their own experiment according to the difficulty, so that students can be more interested in the subject.

4.2 Based on the race, and actively carry out innovative activities of science and technology activities

In order to train students' hands-on ability and innovative ability, the DSP technology course must be strengthened the practical[8]. But from the point of the teaching and experimental classes, most students only pursue simple development using DSP, but there are some students have strong interest in DSP, they are not satisfied with their current classroom teaching[7]. Students are encouraged to use DSP to complete graduation design, college electronic design competitions and innovative entrepreneurial activities. Let them take on some social projects or get them to join a teacher's research projects. Based on the practical project, the innovation and entrepreneurial activities based on DSP are actively carried out, which will enable some students to truly master and apply DSP technology.

5. Summary

In recent years, Chinese colleges and universities have emphasized practice in teaching to cultivate the practice ability of college students. In this context, Tianjin University of Technology and Education has strengthened the investment to the DSP technology course, the introduction of experimental equipment, the open laboratory, introduction and strengthened the training practice of DSP technology course, really achieve the combination of theory and practice. In conclusion, teaching should be accumulated, explored and reformed so that we can cultivate innovative application talents.

6. References


