Research on Microcomputer Practice Teaching Based on Pocket Experiment

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Abstract. Single chip microcomputer course is a practical course. The traditional practice teaching requires students to practice activities at a fixed time and a fixed place. The pocket experiment breaks the limitation of practice activities on time and place. This paper mainly discusses the system and teaching mode of microcomputer pocket practice teaching. The teaching system includes basic experiment, comprehensive experiment and design experiment. In the teaching process, pocket experiment equipment is the main part, and students are the main part to complete practical teaching activities, so as to cultivate students' autonomous learning ability and practical ability.

Keywords: pocket experiment, practical teaching, single chip microcomputer

1 Introduction

Pocket experiment is a new type of student practical mode proposed in recent years. It provides students with a small miniaturized experimental device that is convenient to carry around, even fitting into a pocket. Due to the pocket experiment device's certain software and hardware resources, basic experiments can be conducted through simple circuit connections, and it can also be functionally expanded to have additional capabilities. The pocket laboratory brings convenience to students for conducting experiments, while minimizing the constraints of experimental venues. Currently, many universities have introduced pocket laboratories, and they are highly recognized[1-3]. The course on the principles and applications of single chip microcomputer, as a core course in electronic information-related majors, is highly practical and plays an important role in cultivating students' practical abilities. This paper mainly studies the application of pocket experiment devices in microcomputer practical teaching.

2 Main issues in teaching

The traditional practical teaching process requires students to conduct experimental operations in the laboratory or engage in practical learning at internship sites at fixed times and locations, lacking flexibility in time and space arrangements[4-5]. With the development of computer technology, computer-based virtual simulation technology has become increasingly mature. By introducing virtual simulation into practical teaching, students can engage in simulated experiments, which only require a computer and corresponding simulation software. However,

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simulated experiments are conducted solely within the simulation software, which does not sufficiently cultivate students' hands-on skills.

In order to further cultivate students' hands-on abilities and stimulate their interest in learning, this paper proposes the use of pocket experiment devices in microcomputer project-based practice to address the aforementioned issues. This allows students to engage in practical activities using pocket laboratories during their free time, in addition to conducting practical activities in laboratories and other practice venues, thereby enhancing students' hands-on skills[6]. The core of using pocket experiments in practical teaching involves the use of Keil software and portable pocket experiment devices to create a self-directed learning mode that combines theory and practice, both in and outside of class.

3 Microcontroller pocket practice teaching system

The concept of the pocket laboratory was proposed by the Texas Instruments China University Program, which refers to the miniaturization and portability of experimental equipment. In our microcomputer practice, we use the Puzhong-A2 microcomputer development board. The microcomputer used in the development board is the STC89C52 microcomputer. The onboard resources include a LED segment displays module, LED module, matrix keyboard module, ADC/DAC module, 8*8 LED dot matrix module, LCD1602 interface, DS18B20 temperature sensor, etc. The resources on the development board can meet the needs of undergraduate students.

The pocket experiment devices are distributed to each student starting from the freshman year, and students are responsible for their own maintenance throughout their four years of university study. The microcomputer practice teaching system based on the pocket experiment is illustrated in Figure 1.

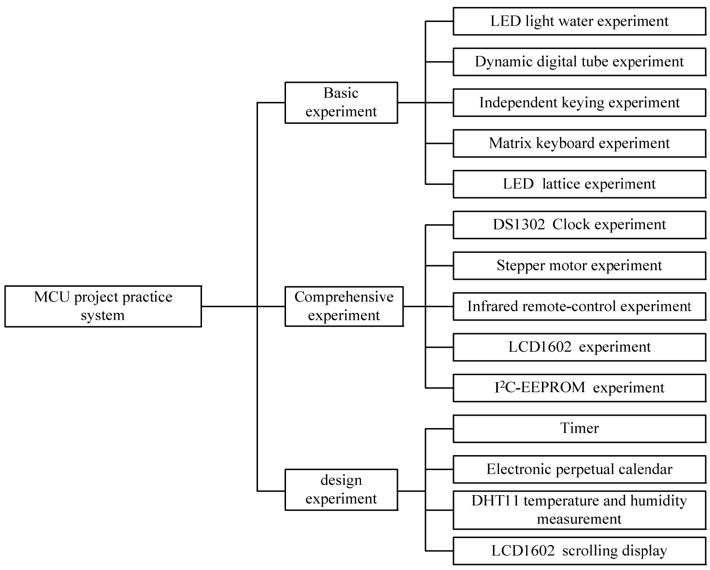

Figure 1. Microcomputer project practice teaching system

In the practical process, the practical content includes basic experiments, comprehensive experiments, and design experiments. Basic experiments are mainly completed through experimental courses that are coordinated with the course of microcomputer principles and applications. Comprehensive experiments are completed through students' major assignments. Design experiments are mainly implemented through graduation projects and academic competitions. Basic and comprehensive experiments can be completed using development boards, and for design experiments, students can use the provided development boards along with peripheral devices, or they can design their own circuits based on the functions they need to accomplish their practicing content[7-8].

4 Exploration of teaching modes

4.1 Combine class with class

In traditional microcomputer practice teaching, the same experimental content is completed in a fixed laboratory using uniform experimental equipment. With the use of pocket experiment devices, the limitations of time and location are removed, allowing for the timely adjustment of experimental content based on students' progress[9]. In addition to the basic experiments, supplementary experiments can be added based on students' completion, and these supplementary experiments can be continued outside of class during spare time, effectively motivating students' learning enthusiasm.

4.2 Combination of simulation experiments and pocket experiments

With the development of electronic computer technology, numerous simulation software tools have emerged. These tools can be employed for demonstration during theoretical explanations and experimental processes, making the content of the lessons more vivid and appealing, thereby enhancing students' interest in learning[10]. For instance, when explaining the experiment of a LED light water, the circuit schematic can be first drawn using Proteus software. During the process of drawing the schematic, characteristics of the components used and precautions for circuit connections can be explained. Finally, the experimental phenomenon can be presented through simulation software, providing students with an intuitive understanding of the entire experimental process. The circuit schematic for the light water experiment is shown in Figure 2.

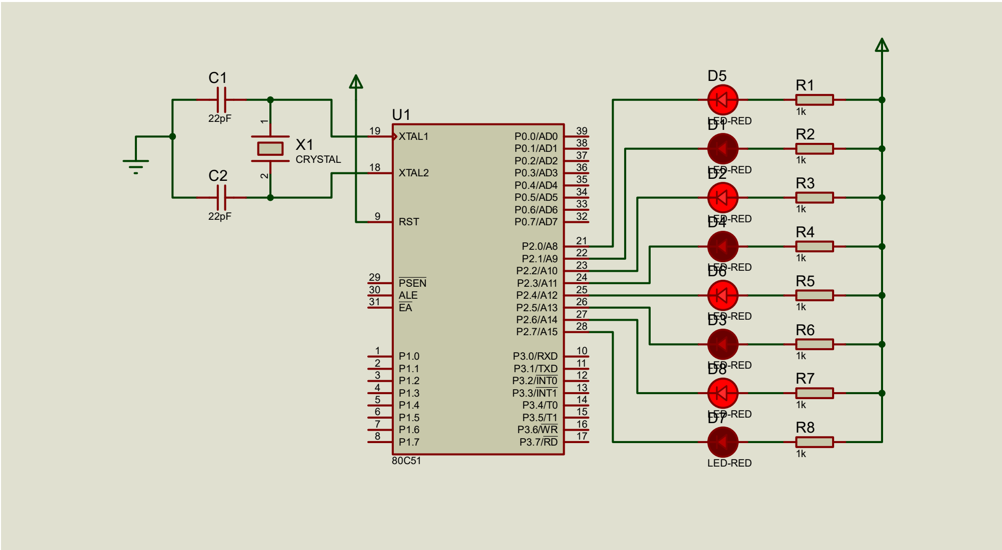

Figure 2. Schematic diagram of the LED light water experiment

From the diagram, it can be seen that the components used in the LED light water experiment include the 51 microcomputer, LED lights, and resistors. When connecting the circuit, attention should be paid to the two different ways of connecting the LED lights. In the common anode connection, the LED lights are lit when the microcomputer outputs a low level, while in the common cathode connection, the LED lights are lit when the microcomputer outputs a high level. In the circuit shown in Figure 2, the LED lights are connected in common anode, and the experimental result is the alternate flashing of 8 LED lights. After the completion of the simulation experiment, the students completed the hardware circuit construction, debugging and experimental data collection of the LED light water experiment through the pocket experimental equipment.

The combination of simulation experiment and pocket experiment is a very promising practical method worth popularizing[11]. The simulation experiment helps students understand the working principle of the circuit and predict the experimental results, the pocket experiment completes the design of the hardware circuit and the collection of experimental data，simulation experiment and pocket experiment are combined to give full play to their advantages. Especially, when implementing more complex circuits, students can be required to conduct simulation experiments first. After successful simulation experiments, they can proceed to hardware experiments. This approach helps in achieving a deeper understanding and analysis of the circuit, while also reducing hardware losses.

4.3 Project-based teaching

In the design experiment stage, students have already acquired a certain level of knowledge in both hardware and software through basic and comprehensive experiments. At this point, project-based learning can be introduced, with students working in groups. Groups can consist of 3-5 students based on the class size, and each group is assigned a microcomputer design project. Students are responsible for designing the project, solving any issues encountered during implementation, and ultimately, their performance is assessed based on the submitted project reports and group presentations, with the assessment results contributing to their overall grades[12]. The project duration is one semester. Through project-based teaching, students' initiative in learning can be fully utilized, helping them to master the process of microcomputer project development, fostering teamwork, and laying a foundation for their participation in academic competitions, further studies, and other professional courses such as FPGA and embedded systems.

5 Teaching effectiveness

Through the study of the microcomputer development board, students have gained a comprehensive understanding of the design and development process of microcomputer hardware systems. This lays a solid foundation for learning other hardware-related systems and enables them to proficiently use relevant software for microcomputer development and perform hardware debugging. As a result, they are capable of designing simple microcomputer-related systems.

Furthermore, it has further cultivated students' hands-on abilities and sparked their interest in learning. Students have developed a high level of engineering competence, strong experimental skills, and practical abilities. The pocket lab equipment has facilitated students in completing competition entries and graduation projects. In the current academic year, over 10 students have successfully completed their graduation projects using the pocket lab equipment.

Finally, It has provided a solid foundation for students to study other pocket lab equipment. For instance, the commonly used STM32 development board can be easily grasped by students who have previously studied the Puzhong 51-A2 development board. This helps students to quickly master the STM32 development board and other types of development boards.

6 Summary

The pocket lab equipment, with its small size and portability, has brought convenience to students' experimental practices and has gained recognition from numerous universities. This article primarily discusses the application of pocket lab equipment in the practical use of microcomputer. It analyzes the issues present in traditional practical teaching, namely the limitations imposed by time and location on practical activities. To address this, the article proposes the use of pocket lab equipment in microcomputer practical work, allowing students to utilize the equipment during their free time to complete practical tasks without being constrained by time and place. In the implementation process, the initiative of the students is fully utilized, with students taking the lead and teachers providing support, aiming to enhance students' self-directed learning abilities and cultivate their interest in learning and practical skills.

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