Reformation of Construction Machinery Course Design Based on Education Idea of CDIO

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ABSTRACT

In order to avoid the disadvantages in traditional course design and improve the students' innovation consciousness, autonomic learning ability and comprehensive practice ability, a reform for course design based on CDIO was proposed. The new course design requires students to build a scale model based on the real machine, and use EPEC as the controller. The prototype's motion is designed to be operated with a hand-held remote. Take a case of the excavator model, the paper introduces the implementing process of the project. Teaching practice shows that new teaching method based on CDIO has got a notable result on developing the student's creative ability.

KEYWORDS

CDIO, course design, prototype of excavator

THE CONCEPT OF CDIO EDUCATION

CDIO stands for conceive, design, implementation and operation, it is an innovative educational framework for producing the next generation of engineers. The CDIO Initiative is developed with input from academics, industry, engineers, and students and is specifically designed as a template that can be adapted and adopted by any university engineering school. Because CDIO is an open architecture model, it's available to all university engineering programs to adapt to their specific needs and it is being adopted by a growing number of engineering educational institutions around the world.

Problem analysis of traditional course design based on CDIO

1. Lack of conceive in tradition course design

For many years, our college always has the same classical topics of course design which are "The design of General purpose overhead crane" and "The design of portal crane". Students' work is only the model designing according to design manual, model building based on software, and simulation. This design process plays an important role ever, but with the transformation and upgrading of industrial structure, its shortcomings exposed: the design process and engineering practice are completely out of line, the students accept knowledge passively and can't be trained the real ability of engineering application.

2. Lack of design in tradition course design

In the course design, students are divided into several groups and design the general purpose overhead crane and portal crane separately, they do not have their own plan and they have to accept knowledge passively. Students must obey the design manual, so they do not have enthusiasm, and cheating become a widespread phenomenon.

3. Lack of implement and operate in tradition course design

For the high cost and complexity of the real construction machinery, the course designs of many colleges do not contain the manufacturing link in the designing process. This traditional type of course design focuses on the theory, emphasis on the accumulation of knowledge, however it dose not develop engineering application ability, and has an adverse impact on cultivating engineering consciousness.

THE REFORM CONCEPTION OF COURSE DESIGN BASED ON CDIO

As the first batch of pilot colleges and Universities admitted by the Chinese ministry of education, Yanshan University initiated a reform on course design, determined training target, modified syllabus, and established courses system structure based on CDIO.

1. The problems have to consider in course design

Based on the CDIO, the course design not only allows students to learn theoretical knowledge in practice teaching process systemic, but also train students' ability to analysis the problems and improve practical ability. Mainly problems have to consider are as follows: (1): what basic theoretical knowledge and practical knowledge the course contains? (2): how to design the process to achieved the teaching of knowledge points in course design? (3): in which form to implement the curriculum design?

2. The solution of the problems

Solution (1): according to the curriculum, the course knowledge point what students need to learn should be analized, classified and arranged. Especially in general theory of knowledge, general basic operation, theoretical basis of practice, professional practice theoretical knowledge. Solution (2): considering the course knowledge point arrangements, based on the process of practicing experimental facilities and venues, teacher's personality and enlightening education grasp of the working process and other factors, realize the course design. Solution (3): determine the form of course design and implementation according to the characteristics of the course and progress. CDIO-based teaching methods are not necessarily confined to the provisions of class time and place, the enthusiasm of the students should be mobilized, extra time can also be used to think and solve problems, teacher need to give immediate guidance depending on the circumstances.

THE REFORM REALIZATION OF COURSE DESIGN BASED ON CDIO

For the concept of student-oriented, we allow students to select their topics by themselves. This not only expand the range of topics, but also improve the students' interests, and give students full of imagination and play space, make them learn to think independently. The results usually stay in drawing and simulation stage in traditional course design, and students do not know whether their design is feasible, leading to the lack of their self-confidence. In order to overcome this deficiency, the new course design requires students to

manufacture the component parts and finish the installation and debugging. Complex parts can be manufactured by 3D printer, which can stimulate the student strong interest. The new course design requires each group of students to complete the design and manufacture a whole prototype, so students have to consider about the structure, process, cost and so on. It is good for students to develop the whole consciousness. Students are divided into several groups, and they will cooperate to accomplish the common goals and tasks. Students' team cooperation ability will be well trained. Specific process was shown following.

Choose the excavator as prototype form and the goal of the new course design is to build a scale model. The reference is XCMG XE215C excavator. The new course design base on CDIO, and the process is as follows:

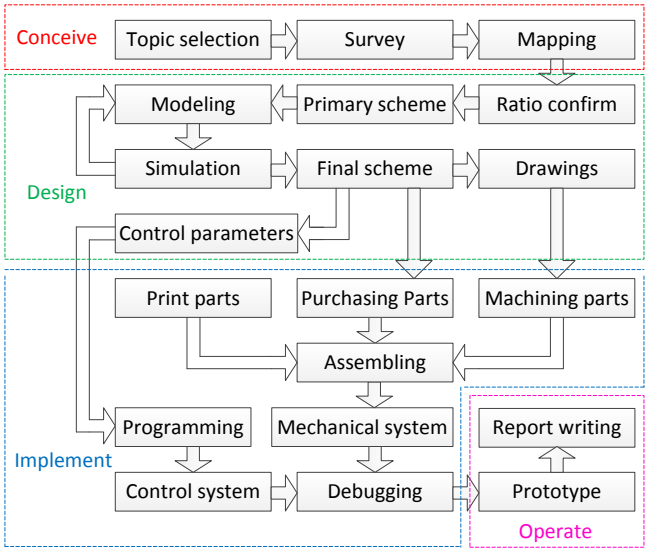

Figure 1. The process of course design

After the topic was selected, students had a specific survey on excavator to know its working principle and components. Then the teachers led students to visit the production of XCMG XE215C excavator. Through the survey and visit, students gained an insight of excavator. On that base, students determined the proportion of the prototype and proposed a preliminary plan.

Depending on the preliminary plan, students completed the working space calculation and simulation, and built the 3D model.

Figure 2. XCMG XE215C excavator

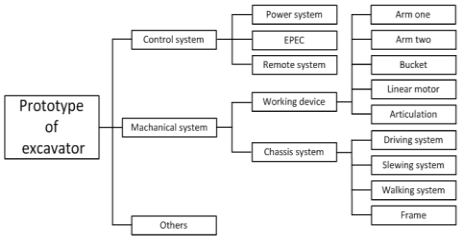

Figure 3. Composition of prototype

Figure 4. Modeling of prototype

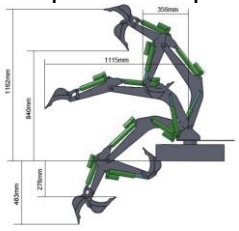

Figure 5. Working space of prototype

After the revision and perfection, students determined the final plan and divided all the parts into machining parts, printing parts and purchasing parts. Then did the job of manufacture and purchase, at last, all parts were assembled into mechanical system.

Figure 6. Machining parts

Figure 7. Purchasing parts

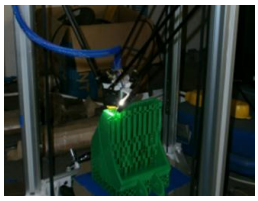

Figure 8. 3D Printing parts

The controller of the prototype is EPEC which is the real controller of the engineering machinery, students used CoDeSys to write the control program. With the telecontrol system, the control system was accomplished.

After the joint debugging of mechanical system and control system, the manufacture of the prototype is completed. Finally, the students wrote the report, in order to complete the final step of course design.

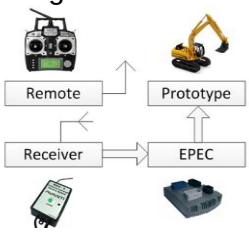

Figure 9. Controlling scheme

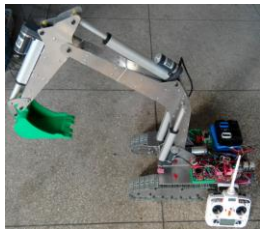

Figure 10. Prototype of excavator

CONCLUSION

CDIO framework considers the basic domain knowledge, personal and occupational skills as well as teamwork, communication and interpersonal skills, and focus on technology applications and the ability to control large systems. As it is urgent need for engineering embedded personnel in the social, introduction CDIO framework into embedded systems teaching is of great practical significance. After the realization, students generally reflect that the effect of course design have been improved than before.

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