Development of an Interactive e-Learning System to Improve Manufacturing Technology Education

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Abstract

The manufacturing technique covers: turning, milling, drilling, holing …etc. Much time and cost are used to teach these techniques. Particularly, computerized machines are continuously increasing in use. The development of educating engineers on computerized machines becomes much more difficult than with traditional machines. This is because of the limitation of the extremely expensive cost of teaching. The quality and quantity of teaching cannot always be promoted in this respect. The traditional teaching methods can not respond well to the needs of the future.

Therefore, this research aims to the following topics;

(1). Propose the teaching strategies for the students to learning machining processing planning through web-based learning system.
(2). Establish on-line teaching material for the computer-aided manufacturing courses including CNC coding method, CNC simulation.
(3). Develop the virtual machining laboratory to bring the machining practical training to web-based learning system.
(4). Integrate multi-media and virtual laboratory in the developed e-learning web-based system to enhance the effectiveness of machining education through web-based system.

1. Machining Basic Features

The purpose of this module is to let students learn the basic concept of manufacturing features, and improve machining skill. Students can learn the machining method for basic manufacturing features from this system. A student can select features of turning process in dialogue. For example: thread feature is chouse. The learning content of turning thread, including graphics and text, is displayed for the student to learn, as shown in Figure 1. Also, a video is cast to illustrate the real turning process for a thread feature.

The selection of process parameters, such as cutting tools, cutting speed, feed rate, ...etc., is one of the key issues in machining processes. Therefore, a mechanism is designed in this system to assist students in learning the process parameters. Once the student inputs incorrect values of process parameters, it will be triggered automatically, and reference information is given to guide the student to input the correct values (Figure 2).

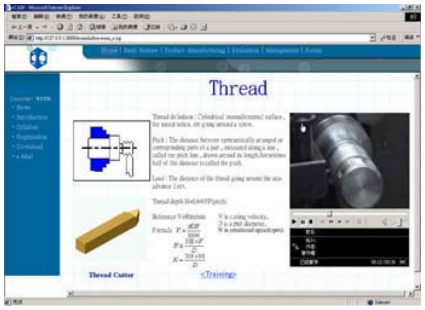

Figure 1 Machining basic manufacturing features

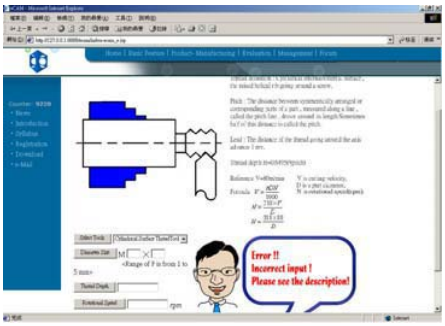

Figure 2 Learning machining parameters

A virtual machining laboratory was developed to bring the machining practical training to web-based learning system. This will allow students to familiarize machining skills before real practice in the laboratory. The virtual laboratory of turning (Figure 3), drilling, and milling (Figure 4) are built to simulate, as real as possible, the skill of machining. In order to facilitate the effectiveness of education by the developed e-learning system, multi-media and virtual laboratory are integrated to demonstrate the machining skill.

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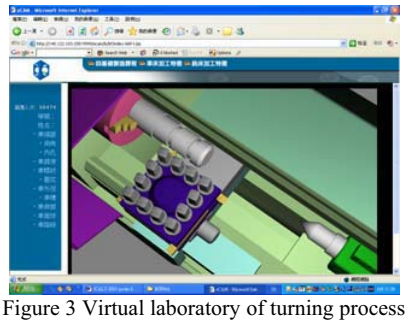

Figure 3 Virtual laboratory of turning process

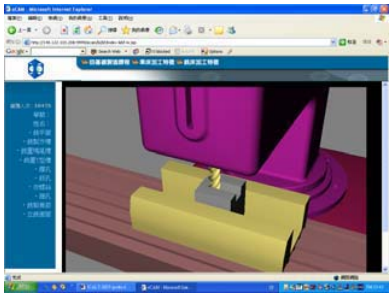

Figure 4 Virtual laboratory of milling process

2. Machining Processing Planning

Students can go further to learn machining process planning, once they have the capability of machining basic manufacturing features. In this step, the geometric information has to be read and specified (described in dialogue in Figure 4) for a complex part.

This system will create a code based on the geometric information specified, and generate the manufacturing features required to fabricate the desired part, as shown in Figure 5. The possible machining procedures are also displayed. The system will indicate the appropriate procedure and give the reasons for decision making. In this phase, one objective is to give the student the ability to extract the manufacturing features for a complex part, from a mechanical drawing in either 2D or 3D. The concept of manufacturing process planning can also be brought to students.

3. CNC Simulation and Machining

The computerized machines are continuously increasing in use. The development of educating engineers on computerized machines becomes much more important than ever. Therefore, learning contents of CNC coding method was established in this system. In addition to, simulation of CNC cutting path is delivered to students using multi media (Figure 6). In order to provide media contents for multi-users, eliminate the delay of casting processes, and increase cast quality, the SureStream is employed to manipulate stream files for casting. The stream media contents are controlled and cast by the Pear-to-Pear casting method to meet the multi-cast purpose as shown in Figure 6.

4. Conclusions

The developed Web-based machining education system is able to carry out part of the practice through the virtual laboratory. This will advance teaching speed and the quality of practical training in the machining shop. The developed Web-based learning system improves the safety and efficiency of hands-on machining practice. Students can learn basic machining and experience machining technology through the virtual laboratory before any real practice. The developed Web-based learning system allows students to learn and practice the machining techniques repeatedly, and much easier than with conventional teaching ways.

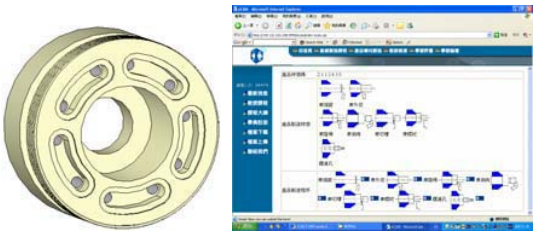

Figure 5 Machining processes for a complex part

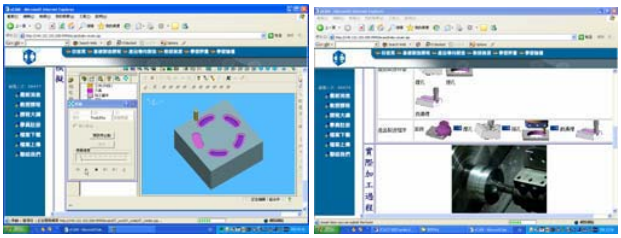

Figure 6 Simulation and Machining for a complex part

5. Acknowledgements

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