

Web-based Student Performance Evaluation System for Engineering Education

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Abstract. A web-based information system has been implemented for engineering education. By this system, we can have a comprehensive student performance evaluation. Process of doing experiments is recorded and investigated into more detail and students can be more engaged in the laboratory activities.

Keywords: Engineering education, Student performance evaluation, Web-based system

1. Introduction

Engineering education is playing more and more important role in university education program [1]. The major goals of engineering education include:

- To let students acquire perceptual knowledge through experiments and thus have a more comprehensive understanding on theoretical knowledge points.
- To develop good habits for research such as deep and careful observation, independent thinking and autonomous exploration.
- To motivate the students to innovate and create when facing new problems.

Typically, students are divided into several groups to do experiments in turn and faculties keep a performance evaluation record for each student. Traditional evaluation of students' performance in experiments focuses on the results only. In order to greatly inspire innovation spirit and cultivate research creativity, and greatly improve the students' engagement [2] in the course, we need to enhance the process evaluation as well as the result one.

However, such a process-oriented performance evaluation means more complex recording and investigations on students' behavior. To assist this, a web-based student performance evaluation system based on wireless LAN (local area network), evaluation rules and Apple's iPod Touch device [3] was implemented. By this system, a comprehensive and coherent performance evaluation has been successfully carried out.

2. Design of the System

For the design of the performance evaluation system, there are two key points:

- In the back-end, set up a consistent evaluation rules set for each laboratory course. The rules are maintained in a database and can be conveniently shared and accessed by different faculties via network.
- In the front-end, use an iPod Touch device to connect to the database wirelessly. Faculties can view student information or input evaluation data instantly through this mobile device.

2.1 Design of Back-end Evaluation Rules Set

In order to fit for evaluation circumstance of variant laboratory courses, a 3-level evaluation rules set is designed under an open database structure:

1) *Experiments*: Faculties can set a group of experiments and configure their properties. These properties include name, credit hours and, most importantly, the evaluation weight assigned for each experiment.

According to the extent of difficulty, complexity and importance, we can assign a corresponding weight for each experiment. The final score of the laboratory course is a weighted average of scores of all the experiments.

2) *Indices*: For each experiment in the first level, we can define a set of evaluation indices. These indices are designed to check and record students' performance from different aspects, including both process and result ones. Such indices can include pre-lab work, in-lab engagement, lab operation skills, testing results and some specific checkpoints set for each experiment. The score of an experiment is a weighted average of scores of all the indices.

We can set quite different evaluation indices for different experiments, for example, some experiments are more process-oriented and some are more result-oriented. As for engineering education, faculties should think a lot over the appropriate evaluation indices and ask/answer such questions as the goal of the experiment, the training emphasis of the experiment and how to guide students to explore as much as they can during the experiment.

3) *Grades*: For each evaluation index in the second level, we can predefine a sequence of grades and set corresponding score for each grade.

Faculties can define the detailed evaluation grades in two ways, to declare the grades explicitly or distinguish grades by a series of data zones. In the former way, detailed grade is declared by its name. For example, grades for the index "Pre-lab job" can be "excellent", "good" and "ordinary", corresponding scores assigned can be "5", "4" and "3". In the second way, grades can be distinguished by data zones. For example, grades for the index "Voltage of testing point A" can be "0~1V", "1~2V" and "2~3V", corresponding scores assigned can be "3", "5" and "3". When faculties input the students' testing data, system will automatically give the score according to the data zone the input data falls in.

After setting up the above 3-level evaluation rules set, it can be conveniently shared and accessed via network. Since all the faculties do the evaluation according to the same rules set, a consistent evaluation can be acquired.

2.2 Usage Model of the Front-end

However, more complete and detailed evaluation rules mean more complex recording and investigations on students' behavior. To bring the back-end evaluation rules into action, front-end usage model becomes very crucial.

In the front-end, we use Apple's iPod Touch device to connect to the database through wireless LAN [4]. Thus, faculties can view student information or input evaluation data instantly.

Through the interaction between the front-end wireless iPod and the back-end evaluation rules database, student performance evaluation can be easily carried out. The implementation method and interaction process will be discussed into more detail in the following section.

3. Implementation of the System

A performance evaluation system based on wireless LAN, evaluation rules and iPod Touch device has been implemented to assist electrical and electronic engineering education in Tsinghua University.

3.1 Hardware Structure

As shown in Fig.1, the system consists of back-end server, client PCs (personal computers), IC (integrated circuit) card subsystem, wireless access point (WAP) and iPod. These devices are connected together through campus area network, lab LAN and wireless LAN.

1) *Back-end Server*: The back-end server acts as database server and web server. Corresponding to the multi-level evaluation mechanism stated above, multiple data tables are designed and stored in the database server. The web server publishes and runs the system application web pages developed under a browser/server architecture [5].

2) *Client PCs*: Client PCs include faculties' office PC, lab PC, students' PC and any other computers connected to the lab LAN or campus area network.

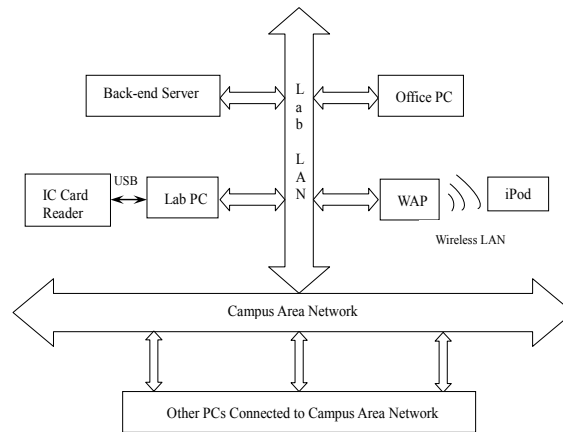


Fig.1 Illustration of system hardware structure

While launching a browser software, such as Microsoft Internet Explorer, clients can visit the application web pages located in the server and fulfill specific tasks.

3) *IC Card Subsystem*: IC card subsystem consists of a lab PC and an IC card reader connected to the PC through USB (universal serial bus) interface. With the use of this subsystem, students can easily log in by their IC cards when coming to the lab and log out when leaving.

4) *Wireless Access Point*: Wireless access point bridges the connection from wireless LAN to lab LAN. In the valid wireless coverage area of the WAP, a wireless client device such as an iPod can successfully communicate with it.

5) *iPod*: With the use of iPod, faculties can view students' information or record students' performance instantly. This brings the comprehensive performance evaluation into reality.

3.2 Software Implementation

Application software is built under a browser/server architecture. Back-end database server is based on Microsoft SQL SERVER 2000. To connect the database and application web page, the JSP (Java script page) technique is used. Faculties can freely share and access database through the browser installed in PC or iPod. Different web pages are developed for PC and iPod separately.

Fig.2 gives a snapshot on the web page for PC client. Main functions include course management, course schedule management, engineering education management, resource management and system management.

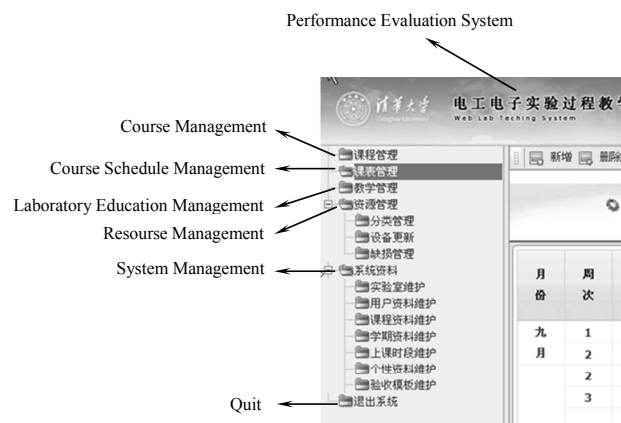


Fig.2 Illustration of web page for PC client

After logging into the performance evaluation system from a PC, faculties can visit different function modules stated below.

1) *Course Management*: By this module, faculties can configure basic course information including the course name, total credit hours and faculties who have the rights to do performance evaluation of this course.

Information for the first level evaluation rule, i.e. experiments, can also be maintained here. For each experiment, we can set the name, credit hour and the evaluation weight. Besides, in this module, faculties can start a procedure to transfer students' information into the system from a Microsoft Excel sheet.

2) *Course Schedule Management*: Use this module to set up a sequence of time slices for the course. Faculties can launch the IC card logging session by selecting a specific time slice item.

3) *Laboratory Education Management* : In this module, faculties can set up the 2nd and 3rd level evaluation rules for each experiment, which includes evaluation indices and detailed evaluation grades. These can be displayed in the web pages for iPod. After evaluation of an experiment is done from iPod, records can be also viewed and modified from PC clients. When all the experiments of the course have been evaluated, score of the course can be automatically calculated and transferred to an Excel sheet.

3.3 Procedure of Performance Evaluation

When the course information and related evaluation rules are ready in back-end server, faculties can use iPod to do the performance evaluation. Fig.3 shows the procedure into detail.

At the beginning of the process, use the course schedule management module to launch the IC card logging session. Then students can log in using their IC cards. Seats are assigned by the system automatically.

Open the web page on iPod and log into the application system, then a list of course schedule will be displayed. When selecting the current time slice from the schedule list, information of students who are involved in the current group can be shown. During the progress of the experiment, faculties can give evaluations on students' performance anytime when needed. When doing evaluation for one student, first select his name and the experiment he is working on, then evaluation rules attached with the experiment will be listed. By selecting one of the evaluation indices, faculties can conveniently input the evaluation data.

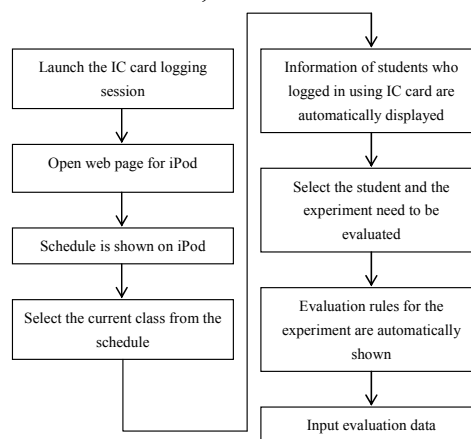


Fig.3 Illustration of performance evaluation procedure

Since iPod is connected with back-end server through wireless LAN, after inputting evaluation data from iPod, this information can be transferred to back-end server and stored in database instantly. Later, faculties can view and modify them from PC clients.

4. Summaries

The performance evaluation system introduced above has been put into practical use for electrical and electronic engineering education in Tsinghua University from 2009. Both faculties and students have been benefitted a lot.

For faculties, the system provides an efficient teaching management platform. Since all the faculties visit the same evaluation rules database, a complete and comprehensive performance evaluation can be easily acquired.

For students, the system helps a lot to build a self-exploration engineering learning environment. When the process of the experiments is investigated and evaluated into detail, students will put more attentions on observation and thinking when working with experiments.

Since evaluation rules set can be flexibly defined and configured by faculties who own the course, the performance evaluation system introduced in this paper can be easily modified to use in other engineering education practice.

5. References

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