THE DESIGN OF PEDAGOGICAL AGENT FOR DISTANCE VIRTUAL EXPERIMENT

Huan-Wen Tzeng[1]

Abstract —Learning about electric-machinery experiment is high risk and time-consuming, students always are not enjoyed at the laboratory, the teacher also need to fully pay attention to all students and equipment, besides it is hard to provide enough machine sets and space for learning. So it is our motivation to design a *Virtual Laboratory* for the teaching of electric-machinery experiment by Internet under the more reality environment without concern about the dangerous, lots of limitations, and also been taught as a plentiful experience teacher by the pedagogical agent is the most important key factor. Taking the above features into considerations, an interactivity *Virtual Laboratory* based on Expert System been designed and implemented to improve the learning, operation and control in electric-machinery experiments. The system we set up is a highly intelligent and interactive mechanism. Through the system, students could have a more completely environment for distance learning.

Key Words —Distance learning, Pedagogical agent, Virtual laboratory, Expert system.

INTRODUCTION

It is an important trend of distance learning; to provide better environment for learner to enrich their experience, not only the character based media presentation as mostly distance learning but also the real operation [1-4]. By the front-end Graphical User Interface (GUI) on Internet, it is possible to outcome machinery control from distance area. In the teaching of electric-machinery experiment, the hand-on experiences are very important during the training process besides theorems learning. Because of the hazardous of operation and costly investment of machinery, students usually couldn't to have enough experiences on wiring and operation. To overcome such plight, using the technology of Virtual Reality (VR) been proposed in recent years than before. Through the VR environment student will have more realization about the physical operation. [5-7]

Through VR technology, it will make GUI more reality and personally for study. But most of existence VR systems using the passive model for learning, students usually response straightly while request are given by the system. [8-12] For promote virtual laboratory is very important about providing a capable environment with intelligent interaction while navigate and operate in the experiment.

It is our major purpose to combine both expert system and VR together for the teaching of experiment. By the technology of expert system, a pedagogical agent will be designed as an experienced educator, who manage the whole learning process, and give the guidance, correction and explanation automatically and personally. Through the agency system, students could have a more completely environment for distance learning with highly realistic and interactive intelligent character described as bellow.

Realistic

Using the technology of virtual reality to setup the Virtual Laboratory. The learner could have a better-involved environment for studying the operation of electric machinery. [7,13-15]

Interactive

In the Virtual Laboratory environment, the system let user having many opportunities to have interactions with system, such as operation domestication after request. The system also let users to interactive with each other; by the way teacher could conduct the learning process and discuss with students [16-19]. There are some proposed interactive VR systems, but few of them talking about interactive laboratory. [20-22]
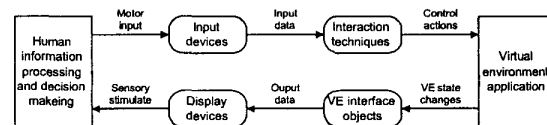

FIGURE 1
THE HUMAN-MACHINE INTERACTION IN VR

Intelligent

The design of intelligent is to monitor and conducting the procedure of learner. The expert system manages each interaction automatically under the experiences of expert educators. According to the rule-base, the system makes feedback to user such as correction, demonstration and explanation. [23-27]

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CONCEPTUAL MODEL AND IMPLEMENTATION

In order to reduce the complex of system model while constructs the virtual laboratory, the architecture of system is separated into three functional planes, such as: Learning Service Layer, Learning Environment Layer, and Network Service Layer (Fig.2). [28,29]

We will introduce the functions of each plane from the distance-learning service view and their relationship illustrated in Figure 1. In addition, the design is considered in the later sections.
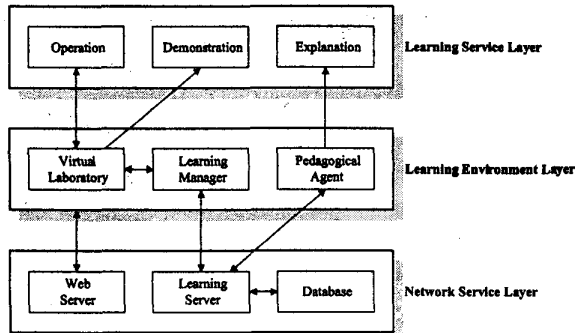

FIGURE 2

THE SYSTEM ARCHITECTURE

Learning Service Layer

This plane provides service functions for students learning about electrical-machinery experiment. It consists with three functions as: Operation, Explanation and Demonstration. In the beginning of the design these functions, we analysis all kinds of experiments of DC machine category of. Then pick out their feature, such as instruments, components, wiring, range and operation procedure. Each experiment consists of some features. After that, we got the common and unique requests of series experiment for the development of services. By the way of service block GUI oriented, it will help students to proceed an experiment more intuitively and flexibly, to complete a complex experiment by different ways under the conduct of expert system as a pedagogical agent. The technology of Java been used for develop this layer.

- **Operation**: This is a function to let students learning about wiring techniques of experimental equipment and instruments. (Such as: armature, exciting field, voltage meter, ampere meter, and etc.) The Connection Service Block (CSB) is for the symbolical connection learning, shown as figure 3. The Wiring Service Panel (WSP) is for the substantial connection learning, shown as figure 4. The Procedure Service Block (PSB) is designed for the training of arrange suitable procedure and range of electrical-machinery

experiment, shown as figure 5.

- **Explanation**: When the learner has a wrong operation, the expert system will give out a notation of correction. Besides, the teacher could supervise from distance in the same VR environment with students, and makes explanation for student individually by the way of appeared as an avatar.

- **Demonstration**: After the request of user, the system wills makes demonstration about partial or whole operation of experiment for him. It contains conclusive symbolical connection, substantial connection and marked out procedure.
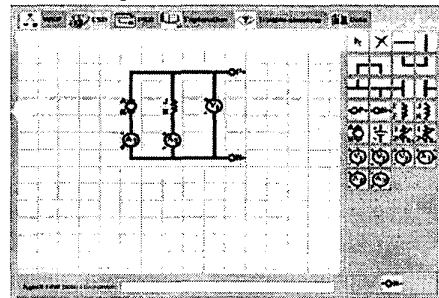

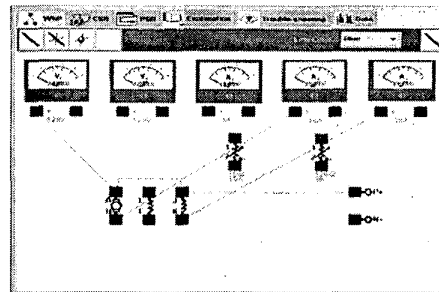FIGURE 3

THE CONNECTION SERVICE BLOCK (CSB)

FIGURE 4

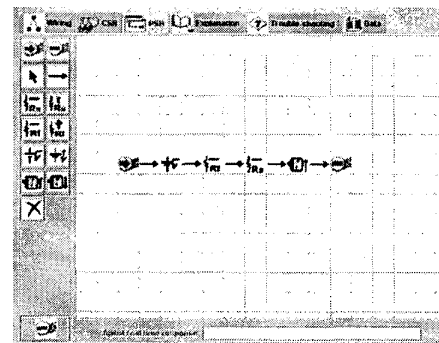THE WIRING SERVICE PANEL (WSP)

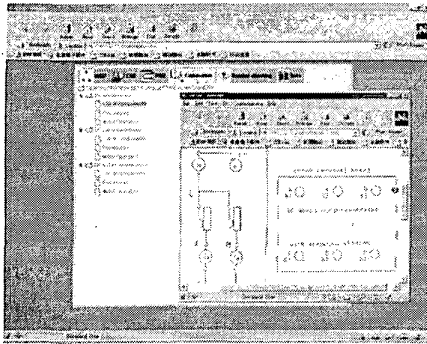FIGURE 5

THE PROCEDURE SERVICE BLOCK (PSB)

FIGURE 6

THE EXPLANATION SERVICE DIALOGUE

Learning Environment Layer

In this plane, the system provide user a highly interactive, functional circumstance for distance learning by WWW. Using the technologies of Java, VRT, and JESS to accomplish this layer. User could makes learning through Web browser from anywhere and anytime without physical limitations. This plane consists of Virtual Laboratory, Learning manager, and Pedagogical Agent. The interaction architecture is shown in figure 7.
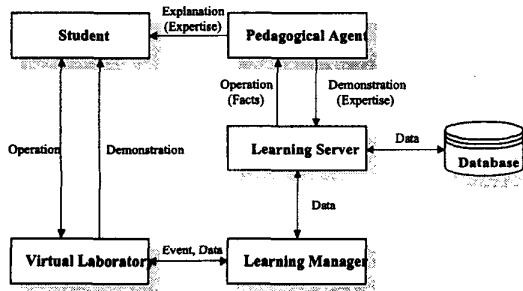

FIGURE 7

THE ARCHITECTURE OF INTERACTION

• **Virtual Laboratory**: In the virtual laboratory, there has some equipment of electric-machinery, like machine sets and control panel for operation. Also avatars of user appeared together in the laboratory as his selection. On the control panel, there are switches, variable resistors and meters for control operation and data reading, and the machine sets has motion according to control results. To accomplish the laboratory, we used the technology of SUPERSCAPE VRT 5.6. The realized laboratory for experiment is shown as below (Fig. 8)
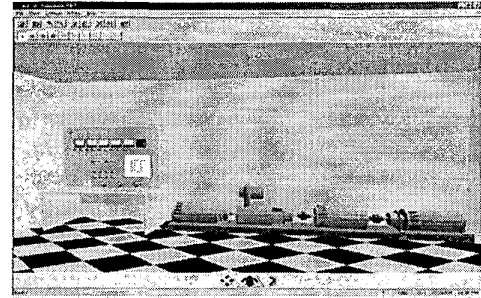

FIGURE 8

THE ACCOMPLISHED VIRTUAL LABORATORY

• **Learning manager**: Using the technology of Java Applet to develop the learning manager. It manages the operation actions of learner in the virtual laboratory. Each operation action will feed in the learning server as an event. The explanation and demonstration functions of system also pass through the manager to virtual laboratory.

• **Pedagogical Agent**: The core technique of pedagogical agent is expert system. The technology of JESS 5.0(Java Expert System Shell) is used here 'to develop the agent. After received the operation message, the expert system wills has reasoning action for give out prospected interaction to learning manager such as explanations or demonstrations. The prototype of expert system for the conduct of operation training is shown as Fig. 9. The conducting system is designed as Fig. 10.
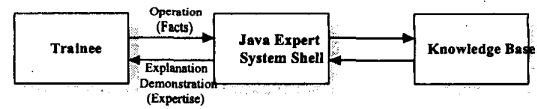

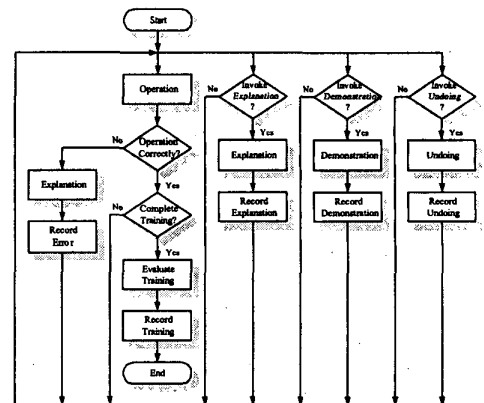FIGURE 9

THE PROTOTYPE OF EXPERT SYSTEM

FIGURE 10
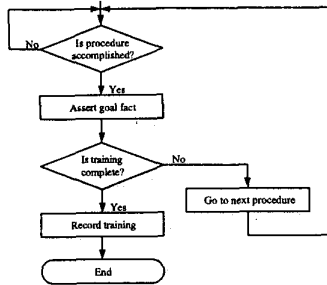
THE CONDUCTING FLOW OF EXPERT SYSTEM
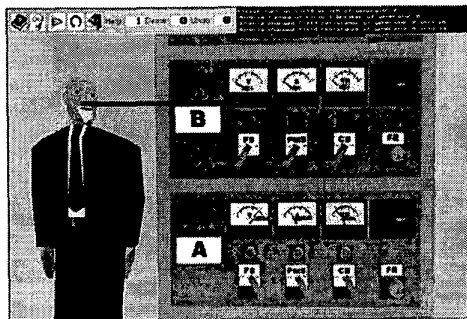
FIGURE 11

AN EXAMPLE OF OPERATION RULES

FIGURE 12

EXPERT SYSTEM EXPLAINS THE OPERATION PROCEDURE

Network Service Layer

This plane is constructed as the mechanism of Client/Server, and set up on WWW for distance learning. The primary components of the plane are Web Server, Learning Server, and Database.

- **Web Server**: The web server here is set up for deposit the related web pages as learning environment, system messages, and down-load file services. This server also provides services for user to browse our system.
- **Learning Server**: The Java Application is used for accomplish this server. All of the events picked by the learning manager will feed in to this server. After record them in the database, learning server duplicate a copy and send it to pedagogical agent for reasoning by expert system. The reasoning results will backward through here to learning manager.
- **Database**: It is designed for record the messages about user browsed in system, such as basic personal data of user, times & kind of explanation, error operation data, and etc. The database will be an evaluation reference at the after determine of achievement.

OPERATING PROCESS OF LEARNING

We create five ladders of processes for the design of Distance Learning in the VR Lab. (shown as Fig.13). They are Login, Navigation, Interaction, Evaluation, and Logout.
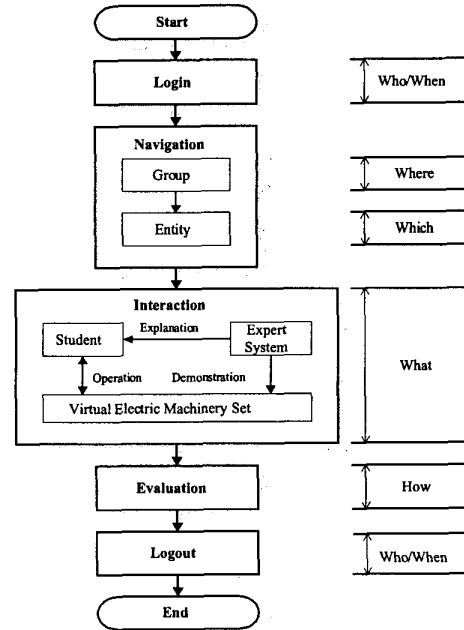

FIGURE 13

THE OPERATION PROCESS OF LEARNING

- **Login**: Whoever login the learning system, the Virtual Laboratory will record about his identity (Who) and time (When) at first. After that, user has to select an avatar as him self for navigation.
- **Navigation**: Avatars could go anywhere in the VR Lab. The VR laboratory (Where) likes a learning group consists of four experimental sets (Which) for users' entity choice.
- **Interaction**: There are three types of interactions in our system; first of all is the explanation (What) from expert system to student. Another interaction from expert system to virtual electric machinery set is the demonstration (What). The human-machine interaction while the operations (What) happened between student and virtual electric machinery set.
- **Evaluation**: When the learning process been completed, the system will transfer his records to teacher for evaluate (How) student's achievement.
- **Logout**: As the user logout the system, all data (Who, When) about this learning will be stored for assessment.

CONCLUSION

In this paper, we describe a Distance Learning system, designed to give engineering students an enhanced study of the theories and operation experiences of electric-machinery experiments. The Virtual Laboratory under the conducting of pedagogical agent we completed, has highly reality, flexibility, and interactively. It is not only for individual learning but also suitable for Team education and Team training.

In our research, using the technology of VRT PARAWORLD Communication for teacher and student individually (shown as Fig. 14,15). Also, the JAVA technology is used for the modules of Wiring Connector, and Control Panel. VRT technology is used for the construction of Virtual Laboratory. These experiences provided here for future works.

The system we proposed was setup in the Electric Engineering Laboratory of *National Taiwan Normal University* (**NTNU**) as a teaching aid for undergraduate while takes the course of electric-machinery experiment (shown as Fig.16).
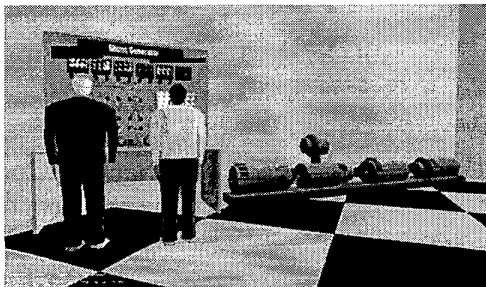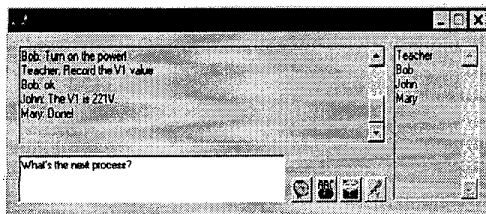

FIGURE 14

THE INTERACTIVE OF TEACHER AND STUDENT

FIGURE 15

THE DIALOGUE OF TEACHER AND STUDENT

FIGURE 16

THE HOMEPAGE OF ACCOMPLISHED SYSTEM

ACKNOWLEDGEMENT

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October 10 - 13, 2001 Reno, NV