An Analysis and Design of Knowledge Based System for Teaching & Learning Processes

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ABSTRACT
A knowledge based system is used to support the teaching and learning processes. This system helps to make teaching and learning processes more productive and efficient by employing modern technologies. It seeks to find new methods to teach a large number of students with no increase in staff. [3] The system is based on an expert system shell which provides a functionally interacting set of theory and problems, and supports student progress through monitoring and assessment. [6] The expert system can be used in different educational organizations for enhancing the quality of teaching and learning processes and minimizes the teaching faults.

KEYWORDS
KBS, Expert System, Expert System Shell, Fault Analysis, Teaching Technique

1. INTRODUCTION
Rapid growth of quality and quantity demands Teaching & Learning Processes in education. Technologically competitive societies make computer-based multi-media education crucial [8]. During the last few years computer-based education has been improved by the introduction of intelligent systems. Such systems can be based on Expert System (ES) technology. An expert system provides built-in support facilities such as debugging aids and knowledge base editors, built-in input / output and explanation mechanisms. These facilities help to make the Teaching & Learning Processes system development much easier and faster. This knowledge based system is intended to supplement, but not replace the traditional teaching techniques such as lectures and laboratory sessions. Variation in educational techniques and materials promotes better understanding of a subject. Simply applying theory is ineffective. Examples can influence learning process much more than the presentation of concepts and even rules [6]. The knowledge based system whose development operates in an active dialogue mode with the student, using examples, and providing immediate explanations and feedback to students. It also allows the students to access to the learning facility at any time that is convenient for them.

2. COMPUTERISED EDUCATION:
Current tertiary teaching is predominantly conducted through lectures, tutorials, laboratory sessions and workshops. However, lectures are not suitable for individualized teaching. Lecturers usually target average students and cannot give adequate attention to weak and bright ones. Tutorials and laboratory sessions used to be an opportunity for individualized teaching. However, the steadily increasing ratios of student to staff and a reduction in laboratory works make it difficult to provide reasonable feedback to students on their performance and understanding of the subject materials. Meanwhile, obtaining feedback is of major importance for both teaching and learning. In order to make feedback effective, it must be provided promptly and include sufficient explanations.

Computer aided education is able to solve most of these problems [4]. It can introduce a wider range of materials, assess the knowledge level of a student and, if it is not sufficient, present additional information, provide prompt feedback to the student with explanations of his or her mistakes and, if necessary, change the learning format, provide feedback to the lecturer on the material students are having difficulties with and, of course, allow the students access to computer based learning at any time. Modern computer-based systems can also allow the incorporation of sophisticated multimedia representations of learning materials [3].

In order to be successful, computer aided tutorials should:

a) Determine the prior knowledge of a student;
b) Gain and maintain attention and reinforce the motivational state of the student;
c) Present examples with clear explanations of key points;
d) Provide interactive mode of learning with prompt response to any student answer;
e) Provide assessment based on the results achieved and time spent;
f) Provide assessment information to the lecturer.

These principles were used to develop the knowledge based tutoring system. In order to investigate the scope for the application of a computer aided teaching system, analysis of balanced and unbalanced fault conditions in proposed systems was accepted.

3. ANALYSIS OF ACCEPTABLE AND UNACCEPTABLE TEACHING TECHNIQUES:
Teaching techniques analysis is one of the basic elements of the proposed system which includes different courses. However, a lecturer normally has very few hours in which to present fault calculation procedures. Clearly, in such a short introduction some challenging problems cannot be considered. In general, the analysis of any fault condition is performed in the following order:

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3. Represent the given proposed system by its positive, negative and zero-sequence networks (the zero-sequence network is omitted for faults without earth, and both the negative and zero-sequence networks are omitted for the balanced three phase fault condition). This representation requires the calculation of per unit (P.U.) impedances for generators, transformers, lines, cables and other elements of the proposed system.

4. Reduce each of the sequence networks to its simplest form. The equivalent positive, negative and zero-sequence Networks are represented as a series and series-parallel combinations of the p.u. impedances. These are replaced by the single equivalent impedance for each sequence network. It may also involve the use of the delta-star or star-delta transformations.

5. Use the appropriate symmetrical-component equations to find the phase-sequence components of the current in fault under the particular short-circuit condition.

6. Determine the required p.u. phase-current values at the point of fault.

7. Finally, calculate the actual values of the phase-currents by multiplying obtained p.u. values by the base current at the point of fault. The procedure outlined above provides a complete analysis of the given proposed system for the specified fault condition and can be easily implemented in computer aided tutorials.

4. EXPERT SYSTEM SHELL

The Leonardo expert system shell has been chosen from among several packages for development of the prototype application. Leonardo is an object oriented tool for developing expert system applications. The Leonardo Development System provides facilities for building and testing expert systems, additional information, for example, procedures and screen design. The inference engine provides a production rule interpreter, a method for finding values of objects, and how? and Why? Explanation facilities. The development engine provides the facilities necessary to create and edit rules for the knowledge base and to edit information into object frames. There are three types of rules: normal, assertive and quantified. A normal rule tests the values of some objects in its antecedent and sets the values of some objects in the consequent. An assertive rule is a simple command which defines the goal object (seek), collects initial data (ask) or prints information (say). A quantified rule can generate an exhaustive search over all members of the class objects. Class objects may be created with several member objects inheriting certain slots. Multiple inheritance is also permitted for class objects.[4] Leonardo automatically generates screens for the user input and output. However, a screen design package is also available to create tailored input and output screens. The graphics package provides built-in procedures to write a wide range of graphic images to the screen.

[5] Leonardo has its own procedural programming language which is used to perform complex computations, access external databases and programs developed in C, FORTRAN and Pascal, print reports, and manipulate the screen and so on. All these features make Leonardo a very inviting shell for the development of expert systems, especially in the idea and prototype stages [9].

5. DESIGN OF THE TUTORING SYSTEM

Proposed systems are subject to the following principal types of faults:

a) three-phase with and without earth connection;
b) phase-to-phase (two-phase);
c) phase-to-earth (single-phase);
d) double phase-to-earth (phase-phase-earth).

![EXPERT SYSTEM SHELL]

Fig. 1

the Leonardo Run System allows the delivery of complete applications to the user and the Leonardo Productivity Toolkit provides efficient aids for tailoring the application. Fig. 1 shows the basic parts of the Leonardo expert system shell. The knowledge base comprises the rules and objects which Leonardo uses for representation of the expertise. The knowledge base can store objects with frames which hold additional information, for example, procedures and screen design. The inference engine provides a production rule interpreter, a method for finding values of objects, and how? and Why? Explanation facilities. The development engine provides the facilities necessary to create and edit rules for the knowledge base and to edit information into object frames. There are three types of rules: normal, assertive and quantified. A normal rule tests the values of some objects in its antecedent and sets the values of some objects in the consequent. An assertive rule is a simple command which defines the goal object (seek), collects initial data (ask) or prints information (say). A quantified rule can generate an exhaustive search over all members of the class objects. Class objects may be created with several member objects inheriting certain slots. Multiple inheritance is also permitted for class objects.[4] Leonardo automatically generates screens for the user input and output. However, a screen design package is also available to create tailored input and output screens. The graphics package provides built-in procedures to write a wide range of graphic images to the screen.

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![INTELLIGENT Knowledge based SYSTEM]

Introduction

PROPOSED SYSTEMS are subject to many different lands of faults A fault can be defined as any abnormal condition which causes a reduction in the basic insulation strength between phase conductors and earth .The principal types of faults are as follows

1 Short circuit of a single conductor to earth.
2 Phase-to-phase faults
3 Double phase-to-earth faults
4 Three-phase with and without earth connection.

Fig. 2: Introduction Screen

The tutorial session starts with the introduction which provides a start-up message.
This message is placed in the Introduction slot of the object targeted by the seek command in the main rule set. When execution begins the corresponding text will be found and displayed on the screen as shown in Fig. 2. Then the illustrative example may be displayed. It provides step-by-step calculations of the symmetrical and asymmetrical currents in the proposed system.

6. ASSESSMENT PROCEDURES

Student assessment is a key element of the developed knowledge based tutoring system. It allows to monitor progress of every student in the class and also present information about overall group performance. On average, lecturers need to allocate from 10% to 15% of their time to student assessment and examination [7]. However, these activities can be now easily automated. Using the knowledge based tutoring system, lecturers are relieved of the tedious tasks of mark allocation and recording, and calculating individual student and group statistics. With the developed system, a student can test his or her own knowledge any time with minimum help from the lecturer.

STEP 1: Choose $S_{\text{base}}$

* The proposed base can be adopted equal to the proposed rating of any proposed system generator or transformer, or may be chosen as a whole number as 10, 100 or 1000 MVA.

$S_{\text{base}}$ is chosen as 100 MVA.

STEP 2: Choose $V_{\text{base}}$

* The choice of the voltage base is determined by the voltage: rating of the bus bar where the fault is located.

$V_{\text{base}}$ is chosen as 132 kV.

STEP 3: Calculate $I_{\text{base}}$

$$I_{\text{base}} = \frac{S_{\text{base}}}{\sqrt{3}*V_{\text{base}}} = \frac{100}{\sqrt{3}*132} = 0.437\, \text{kA}$$

Fig. 5: All tutorial problems concerned with fault analysis in proposed systems are divided into three groups at different levels of difficulty. Every problem is in turn subdivided into smaller elements and each of the elements is given an appropriate score depending on the difficulty level of the problem. Students should perform their calculations to an accuracy of 10%. Additional 5% inaccuracy is also allowed but 0.5 of a mark is
subtracted from the final score. If the student makes any mistake and his or her input is incorrect, the explanation and guidance will be provided automatically but marks are subtracted accordingly. When the student completes a problem an assessment of his or her mistakes is displayed. If the student has solved all problems in the tutorial set proposed by the system, a detailed assessment will be provided. The total score obtained by the student is divided by the maximum possible marks and multiplied by the difficulty level. Then the student is asked to insert in drive A an assessment diskette [5] which must be obtained from the lecturer. A group’s performance can be reviewed by the lecturer using the assessment diskette. The lecturer may analyze the student’s work by applying any available option shown on the above screen. The chronological order option indicates the score obtained by the student, time taken to complete the task, date and the difficulty level. The alphabetical order option provides the same information but lists the students in alphabetical order[5].

7. FAULT ANALYSIS: Level 3
Number of problems solved: 4
Mistakes committed Number Marks Subtracted
1. Wrong I base 1 2
2. Inaccurate I-base 2 1
3. Wrong generator reactance 1 2
4. Inaccurate generator reactance 2 0.5
5. Wrong transformer reactance 1 2
6. Inaccurate transformer reactance 1 0.5
7. Wrong transmission line reactance I 2
8. Inaccurate transmission line reactance I 0.5
9. Wrong equivalent reactance I 2
10. Inaccurate equivalent reactance I 0.5
11. Wrong fault current I 4
12. Inaccurate fault current 2 0.5
13. Wrong fault MVA I 2
14. Inaccurate fault MVA 1 0.5
15. Assistance required 4
Martin Kenneth, your mark is 46.0 / 70 * 100 = 65.7%
Saving is complete. Return the assessment diskette to your lecturers.

8. STUDENT INTRACTION & COMMUNICATION:
The Leonardo based tutoring system is a valuable tool for teaching fault analysis in power systems. In October 1994, the
system was installed in a computer network and it can now be accessed from any computer in the Department of Electrical and Electronic Engineering. It has been found that network delivery of computer-based tutorials is the most cost effective. Based on the student comments and recommendations, a few new more challenging problems have been added into Level 3. It should also be noted that materials used in computer aided teaching must be prepared very carefully, keeping in mind that the lecturer cannot be accessed during every tutorial session to explain or clarify difficult points.

9. CONCLUSION
A knowledge based system for teaching and learning process along with fault analysis in proposed system has been developed and successfully used by the proposed students. The students have found the tutoring system easy to use and understand and have received a good introduction to fault analysis in proposed systems. The system provides an automatic student assessment and helps lecturers to identify the most common mistakes and bottlenecks in the tutorial problems.

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