Proceedings of the IASTED/ISMM
International Conference

MODELLING
AND
SIMULATION

April 25-27, 1996
Pittsburgh Pennsylvania USA

Editor: M.H. Hamza

A Publication of
The International Association of Science
and Technology for Development - IASTED

ISBN: 0-88986-201-X

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Applications, Education, Methodology
ACADEMIC ADVISORY EXPERT DATABASE SYSTEMS:
THE IMPLEMENTATION OF RELATIONAL DATABASE SYSTEMS
AND EXTERNAL KNOWLEDGE BASE SYSTEMS
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ABSTRACT
The Relational Database Systems (RDBS) integrates data information at various remote sites into a coherent single picture for the user. While the External Knowledge Base Systems (EKBS), knowledge represented by some rules and facts. The inference mechanism of the expert system can create solutions and provide explanations based on the rules in the external knowledge base. The rules are written in the database definition language. Therefore those rules can be changed or manipulated as required, and the recompilation of the whole system is unnecessary. This means that the expert system has a flexible knowledge base or rules or facts, capable of improving the performance of the system.

KEYWORDS
Expert Systems, Relational Database, External Knowledge Base, Academic Advisor, Inference Mechanism

I. INTRODUCTION
Computer application in the information systems processed big amount of complex structured data. Some of these applications require specific expertise and capability of two separated system. The Expert Systems and Database Systems integrated into the Expert Database Systems.
The program sample of this system’s application is the students problem in determining courses for the next semester, referring to his or her record of assessment and the rules of the educational institution. In general, this decision will be very important for their future. In this case the expert system will provide solution and reasoning, regarding all the rules and data. It is functioning as an external knowledge base.

II. BASIC CONCEPTS OF EXPERT SYSTEMS AND DATA BASE SYSTEMS
Expert Systems is a computer systems operating with the inference mechanism. The purpose of this paper is to show the development of a system with an expertise that normally belongs to an expert in one field. This expertise is represented by some knowledge and rules, available at the external knowledge base system. The main components in expert systems are Knowledge Base, Inference Mechanism, Working Memory and User Interface [1].

RELATIONAL DATABASE
Relational model organized data into a uniform representation. Data or information in a relational database are represented in a 2-dimensional table, related through the same attribute or index.

RELATIONAL DATABASE MANAGEMENT SYSTEMS (RDBMS)
RDBMS is a software that controls interaction between user & application program to the database. The main purpose of RDBMS is to acquire an independent and loosely data. This is deemed necessary when the user update the data, without wanting to change the application programs.

III. EXPERT DATABASE SYSTEMS
Expert Database Systems have a few definitions as follows [2]:
- An effort to merge an available software tools such as DBMS and expert system to solve problems
- An expert system is facilitated to handle database management systems with a deduction component
- A system is located at the intersection of software engineering and knowledge engineering
- Each system is located at the intersection of Artificial Intelligence and information system's engineering

Combination of those technology create positive impacts to the expert systems and Artificial Intelligence technology, which generally can enhance database systems capability in processing data, by including solution and its reasoning. A database systems will enhance the expert system’s potency in storing, manipulating, and processing data, including knowledge. Therefore the system will be more flexible.

According to Alzubiad [3] there are two types of expert database system. The enhanced database system and independent expert systems & database systems.

THE ENHANCED EXPERT SYSTEMS
The enhanced expert systems is an enhancement of expert system provided by DBMS facility. This can be done in 2 ways [4]:
- Internal and External enhancement
- Internal enhancement is generated by widening the environment of the programming language being used to create deduction system
- The external enhancement of an inference mechanism in the expert systems have a direct relation to the multipurpose external DBMS. This can be
accomplished in 2 ways: loose coupling and tight coupling.

**EXPERT SYSTEMS AND INTERDEPENDENT DATABASE**

This type of expert database systems make the expert system and database systems as an interdependent expert systems and database systems, and be able to communicate through the same channel. This problem can make expert systems and DBMS operate as two independent but cooperative systems. The problem arise is the existence of the main control relating these two systems. The three methods[2] of this types are Distributed process and control, One dominance, and the use of Controlling routine.

In controlling routine expert systems have knowledge base, and the database can be manipulated through DBMS. The time controlling routine organize expert database systems as an integrated system. The user can choose, whether to use application that only will use database or an expert systems application.

In this case knowledge database can be treated as a simple database file, which can be manipulated, updated, added or deleted. A deduction routine consists of main rules to be executed from knowledge base and the result is placed into working memory.

**EXTERNAL KNOWLEDGE BASE SYSTEMS**

External knowledge base system is a knowledge base system separated from the expert systems itself. The knowledge base separation enables user to manipulate rules from the knowledge base, such as the normal database. The performance acceleration achieved because the expert systems have to read knowledge base outside the systems. This problem can be overcome by writing deduction systems inside database application program.

By the database application program, the access to manipulate data can be executed quickly because database application program have been designed to execute task such as searching, querying, and sorting. Variables in the rules tables must be recognized by the working memory, prior to the execution. Therefore these variables have to be declared before. A table consist of the variables that will be used, have to be designed first. The table have to be read first to enable the execution of conditions of the table.

The next step is the creation of a table consist of the reason of each facts. The rules that satisfy the prerequisite (TRUE) of the rule field of that rules tables can be copied to the facts field at the reason file. The condition field of the rules table that satisfy the requirement, is translated first into a standard statement mode, by using a parser program. Then the standard statement have to be copied into the field, because it is located at the reason's table.

A facts can consist of a few records, depend on the number of parameter or the condition of the rule condition at the field of condition of the rules table. The written reason is only the parameter that will assigned TRUE value.

By the same method, a given course condition of this application software also use external knowledge. The rules to check a course is stored at the table of criteria. A few table being used such a reason table is called a cursor. A cursor is a temporary file located at the working memory, and will be deleted when the program is finished.

**KNOWLEDGE BASE FILE TABLE**

Beside simple tables that consist of regular data, there are knowledge base file tables which consist of variables and rules that will be read by inference mechanism before inserted into working memory.

All table file can be manipulated as a standard database table, but the updating of the content can be executed by authorized user only. The Field number at the rules file table and criteria is used to show sequence of the rules and criteria that will be read by inference mechanism. This sequence is very important because it interfaced the result to the system. The file table variable dbf is treated specially. Except being read and declared by the inference mechanism, at the end of the session all variables will be deleted from working memory.

**THE SOFTWARE PLATFORM**

This application model is design by Microsoft FoxPro for Windows version 2.6 software, which has relational database ability and SQL support.

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Figure 1: The Expert Systems Flowchart

**IV. THE DESIGN MODEL**

This application program is designed to help academic advisor to give suggestion about the academic
condition of the student and help them in selecting courses which will be taken at the subsequent semester.

This program can be divided into three main parts:
1. Expert Systems that analyzes and provides solutions to the user.
2. A DBMS/KBMS that controls the manipulation and maintains all of the database (DB) and knowledge base (KB).

THE EXPERT SYSTEMS ALGORITHM

The Expert Systems procedure to analyze data and to provide solution & reasoning to user can be seen in figure 1.

V. IMPLEMENTATION AND TESTING SYSTEM IMPLEMENTATION

The program requires a 80486DX computer with 8 Mbytes of memory to work optimally.

EXPERT SYSTEM TESTING

The testing is done by inputting name and number of a student that have an academic record. The expert system will count all academic records of the student and create a course domain base on rules from rules table. The system then will create reasoning from the condition in a standard format.

At figure 2, if a user need a reason for a condition, user will only have to select condition that he/she desire to know, then it will be elaborated at the field of reason.

At the testing phase of the system, the criterion table that will give a value to the course if it satisfies the reason from criterion table, is justified. According to the total value of each course, the system will give a conclusion of which course have to be taken and its priority. System will also elaborate the reason.

KNOWLEDGE BASE SYSTEM TESTING AND DATABASE SYSTEM

The testing of these 2 systems principals the same, but for the knowledge base system, user will be able to manipulate the rules, criterion and variables that will be used by the expert systems (Figure 3).

THE RESULT OF THE TESTING

-  System can read and execute all rules, criterion and variables, located at the external knowledge base.
-  System can give solutions and explanations about academic conditions and courses that should be taken by the students, according to the rules and criterion on the external knowledge base.

VI. CONCLUSION

- By using this external knowledge base, the system will gain a flexible developing tools because rules and criterion from knowledge base can be manipulated and updated without having to change the content of the overall expert systems.
-  Implementation of the expert system with the commercial and popular database application, provide opportunity to develop the system further into a networked and multiplatformed system.
-  The academic advisor information system can help the academic advisors and students by providing information, solutions and explanations of the courses that should be taken at the subsequent semester.

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