A Case based Reasoning System for Academic Advising in Egyptian Educational Institutions

Lamiaa Mostafa, Giles Oately, Nermin Khalifa, and Walid Rabie

***Abstract*—**Each university or college provides degrees as bachelors and masters degrees. Each degree consists of courses or subjects that are taken in specific period (semester). Academic advising is process of selecting the courses that academic student will register in each semester to fulfill the degree requirement. The academic advisor suggests to the student which course to register. One of the important processes in student educational life is the advising process.

This paper proposes and implemented a case based reasoning (CBR) system that recommends to the student the most suitable major in his case, after comparing the historical cases by the student case. The system converts each departmental course into a group of concepts for each course. The system checks the similarity between the student taken course and the stored course in each department. CBR system had proven its effectiveness in the transfer cases between major. Based on the CBR system recommendation, the student can take a decision which major is the best based on the achieving level.

***Keywords*—**Educational Service; Academic advising; Case based Reasoning; Concept; Major Transfer ;Major Decision.

I. Introduction

SHARING information is an essential step in the educational services. Knowledge sharing, knowledge management are considered emerging concepts that different researchers discuss [1].

Academic students should register courses based on their profiles and each major they prefer. For this reason, academic advising makes the students achieve their educational goal. There a relationship between the student and the academic advisor in which the advisor plays the facilitator role ([9], [11]).

Manual academic advising has many drawbacks as labor intensive, time consumption, human advisors use their accrued knowledge and the large number of students compared to the number of advisors [6].

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The aim of this research is to produce a CBR system that avoids the manual academic process and converts this process into an automated one. The implemented system aim to reduce the following manual advising process: limited number of advisors (labor intensive), complication of the advising double curricula (double major) process ([6],[9],[12]).

The paper is organized as follows. The first section is the problem identification. Second section is the theoretical background of the academic advising process. The third section is the CBR system implementation. The last section includes the advantages of the proposed approach and the directions for future work.

II. Related Work

The following subsections will define the following main ideas: researches in (educational services, academic advising and different techniques for automated advising).

A. Educational Services

E-advising has many benefits as stated in [1]. E-advising enhances online student retention; handle the communication between the student and the advisor in an easy way with different tools: text/chat mode, an audio mode. E-advising provides timely, quality advising services and it provides an innovative response to questions using personalizing communication in anytime, anyplace since the information will be available on the web.

In e-learning systems, student can search for courses using the recommender of e-learning system [8].The recommendation system collects information from the log of student history and course ontology that shows detailed information of each course and its pre-requisites courses.

Learning recommendation and course modification can assist students in their learning performance, also it can handle the students' learning behavior, evaluating the in e research [13], a web education tool was created for covering the course materials and getting feedback from teachers and students.

Data mining definition is the extraction of hidden information from large databases [1]. Data mining is used in academic advising based on the following researches ([1], [3], [8], [9], and [13]). Another field that can use data mining can is the major selection ([5], [6]).

Student syllabi is the document that include all the courses taken by the student, and their grades, also it includes the rest of the courses that should be taken to graduate from the specified major. Researchers in [2] try to extract information from syllabi document. HTML application was created for this purpose.

E-advising process is the process of advising automation, different users of the e-advising process should evaluate the quality of e-advising.

B. Academic Advising

Academic advising "step is defined as the process of supporting, motivating student's thought-out university's study plan and along the achievement of their educational goals"[1].

Major selection is a very important step in the academic student life. In [8], the researchers created a decision support system. The mechanism of the system works as follows: the system calculates the supporting degree (passing mark) for each course; second the system counts it to reach the whole major supporting degree. At the end, the system suggests the major of highest supporting degree to the student [8].

The expertise of the academic advisor is so important. My Majors is a web application that can be used by the students or the academic advisors. My Majors proposed benefits are: reduces the time consumed in advising process, it improves the enrollment of 24 hours a day, everyday [6].

In medical Iranian school, research in [11] observes the academic advising process. Most of medical students do not know the main tasks of the faulty advisors. Educational workshops were established for the sake of students and to understand brief information about roles.

C. Case based Reasoning in Academic Advising

Previous researches identified the most of academic advising problem and obstacles. This section will explore such techniques in-depth. These techniques include: Decision Support System, Decision Tree, Data Mining techniques, Decision Matrix, and Rule-based Reasoning.

Knowledge management definition depends on the nature and needs of the business or organization; however knowledge is the management of the cognitive production factors accommodated in a business or government organization [1]. Knowledge provides number of the benefits in education: student's information will be increased through capturing, storing and sharing of knowledge. The proper and efficient knowledge sharing cannot be done using the human interaction only, however a systematic approach should be used [1].

Different automated techniques such as ontology (known tools are used for the enhancement of the educational service and the academic advising ([3],[15]).

CBR used for many purposes as robotics, electronics, mechanics and real estate [19], consumer services [20], urban planning [20], medicine [21], tourism [22], software development-computer engineering [23], environmental planning [24], civil engineering [25].

Textual Case based reasoning (TCBR) is defined as "a research area that deals with solving new problems by reusing previous similar experiences documented as text" [[26],[27].

Choosing the right data mining technique in real application is a very hard decision. There are two parameters to choose the data mining technique the first is goal of the problem to be solved and the second is the structure of the available data. [28] Classified data mining techniques based on a conceptual map into 4 categories : descriptive model, associative model, discriminator model and predictive model. CBR is classified in the discriminate model based on [28].CBR is a predictive model based on historical data.

RubricAce is software used for testing. RubricAce TCBR is developed in [27] for recommending textual feedback for students assessment. The assumption of this system is "students with similar grades should be given similar feedback".

III. Proposed Approach

CBR framework is composed of two main phases: adding archival cases, testing the new case. The proposed approach compares the new case of the student transcript by course in different major curriculum. Each course is divided into concepts with weights to represent its importance. The similarity process compares the student taken concepts and the concept of each major stored in the advising database. After this, the CBR system proposes the nearest major to the taken concepts, the major of highest achievement level is the chosen major unless the students indicate other preferences. The following figure shows CBR framework. The framework components are graphical user interface that deals with the user, functional level that includes the features, archival cases and testing the new case. The functional level interact with a database that is called advising database.

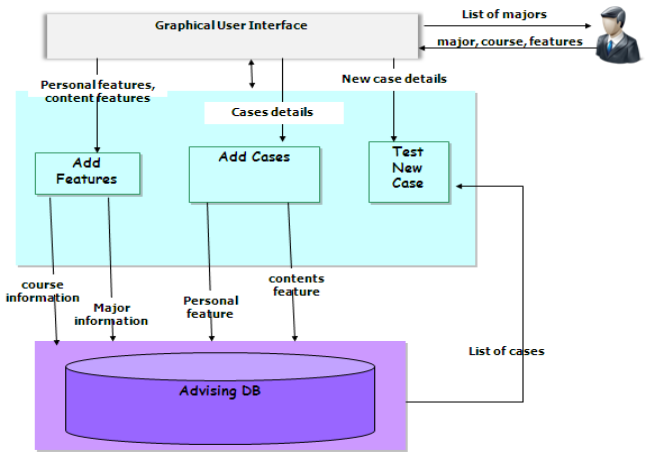

Fig. 1 CBR Framework

A. Proposed approach phases

The first phase is the storage of the archival cases. Each case represents a student. Each student had taken group of courses. Each course is divided into a group of concepts course training one. The course name is given as an input for this phase; the first module represents transferring course into

group of concepts. So proposed mechanism checks the syllabus of course from the database and converts the syllabus into concepts. The list of concepts forms an input to the second module.

There are three main functions. The first function is adding the case features of the case, second adding the content features of this case that include the courses concepts and finally adding the case major to include all the required information about the course, as shown in the following figure.

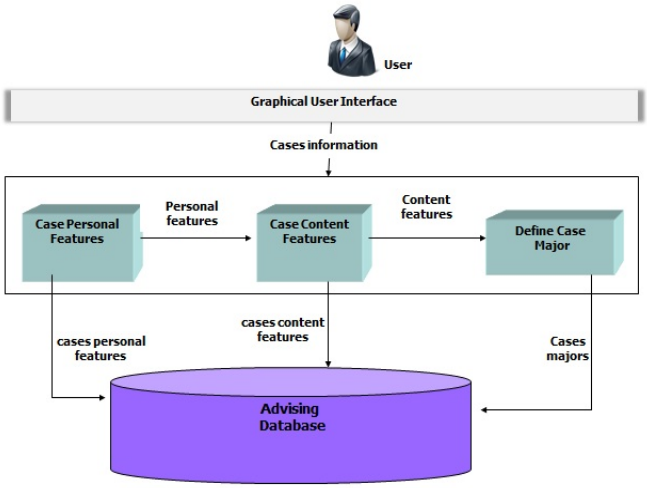

Fig. 2 Adding Archival Cases

The second phase is the classification of the new case; this step focuses on matching process between the course given by the student and courses included in each major. The tested case is given a decision which major to enroll in, as shown in "Figure 3".

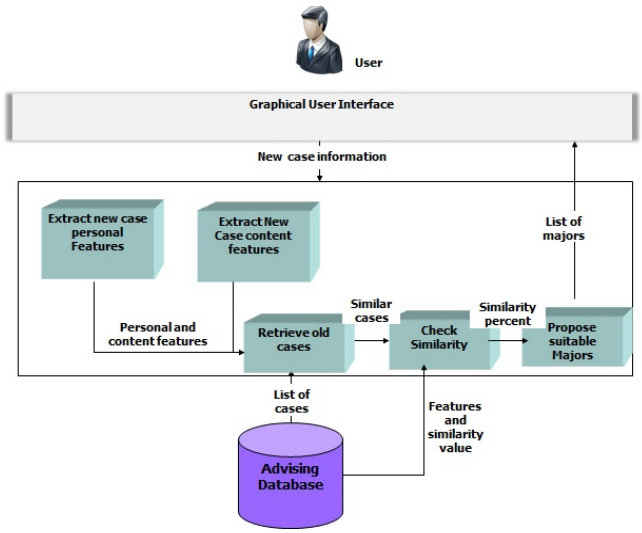

Fig. 3 Testing the New Case

The result of the comparison/matching process is the achieved level that supports decision making for the major choice. The major with the highest achievements level is the most suitable one for the student based on the framework.

B. Approach Tools

This research idea can be divided into six main items: implemented system, database, case representation, data collection, course syllabus and features and weights.

For the system implementation, Microsoft Visual Studio.Net 2010 is the tool for the implementation. The advising database that stores all the required information is created using Microsoft SQL Server 2008 tool. Each c reason archival Cases from Business information system Department is extracted.

Courses Syllabus and list of keywords are created using ISO Forms Business information system Department. Finally the Features and Weights are created using Focus Group, expert in each Course. For the validation of the CBR system, a survey is created and spread to all the academic advising.

IV. Implemented System

The graphical user interface of the CBR system is running under a windows application. The CBR system starts with the user choice between adding course, adding feature and adding student case which is shown in Figure 4. The historical cases are added using Figure 5. Each student is represented as a case. The case properties are divided into two types. The first type of properties are personal information, the second type of properties are the feature of each course taken by the student. The course is divided into a group of concepts with weights. The weights of the concepts represent the importance of the concept to represent the course.

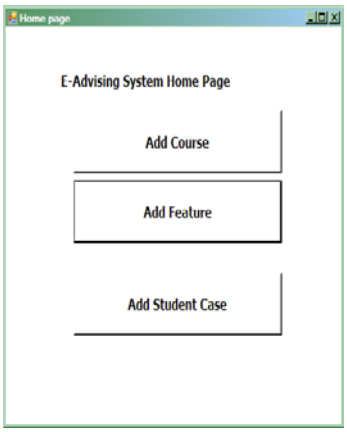

Fig. 4 CBR homepage

After adding the historical cases as shown in Figure 5, the academic advisor will test the system for a new case. The features of the new case are like the features of the historical cases either personal features or contents feature. The system measure the similarity between the new case and the other old cases by checking the nearest features and values to the new case. The following is Cosine Similarity[1] function that is used to compare cases.

$$sim(s,d) = \frac{\sum_{t \in \{s \cap d\}} w_s(t).w_d(t)}{\sqrt{\sum_{t \in s} w_s(t)^2}.\sqrt{\sum_{t \in d} w_d(t)^2}}$$

[1] http: //www.mislita.com/termvector/ term-vector-3.html.[Last reviewed: 25.8.2009]

Where s is the Old case and d is the New case, ws (t) is the weight of features (t) in the old case, wd (t) is the weight of term (t) in the newcase.

Fig. 5 Adding the features of the case/student

Figure 6 shows the result of selecting the best major option. Recommended major is the major with the highest similarity value.

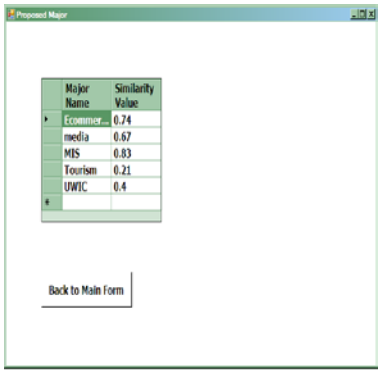

Fig. 6 Major Recommendation Screen

V. System Evaluation

A. Experiment Design

The implemented CBR system provides an automated advisor that assists students in major transfer. CBR system provides accurate "match making" process using majors curriculum and course syllabus. Each case stored in the database is compared by the new case. The case with the highest similarity value is the proposed major for the student. The implemented CBR system tries to solve the deficiencies of the theoretical background and the previous studies

The CBR system is implemented and tested in the Arab Academy for Science and Technology and Maritime Transport, College of Management and Technology. The CBR system uses 500 cases which is stored in the CBR database. The cases are related to business information system department.

B. Experiment Results

The process of transferring from manual phase to automated phase is an important step in the efficiency of the advising step.

CBR system compares the new case by similar cases which are feed into the system. The results of the CBR system were indicated by students and academic advisors.

The results of the survey indicated its usefulness and speeding up the process of academic advising especially in transfer cases.

Based on [29],"Three major perspectives for defining and identifying the quality of a software product: product revision (ability to undergo changes), product transition (adaptability to new environments) and product operations (its operation characteristics)". As shown in the following figure the

CBR system quality was tested using the following software quality attributes: efficiency, reliability, usability. Two other functional attributes are added: accuracy and time consumption.

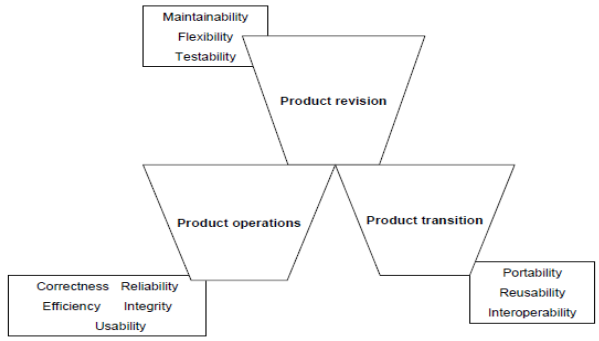

Fig. 7 McCall quality model [29]

The main objective of experiment is to validate the proposed approach; the mechanism was evaluated by a group of academic advisors working in college of management and technology. The following figure shows the proposed survey that will be spread on the academic advisors.

	Question	1	2	3	4	5
	Usability					
1	Does the user comprehend how to use the system easily?					
2	Can the user learn to use the system easily?					
3	Can the user learn to use the system easily?					
4	Does the interface look good?					

Section 4: The following questions ask about your perception of Software Efficiency.

	Question	1	2	3	4	5
	Efficiency					
1	How quickly does the system respond?					
2	Does the system utilize resources efficiently?					

Section 5: The following questions ask about your perception of Software Maintainability

	Question	1	2	3	4	5
	Maintainability					
1	Can faults be easily diagnosed?					
2	Can the software be easily modified?					
3	Can the software continue functioning if changes are made?					
4	Can the software be tested easily?					

Section 6: The following questions ask about your perception of Software Portability

	Question	1	2	3	4	5
	Portability					
1	Can the software be moved to other environments?					
2	Can the software be installed easily?					
3	Does the software comply with portability standards?					
4	Can the software easily replace other software?					

Fig. 8 Academic Advisor Survey

VI. Conclusion And Future Works

The paper provides a CBR system for academic advising in university system, case applied in AAST. The CBR system provides solution for transfer cases between university majors. The comparison process indicates the similarly of course contents and such course similarities was used in major matching and calculating the achievements level. A survey was spread and filled in by academic advisors to evaluate its results and compares it with the traditional manual system.

The CBR system could be extended to include different majors of different colleges and differentiated course syllabus. Transfer cases between different colleges of different majors could be handled using this paper contribution. The CBR system could include student preference as well prior to recommendation phase in order to filter the results and propose the most convenient major to his/her preferences.

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