Artificial Intelligence Approach to Effective Career Guidance

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Abstract

With the vast opportunities available for IT education, career guidance has become a crucial theme for deciding the appropriate career path of students. The lack of such expert career guidance systems in this domain inspired us to come up with the initial idea. This paper reports on a Career Advisory Expert System, named iAdvice to guide students engaged in their higher education to determine their career paths and to select their course subjects to be inline with their career goals. Expert System features such as reasoning ability, providing explanations providing alternative solutions, providing uncertainty and probability measures, questioning ability are found in iAdvice. The design of Career Advisory Expert System takes into consideration factors such as past examination performance, student preferences and skills, industry alignment with subjects, which are the main factors also considered by a human expert in providing career guidance. According to the evaluation carried out it was found out that the model has a capability of about 70% accuracy in predicting the performance, about 85% relevance of the advice provided, the self-explanatory nature of the system and about 87% provision of informative and useful advice.

1. Introduction

Career guidance is a domain which involves human experts such as councilors who provide advice to select appropriate career paths for individuals after considering the personnel information and available options. This facility is vital to any higher education institute, because students tend to consult experts in determining their career paths. This activity helps out when students are not confident of their future career and when having problems in determining what is best for them out of the available options.

Further, the universities and other higher education institutes generally provide the flexibility to the students of choosing the subjects of their liking by providing elective subjects in their curriculum.

However, if students are not properly guided or given advice in aligning their decisions with their ultimate career goals, they will not be able to operate in their full potential in the future. More seriously, one may select an inappropriate career path and develop unrest and dissatisfaction in his/her own life, also being a cause for graduate unemployment in the country. Thereby, the objective of higher education will not produce its intended benefits. According to Labor force statistics of Sri Lanka, the unemployment rate of the labor force with the education level higher than G.C.E. Advanced Level in year 2005 amounts to 13.8% indicating its significance. This has pointed out the need for career guidance in higher education [3].

Being one of the oldest Artificial Intelligence techniques, expert systems have the ability to implement the problem solving ability of human experts based on exposure to knowledge in a particular domain. Expert Systems have been proven successful over the last fifty years in areas such as medical diagnosis, fault-diagnosis, interpreting measurement data, configuring systems to mention a few [2]. The major reasons for using expert systems are improving productivity of human experts, economic measures and disparate locations of human experts, applying expertise uniformly, impartially towards preserving experts' knowledge and saving time of human experts.

University Grants Commission of Sri Lanka has promoted career guidance services in universities since 1998 [9]. Yet only a few would actually take advantage of such facilities mainly due to limited availability, anonymity and time constraints. However, it is known that no Sri Lankan institutions have launched a proper computer-based career guidance system [4]. We argue that computer-based

career guidance system with expert system features would be a productive method to be applied in this domain to assist the human career guidance councilors as well as to provide effective advice to students. This paper reports on our Career Advisory expert system, *iAdvice*, as a means for providing effective guidance in the selection of appropriate career paths and elective subjects.

This expert system will pave way for the undergraduates to get advice on their career path that they wish to take. For the students who do not have a clear vision about a career path, *iAdvice* will provide the possible paths that one can take based on their past track records and their preferences. It will also provide alternatives and options students can take in order to mitigate the risk that could prevail in some paths although the student opts for certain subjects. It also expresses certainty levels for each career path proposed for the student and recommends what is best for the student. *iAdvice* provides the users with a clear explanation about the advice provided by means of reports as well as performance, skill and capability evaluation diagrams. *iAdvice* also advices on the subject areas a student should improve if the performance is not up to the required standard. The expert system also has the ability to ask specific questions from the user to determine the user skills and preferences, providing a rich interaction capability along with working on incomplete information.

The rest of the paper is organized as follows. Section 2 describes our approach to the development of *iAdvice*. Section 3 is on the design aspects considered in the development of *iAdvice*. Section 4 reports on the implementation of this system incorporating the expert system features and the knowledgebase. Section 5 describes the actual process that the users have to perform to get the advice from *iAdvice* and also illustrates how it is practically being used as a career advisory system. The evaluation process carried out on this research, the evaluation results and their explanations are described in Section 6. Section 7 concludes the research findings of *iAdvice* and its applicability in the real career guidance process in the higher education system.

2. Approach

The scope of the research was mainly focused at the Faculty of Information Technology of University of Moratuwa. This faculty offers a Bachelor's Degree Course in Information Technology as B.Sc. in Information Technology and B.Sc. in Information Technology (Honors). The undergraduate students who are both eligible and willing to do the specialized degree have the option of selecting from a range of optional subjects offered. In this scenario, the students

have to select the subject preferences that they would like to take up based on their future career goals or their preferences. In order to cater to this problem, we came up with *iAdvice* which can provide advice to prospective Level 4 students in determining their subject selection and to provide advice in improving their performance.

iAdvice has been implemented as an expert system, that behaves like a human expert usually in a narrow domain of application, in this case being the career guidance domain.[2] In general, an Expert System is a program that represents and reasons with knowledge of some specialist subject with a view of solving problems or giving advice. The expert system will act as an intermediary between the problem space and the decision maker playing the role of an assistant to the decision maker [5][8]. In this case, the problem is lack of proper career guidance to students where ultimate decision should actually be made by the particular student. *iAdvice* has been implemented as an expert system playing the role of a useful and supporting intermediary between the problem and decision maker by providing career related advice to the students by analyzing a set of factors that affect the future career path determination.

Identifying targeted user groups was one of the important aspects during this research. The sample for our survey comprised of around 100 students who are currently undertaking the B.Sc. in Information Technology Degree Course at the Faculty of Information Technology. Preparing the questionnaires to collect data from specific target groups was the first action that was performed during this research. The intention of the questionnaire was to identify the subject preferences of the students with the career goals that they have in mind, so we could find the correlation with the subjects and the career paths. This was used to capture the requirements for the building of the knowledgebase. Questionnaires were prepared in two different sets to cater to both the old and new revised syllabuses.

From the answers that were given in the questionnaires, the trends that were available in the subject selection of students with regard to their career paths and their past performance were analyzed in detail. This was useful in developing the "Question Bank" with regard to skills and performance in the expert system and for the development of the business logic behind the system. Figure 1 illustrates important factors that were taken into consideration in the approach to the advisory system. Identification of the bylaws applicable in the university and referencing of career paths of some of the leading software companies and their required qualifications and skill levels have been considered.
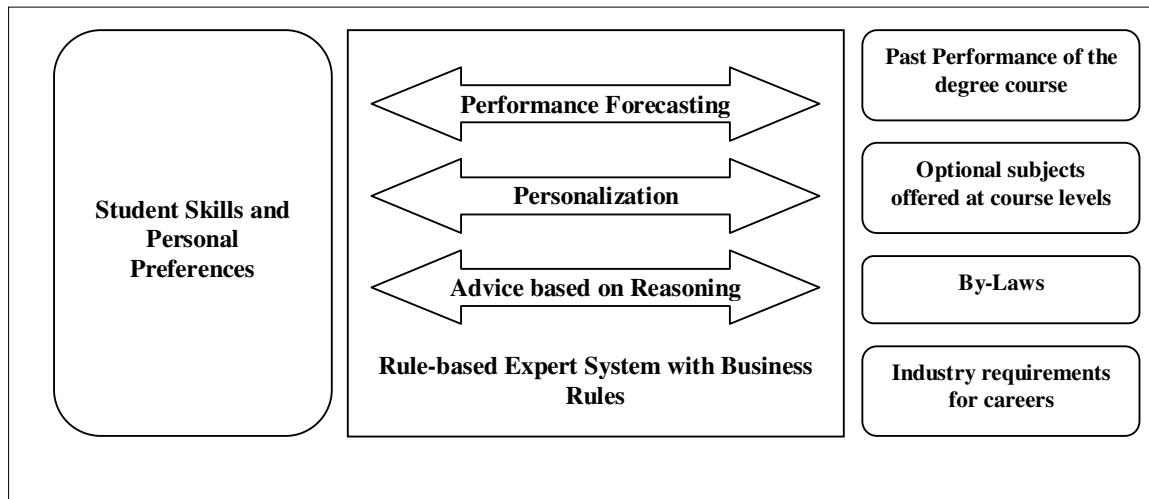
Figure 1: Overview of iAdvice

An expert system should mainly consist of three main modules as a knowledgebase, an inference engine and a user interface [2]. To facilitate this requirement, a literature survey was then carried out to find the expert system features and how expert systems can be implemented. Although there were different approaches to build expert systems in terms of knowledge representation, building the inference engine and the user interfaces, we decided to use the method of rule-based expert system methodology known as *production system* for this purpose. Further, reasoning types such as case based reasoning and rule based reasoning were considered. Most case based reasoning systems make use of general domain knowledge in addition to knowledge represented by cases [1].It was found that, rules were a popular approach to represent knowledge which can be easily expressed using logic where the reasoning process becomes less complicated; secondly easier in handling uncertainty; thirdly ability to incorporate explanations and to find alternative solutions. Rule-based expert systems necessarily operate in forward chaining and backward chaining methods. Then we also considered the possibility to build the expert system from scratch or to use available tools to make the process more productive. In this process, it was found that an existing expert system shell would be more applicable with the support to integrate with other applications and using specific knowledge representation languages to build the knowledgebase. Finally, we used forward chaining, backward chaining, and rule-based inference in designing this expert system with the use of an expert system shell which is more feasible with the time and other constraints and being more applicable to the domain.

3. Design of *iAdvice*

iAdvice has been designed in a modularized manner in order to maintain greater efficiency and maintenance. The modularized components ensure that any change required in terms of the logic being used can be easily incorporated into the system with a minimum effort. We designed the system based on three-tier architecture consisting of a Presentation Layer, Business Layer and Data Access Layer. The system has been divided into two main sub-systems according to the functional requirements.

- *Career Known Subsystem* provides advice when the student has a specific career goal. Backward-chaining is to start from a particular fact or from a query and by means of using deductive reasoning to try to verify that fact or to obtain all possible results of the query. Typically, the reasoner decomposes the fact into simpler facts that can be found in the knowledge base or transforms it into alternative facts that can be proven applying further recursive transformations [7]. Since the ultimate goal is already known in the scenario in concern, Backward Chaining was used as an approach for reasoning to determine the achievability of that goal.
- *Career Unknown Subsystem* provides advice when the student is unclear about career objectives. Forward-chaining is to start from the known facts and to perform the inference in an inductive fashion [7]. In this subsystem, the past performance and skills are identified to derive the possible career paths using the Forward Chaining reasoning.
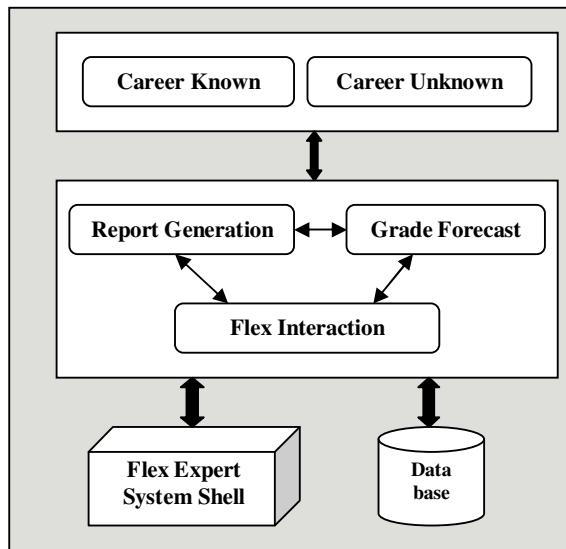
Figure 2: Top Level Architecture of iAdvice

Figure 2 shows the top level architecture of the *iAdvice s*ystem with five modules namely Career Known System, Career Unknown System, Report Generation Module, Grade Forecast Module and Flex Interaction Module which are described in detail in the next sections. From an expert system point of view, the Flex expert system shell's knowledgebase and the database served the purpose of the entire knowledgebase, whereas the inference engine was implemented with both the Flex's inference engine combined with business logic layer and the user interface being provided at the higher level for both Career Known System and Career Unknown System.

3.1. Career Known Subsystem

The main functionality of this subsystem is to indicate whether the user is capable of achieving his/her career goal and to provide advice on the subjects that the student should take up in the next level. It also provides advice on areas to improve to get better performance.

3.1.1. Career Known Module
This is the main module specific to the Career Known Subsystem and the process is described as follows.

- The eligibility criteria for the student to continue into the Honors Degree program is checked, by checking if the student has a GPA (Grade Point Average) of above 2.7. When the career is chosen by the student, this module would first fetch the subject categories which belong to that career
- For each of the subject categories the predicted value for the next level will be determined by using the Grade Forecast Module

- For each of the subject categories the career value for the future level will be determined by using the following formula

  Category Career value =
  *   Predicted Category Value ***
  *   Category Career Weighting*

- The Benchmark Limit for each of the categories will be also be calculated by considering career weightings applying for each of the categories in order to determine the subject categories the student needs to improve in the future.

  Benchmark Limit =
  *(Maximum GPA + Minimum GPA to Pass)/2 ***
  (Category Career Weighting)

- The subject categories which are below the Benchmark Limit will be sent to the Flex Interaction Module in order to retrieve the relevant Category Advice. By adding the individual Category Career Values, the overall Career Value will be calculated.
- The difference between the maximum Career Value which is 4.2 and the actual Career Value will be sent to Flex Interaction Module in order to retrieve the relevant Career Advice. Then it executes the generation of the detailed Career Evaluation Report by sending the datasets on performance, evaluation and advice subjects to the Report Generation Module

3.2. Career Unknown Subsystem

The main functionality of this subsystem is to provide advice on the possible careers for the student by analyzing the past performance as well as the student's interests and skills.

3.2.1. Career Unknown Module
The process of this module has several steps. The major steps are listed below.
- The eligibility criteria for the student to continue into the Honors Degree program is checked, by checking if the student has a GPA of above 2.7
- For each career, the subject categories should be retrieved and for each of the subject categories the predicted value for the next level will be determined by using the Grade Forecast Module
- For each of the subject categories the career value for the future level will be determined by using the same formula used in the Career Known module
  - By adding the individual Category Career Values, the overall Career Value will be calculated for each of the careers

- By using minimum career value of 2.0 the careers which have a Career Value above that limit will be chosen
- For all the chosen careers, selected on performance basis, the specific questions for the career which inquire student's interests as well as other skills required for the career will be retrieved by using the Flex Interaction Module. All the questions will have answers as either "Yes" or "No".
- The Response Ratio for the questions of each of the careers will be calculated as follows.

  Response Ratio =
  No: of positive answers / Total no: of questions

- The Careers which have a Response Ratio of more than 50% will be filtered as the final set of possible careers.
- The generic skills required for the final set of careers will be checked with the user in the form of questions. These questions will be retrieved by using the Flex Interaction Module's Question for Careers sub module. According to the Response Ratio of the Generic skills appropriate advice will be given to the user.

- For each of the chosen careers a Performance Ratio will be calculated using:

  Performance Ratio =
  Career Value / Maximum Career Value

- By considering both the past performance and the qualitative aspects in terms of skills and interests, overall probability of achieving each of the possible careers will be calculated. The careers would be ranked according to the results and advice would also be given accordingly.

  Career Performance Probability =
  Career Performance Ratio / Total Performance Ratio for possible careers

  Career Response Probability =
  Career Response Ratio / Total Response Ratio for possible careers

  Overall Career Probability =
  ((Career Performance Probability +
  Career Response Probability)/2)*100

3.2.2. Grade Forecast Module

The module is required by both the career known and career unknown subsystems to calculate the values for the respective subject categories based on the past performance of the students and to determine the most realistic future performance on a linear regression basis. The functions of this module are described in detail as follows.

- To calculate the value for a given category for each of the past levels of the student
- To predict the category value for a future level by analyzing the trends of the past performance for that category
- To save all the category values derived for each level in the database so that a graph could be plotted to visualize the situation
- Determines the current level of the student based on the Category Code and the Student ID and then for each level, the Category Value is calculated by considering the credits and the GPA achieved for each of the subjects in the respective level which belongs to the particular Category.
- Once all the category values are calculated for each of the past levels the average slope is derived, which is then used to predict the slope up to the next level.

3.2.3. Flex Interaction Module

The main responsibility of this module is to interact with the Flex Expert System Shell by providing input and passing the result derived by the inference engine back to the module which requested it. According to the type of advice given the Flex interaction could be further decomposed into three sections as:

- Career Advice

The difference between the maximum value and a student's actual value for a respective career will be calculated and passed on to the Knowledge Specification language file. According to the inference rules, student's performance will be evaluated and as the result the appropriate advice would be sent back to the student from the Flex engine.

- Category Advice

The categories of a particular career which have values less than the benchmark limit defined will be sent as the input and using the inference rules it will advice on the subjects that the student should improve, in order to get better results.

- Questions for Careers

When a single career of a career combination is provided according to the inference rules the system would return the suitable questions for the provided input, in order to conduct a qualitative analysis regarding the skills and interests of the student.

3.2.4. Report Generation Module

This module facilitates the students to get the advisory details and the past performance details in a comprehensive format along with tabular and graphical representations. There are two main reports generated by this module.

- Career Evaluation Report

This report contains a performance evaluation of the student for a chosen career and it is generated by both subsystems. The Career Evaluation Report has been divided in to three sub sections namely Performance Graph, Performance Evaluation and Subject Advice. Performance Graph section includes a line chart indicating the predicted and past category values for each level for the categories belonging to the chosen career. Performance Evaluation section shows the future values derived for each of the categories used in arriving at the final advice including the Performance gap. The section on subject advice is where the student is given advice on the subjects he/she should select in order to be in line with the career goal and also the subjects which the student needs to put more effort in order to improve, in the case of having a value lower than the acceptable performance gap.

- Career Choice Evaluation Report

This report contains a performance evaluation and an evaluation on skills and interests for the possible set of careers for the student. This report provides the rationale behind the selection of possible careers and it is generated by the Career Unknown subsystem. First sub section contains a line chart indicating the Category Values for each level for the categories belonging to the selected set of careers. The section on Performance & Skill Evaluation contains the Performance ratio and the Response Ratio for each of the careers and ranks them according to the derived overall probabilities and also contains the advice on which career is best suited for the student.

4. Implementation of *iAdvice*

The system has been broadly categorized into two sections for the purpose of implementation, being;
- Implementation of the expert features
- Implementation of the business logic

The core functionality of this system is to give customized advice to all its users depending on their performance and career preferences. The knowledgebase and the part of inferencing are implemented through the Flex Intelligent Server. The business logic for the inferencing and the user interfaces of *iAdvice* we used Visual Basic DLLs(Dynamic Link Libraries) and Standard Executables. In addition, the reports are created using Crystal Reports 8.5, which is integrated with the

Visual basic DLLs through the references namely Crystal Data Object, Crystal Reports 8.5 ActiveX Designer Runtime Library, Crystal Reports 8.5 Standard Wizard Library, Crystal Report 8,.5 Library and Crystal Report Viewer Control.

4.1. Implementation of the Expert Features using Flex Intelligent Server

iAdvice has to interact with the expert system shell to retrieve appropriate advice to the students regarding various aspects, like the subjects that the student should improve on, whether the student is in-line with his/ her career goals, generating questions on the fly to find the student preferences and skill levels based on a customized manner for each and every student, etc.

Flex supports frame-based reasoning with inheritance, rule-based programming and data driven procedures fully integrated within a logic programming environment, and contains its own English-like Knowledge Specification Language (KSL) [9]. The expert system's knowledgebase was implemented using KSL for defining rules, frames, procedures, etc. The KSL enables developers to write simple and brief statements to handle the expert domain and produce virtually self-documenting knowledge-bases which can be understood and maintained by non-programmers. The knowledge-base comprises of frames, actions, rule-sets, rules and groups. The knowledge-base of our expert system contains three KSL files containing three types of different information namely:

- careeradvice.ksl
- subjectCategoryAdvice.ksl
- questionGroups.ksl

    "careeradvice.ksl" contains advice on whether the student is in-line with his/ her career goal. The difference between the calculated final weighted average performance value and the upper limit of the value specified as 4.2 is sent to the expert system, which will in turn make the decision whether the student is in-line with the goal and then accordingly provide an appropriate advice to the student. The action of the knowledge-base will receive the value of the difference, and then using the forward chaining engine the appropriate rules will be fired, and finally a suitable advice will be given to the student. A code snippet of the "careeradvice.ksl" is shown in Figure 3.

frame studentAdvice;
default value is 0.0
and default advice is unknown.

rule advice_type_1
  if studentAdvice`s value =< 0.5
  then advice of the studentAdvice becomes 'You have performed extremely well. Good luck in achieving your career goal '.
rule advice_type_2
   if studentAdvice`s value =< 1.5 and studentAdvice`s value > 0.5
   then advice of the studentAdvice becomes 'You have a high probability of achieving your career goal if you work hard at it '.
rule advice_type_3
   if studentAdvice`s value > 1.5
  then advice of the studentAdvice becomes 'You need to improve a great deal to be successful in your career '.

Figure 3: Frames and Rules in "careeradvice.ksl"

"questiongroups.ksl" will determine the type of questions that should be asked from the student, in turn to determine the career path of a student, who does not currently have a career of choice. The knowledge-base contains a vast amount of questions, and from these questions the expert system will dynamically decide on what kind of questions should be asked from the particular student, according to his/ her previous answers. The questions are grouped according to career paths and all the possible combinations of career paths and a small section of such implementation is shown in Figure 4.

group '1,2,3'
'Are you good in leading teams?',
'Are you comfortable when working in teams as compared to individual work?',
'Are you willing to share your learnings among team members?'.

group'1,3,4'
'Can you guide others and give assistance?',
'Are you good in problem solving?',
'Do you have analytical skills?'.

Figure 4: Implementation of the Question Bank

"subcategoryadvice.ksl" will determine the subjects that the student should perform well in the following year, in order to be in-line with his/ her career goal. All the subjects are categorized into different groups

in the KSL file and then the rules define which subjects to be advised based on the values passed from the business logic layer, which is shown from a part of the KSL file in Figure 5.The expert system advices the students on which subjects that he/ she should concentrate more on the following year. This advice is only given to the students that are not in-line with their career goal.

…………………………………
group 'MTH'
' Computational Mathematics '.
group 'CSC'
' Embedded Systems ',' High Performance Computing ',' Human Comuter Interaction '
group 'DOM'
' Bio Informatics 2 '.

group subjectCategory
'MGT','NET','DBS','MUL','AIS','MTH','CSC','DOM','PRG'.

rule categoryAdvices
if X is categoryAdvice`s name and X is any subjectCategory
then subjects of the categoryAdvice becomes all X.

group rules_group
categoryAdvices.

ruleset validate_category_advice
contains rules_group;
update ruleset by removing each selected rule

Figure 5: Section of subjectcategoryadvise.ksl

4.2. Implementation of the Business Logic

The business logic of the system is implemented through five classes namely *CareerKnown.cls*, *CareerUnknown.cls*, *FlxInteract.cls*, *GradeForecast.cls* and *Utility.cls*.
AdvisoryBusinessLogic.dll is the main component of *iAdvice* which takes care of the activation of the initial entry points. In the Career Known system, it executes the *GetCareerAdvice()* method in the *CareerKnown Class*. This method gets all the Subject Categories belonging to the Career chosen by the user and then calculates the predicted value for the next level. The subject categories and the level of the user are retrieved from the database using the *UtilityData class*. The predicted value for each of the subject categories is calculated using the *GradeForecast class*. Then the *FlxInteract class* gets relevant advice for weak subject categories and according to the past performance from the Flex Intelligent Server.

Career Unknown System is implemented in such a way that *GetPossibleCareers()* method in the *CareerUnknown class* of the A*dvisoryBusinessLogic.dll* is used to determine the careers which the user can attempt according to the past performance. This is done by determining the career value for all the careers in the system and selecting the careers which have the career value above a specified limit. The required data such as the careers and the subject categories and their information for each of careers are retrieved from the database using the *UtilityData class* in the *AdvisoryDataAccess.dll*. The predicted value for each of the categories is found using the *GradeForecast class*. The Grade Forecast Module initiates the Report Generation Module to make reports on the fly through the datasets which are passed to the Crystal Report object. The retrieval of data for the creation of reports is implemented in the *ReportData class* in the *AdvisoryDataAccess.dll*. Sub Reports are also attached to the main report as on-demand reports so that the user could drill down to detail level, if required.

5. *iAdvice* in Practice

iAdvice is presented to the user as a stand alone system with simple user interfaces to interact with the system. This provides the users an easily navigable and understandable process which actually hides the complicated logic and expert system functionalities at the back end from the user.

The user's entry point to the system is through a login screen. If the user hasn't registered with the system it provides the facility for the user to register. When the registration is completed a trigger is activated to get student grade information to the local student database from the universities main database where student grades are being stored. Figure 6 is a screen shot of the main user interface that a user sees while accessing the system.

Once logged into the system, it is directed to the next personalized screen which asks the question "Have you decided on a career path?" which determines what subsystem to be implemented. If the user chooses "Yes" option button it executes the Career Known subsystem or else it executes the other subsystem which is the Career Unknown subsystem. If the user opts for the career known option, then a screen will appear showing all the possible career paths available for the user to select. When the "Get Advice**"** button in the above screen is pressed after the selection of a particular career, the system executes the relevant modules to calculate the predicted value for the next level.

Figure 6: Log in Screen of iAdvice

Using the predicted value for each of the categories a predicted value for the entire career is calculated using a formula specified in the Design Specification, and then it uses Flex interaction module to get the appropriate advice for the user. After all the calculations and appropriate advice is acquired, the final summarized advice is displayed to the user as shown in Figure 7. The advice consists of eligibility of the student to do the special degree, the current SGPA of the user as well as whether the user is in a position to meet the career goal with the current performance level. It also states what subjects to put more effort at the next level to achieve the career goal if the user has under performed in the past on some of the subject categories. By pressing the "View Details" button on the screen the user can get a system generated detailed report on the performance and the justification for the advice.

At the initial point where the system inquires the student as to whether he/she has already determined a career goal, and if the student states "No", then the system proceeds accordingly. *iAdvice* advices on the careers which the user can attempt according to the past performance. This is done by determining the career value for all the careers in the system and selecting the careers which have the career value above the limit. The required data such as the careers and the subject categories and their information for each of the careers are retrieved from the database and are calculated wherever necessary.
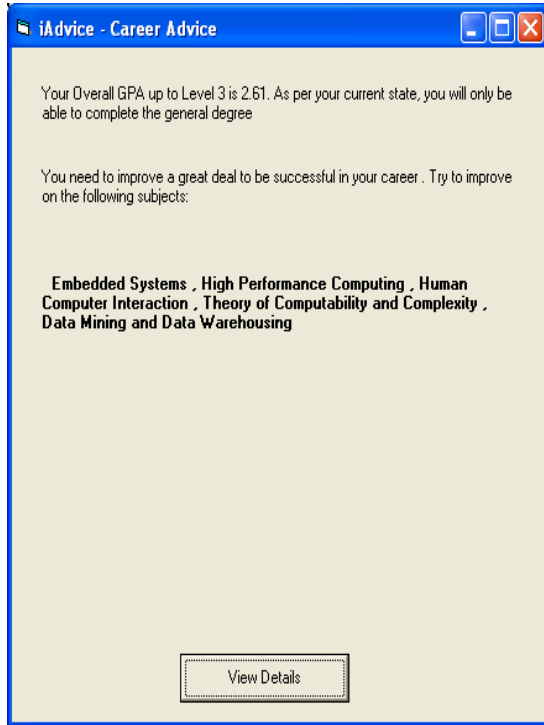
Figure 7: Customized Advice Screen

Once the possible careers are determined the user is prompted with several questions in order to determine user likings and skill level. The expert system will provide the questions relevant for the careers identified by inferring the knowledgebase. The questions will be displayed in the another user interface as shown in Figure 8 and by pressing the next the user could answer all the questions in terms of Yes/No.
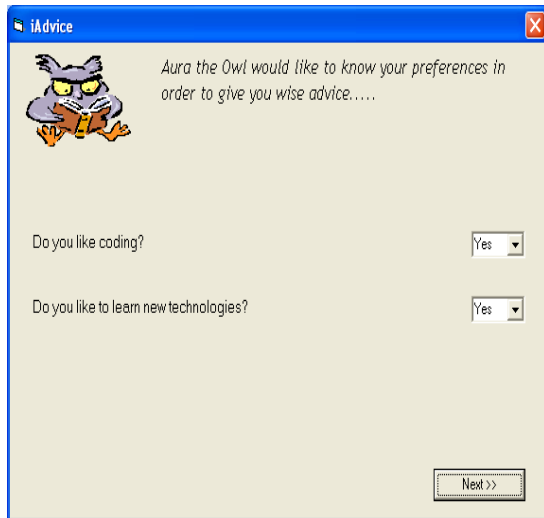

Figure 8: Screen for Questions on Skill Evaluation

According to the responses given, Response ratio is calculated. Using both performance ratio and the response ratio the probability of success is determined. Based on the overall probabilities, the relevant advice is given in a summarized form in the next screen shown in Figure 9. This advice consists of eligibility of the student to do the special degree, the current SGPA of the user and the probabilities of suitability of the possible careers for the user. This interface provides the user to view two sets of reports named as Individual Career Report and Detailed Career Report.

The Individual Career Report would generate a report containing the Performance Evaluation for a chosen career out of the recommended list of careers. This is the same report generated by the Career Known Subsystem which contains the line chart of the user's performance, Performance Evaluation and the Subject Advised along with relevant advice for the user on the considered career. The Detailed Career Options contains a sub report which contains the Performance, skill level of the user for each of the careers and the probability derived accordingly.

Figure 9: Screen providing Possible Career Options and Advice

Once the user has got all the advice that is required, the user can log out of the system. If the user requires more up to date advice, he/she can reuse the system whenever it is needed and *iAdvice* will always give the most appropriate advice based on the changes being made to the grades or due to the access to more recent student performance.

6. Evaluation

In order to assess the functionality of *iAdvice*, an evaluation was held which considered 30 students as sample data. Accordingly the students were given an evaluation form which covered a range of criteria which the model considered, in order to evaluate whether the advice and the guidance given by the expert system matches the user profile. The criteria considered in the evaluation form are shown below.

- Predicted Performance and actual capability
- Conformity of subjects suggested
- User capability and preference for careers proposed by the system
- Ranking of careers
- Rating of the overall system

According to the results of the evaluation, there was positive feedback for the system from all viewpoints as depicted in Figure 10. 81% students agreed that the predicted performance values reflect a true possibility according to their capability. However, there were also a few students who thought that they are capable of performing better in certain categories than predicted. 18% of the students felt that the system was reflecting over-performance than actually within their capability limit due to the side-effect of using past exam grading, and psychological impact of the users.
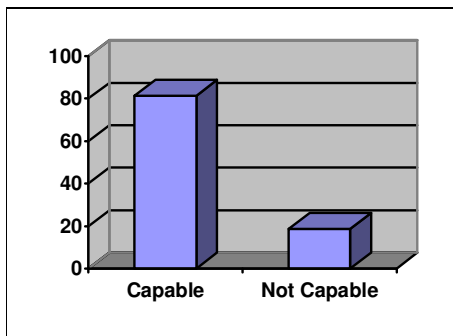

Figure 10: Capability in performing well in all of the proposed careers

When the user did not specify a career path, the system was able to specify a list of probable careers in line with user likings and capabilities every time, and out of which around 70% assured that the order

specified were also accurate. The evaluation of the accuracy and compliance of ranking of the possible careers showed that about 60% of the time it is almost truly in line with the student expectations whereas 40% of the time the ranking differed with the same set of careers which is graphically shown in Figure 11.
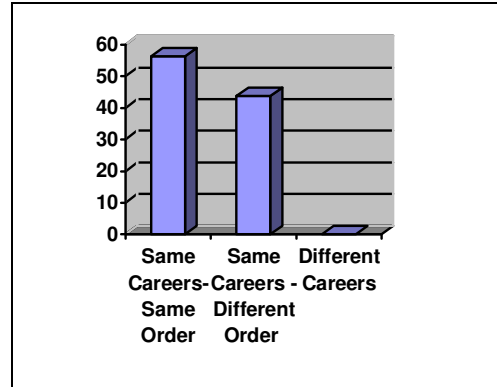

Figure 11: Comparison of the actual preference of careers with the predicted careers

It was evident that most students found this as a useful system to find which career is more suitable as well as subjects that need to be focused to achieve the career goal. Around 85% were impressed with the reporting facility which gave a comprehensive view of once performance as well as a rationale for the advice provided. Table 1 shows the factors given to the students in evaluating the overall system rating which is the final criterion considered in the evaluation form.

Criteria	Good (%)	Medium (%)	Bad (%)
Usefulness - Career	87.5	12.5	0
Usefulness - Subjects	75.0	25.0	0
Relevance of Advice	87.5	12.5	0
Reports	87.5	6.25	6.25
Coverage of Factors	62.5	37.5	0
Overall System	87.5	12.5	0

Table 1: Overall System Evaluation

7. Conclusion

This paper has reported on *iAdvice*, the Career Advisory Expert System as a supportive tool to the students in determining their future career paths and consistently be in line with their career goals.

We have reported on the approach taken for the development of the expert system, the design, implementation and the user process of using *iAdvice*. This system has been developed by targeting the undergraduates of the Faculty of Information Technology of University of Moratuwa. However, *iAdvice* can be used for the purpose of providing effective career advice to any student, with little customization. It can even be useful for the secondary education system, where school students can be guided to be inline with a future career goal from the early stages itself and can also be used as a general career guidance expert system with some modifications to the knowledgebase to suit the particular requirements.

The evaluation of the system has been conducted using a sample of 30 undergraduates and it has been found that the system is quite successful. 81% students agreed that the predicted performance values reflect a true picture of their actual capabilities. Compliance of ranking of the possible careers showed that about 60% of the time it is truly in line with the student expectations whereas 40% of the time the ranking differed with the same set of careers. With regard to the overall system, around 85% provided positive feedback. Therefore, we conclude that *iAdvice* can be effectively used as a career advisory expert system to be used by any student. We wish to point out that this system can also be used by career guidance counselors as a supportive system in providing advice. By doing so, they can have more access to information from various sources such as past examination details and industry requirements while ensuring that the quality of the advice is improved.

Further work of this project includes making it available as a web application, enhancing the system as a customizable solution to suit any educational institute requirement and incorporating Natural Language Processing (NLP) features. By introducing NLP to *iAdvice*, it will increase the usability of the system since it is believed that the effective use of language is intertwined with human general cognitive abilities [6].

8. References

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