



EXPERT SYSTEM FOR SELECTION OF RESEARCH AREA IN ACADEMIA

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ABSTRACT

Research is an essential component in the career of academicians. As per informal discussion with students looking to pursue academic research, it is found that selection of research area and research topic is one of the most difficult phases. Moreover, many research supervisors also find it difficult to suggest appropriate research area or topic to the students. The process of finalizing area of research as well as topic of research is very confusing and time consuming activity. To simplify the task of supervisors and research seekers, an expert system is developed which assists the user to finalize the research area and topic in the field of computer science and application. This paper focuses on the expert system for assistance in analysis of the user responses to the questionnaire asked by the system, to suggest the most suitable research area to the user. The expert system is implemented as a component of a decision support system being developed for selection of research topic and prevention of plagiarism.

Keywords: Expert System, Knowledge Base, Inference Engine, Forward Chaining, Decision Support System

INTRODUCTION

An expert system is a computer based system which emulates the ability of decision-making of a human expert. [2]

An expert system is divided into two disjoint components: (i) inference engine and (ii) knowledge base. The knowledge base represents facts and rules. The inference engine applies the rules to the facts which are known to produce new facts. [3]

This paper explains the research work done to design and implement an expert system to assist in decision making for selecting an appropriate research area. The system provides a user interface, which is a questionnaire containing 20 questions. There are three categories of questions: (i) to know attitude and aptitude of student towards various types of researches (ii) to know the area of interest of student (iii) to know the interest of student in inter disciplinary research. Based on responses given by student, the inference engine generates output. The output is the suggestions to the student in textual format. The student may decide area of research based on this output or can reappear in the questionnaire for more clarification.

SCOPE OF THE SYSTEM

The expert system for assistance in selection of research area in academia is a component of a model of decision support system for research topic selection and prevention of plagiarism. [1] The parent system is for

assistance in making choice of research topic for research in academia. The model of parent system is based on the combination of the approaches of decision support system and web mining to finalize the most suitable area of research for the student.

The model of parent system and place of this expert system in the model is as shown in figure 1. [1]

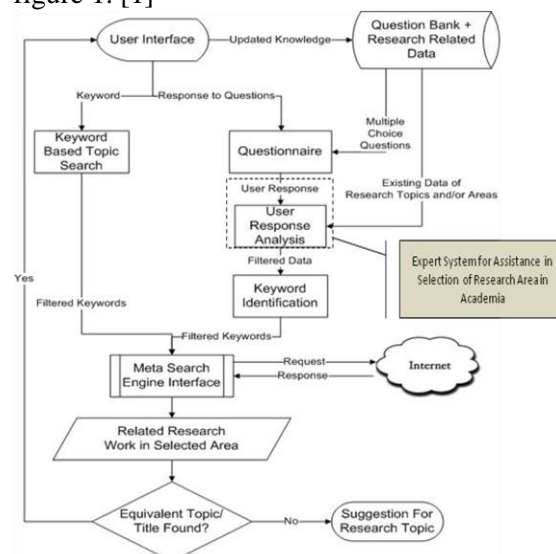


Figure 1: Relationship between the expert system and its parent system

The dotted rectangle highlights the component of the model which is implemented as an expert system for assistance in selection of research area in academia.

Thus, the developed expert system is a subsystem, whose output, in textual format, is consumed by the parent system to generate the final output which is the suggested research topic.

LITERATURE REVIEW

There is an ample of work done on expert systems in various fields, but if one has to consider the expert systems in the area of selection of research topics in academia, much work is not found.

Li Yu, Jie Yang, Dong Yang, and Xiaoping Yang have described a research topic decision support system to help a user to quickly find suitable research topic based on iteratively paper recommendation .[1]

A framework and model of a Decision Support System (DSS) is presented by Iyigün, M. Güven, as a tool to help choose projects using complex criteria such as risk, cost, decision hierarchies, and budget objectives. [1]

A research work is carried out and hosted in Purdue University, Indiana in the field of selection of research topic in the area of computer science. Name of the tool is “A CS Research Topic Generator” or “How To pick A Worthy Topic In 10 Seconds”. [1]

The study is also done of websites of the of Massachusetts Institute of Technology, University of Buffalo, and University of Illinois Urbana-Champaign for guidelines of research topic selection. [1]

In nutshell, after conducting review of literature thoroughly it is found that there are many systems which guide the students for selection of research topic, but none of these systems provide an expert system for decision

making in selecting a research area and research topic.

SCOPE OF RESEARCH

Academic research faces many challenges. One of the prominent challenges is the first step of research, that is, selection of the area of research. Many students who are desperate to conduct research face trouble in deciding the area of research. Especially, in the field of computer science where industry is giving tough competition, finding area of research is really a confusing job.

Same challenge is faced by supervisors. They are expected to guide the student in the selection of area of research. If the supervisor is not aware of attitude and aptitude of a student towards various areas of computer science, it is really very difficult to suggest the suitable choice for the candidate.

Thus, there is a need of a system which can assist the students to decide the area of research that is suitable to his/her personality.

MODEL OF THE SYSTEM

The system consists of two components, (i) user interface and (ii) user response analysis as shown in figure 2.

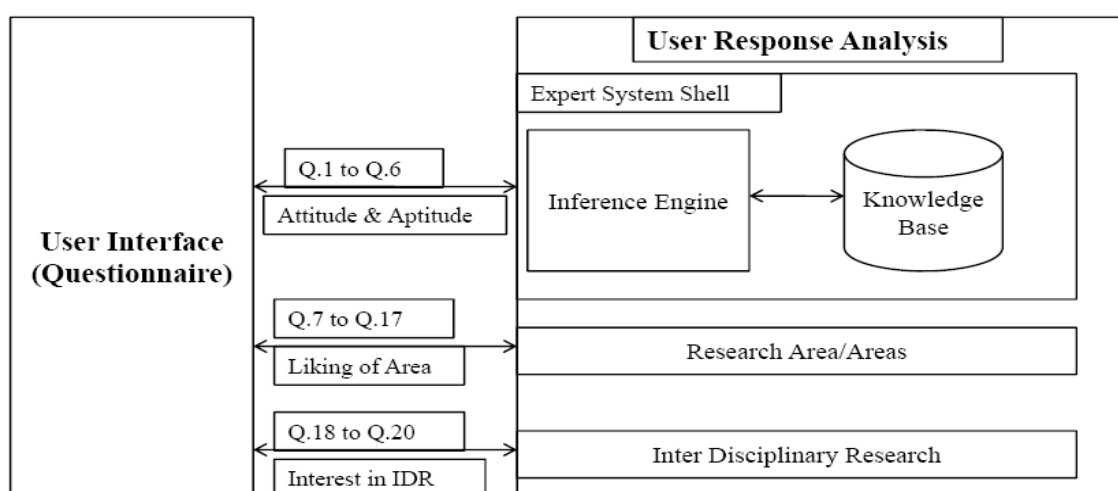


Figure 2: Model of the Expert System for Selection of Research Area in Academia

5.1 User Interface:

The user interface collects input from the user. The user interface has a questionnaire consisting of 20 multiple choice questions. Among these questions, first six questions fetch information about attitude and aptitude of the student towards the research areas mentioned in the knowledge base. Questions 7 to 17 asks student about his/her willingness to work with the various areas of research at certain level. That is, if he/she is interested to work with the particular area of research or not. If yes, then whether it is the area of research in which student wants to work or

he/she wants to use applications of that research area. Questions 18 to 20 collect the information about the willingness of the student to work with inter disciplinary research areas. The structure of questions and multiples choices for the same are based on knowledgebase. The knowledgebase is created after conducting personal interviews and discussions with the eminent professors of the reputed universities of Gujarat like The M. S. University of Baroda, Saurashtra University, Sardar Patel University, and Uka Tarsadia University. The questionnaire based on knowledge base is shown in Table 1.

Table 1: Structure of Questionnaire based on the Knowledgebase

Questionnaire Based on Knowledge Base					
Q. No	Question	Option A	Option B	Option C	Option D
1	Which was your favourite type of subjects during your post graduation study?	Analysis and Design of Algorithms/Protocols for various Processes	Low Level Programming/Design of Compilers/API	Theoretical Computer Science/Software Engineering	Window/Web Application Development
2	Which type of research work would you like to carry?	Development of a system which is directly applicable to solve a problem	Development of a model/conceptual idea which can be used to solve a problem	Comparative study of existing models/systems to find most suitable one to solve a problem	Development of a system which could be a sub-system of existing system
3	How good are you at programming skills?	Poor	Average	Good	Excellent
4	How good are you at designing new algorithms?	Poor	Average	Good	Excellent
5	How good are you at analysis of existing system?	Poor	Average	Good	Excellent
6	Which method of learning do you like the most to understand any concept/topic?	Reading Books	Online Tutorials	Reading Journals	Reading Magazines
7	Up to which depth would you like to work on Digital Image Processing and Analysis?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
8	Up to which depth would	Would not like	May use	Would like to	Would like to

	you like to work on Artificial Intelligence and Machine Learning?	to work on	applications of it	work in depth	know about this area
9	Up to which depth would you like to work on Compilers/Interpreters/Assemblers?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
10	Up to which depth would you like to work on Software Engineering/Process Design/Process Model Design/SDLC Phases?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
11	Up to which depth would you like to work on RDBMS/Big Data/Data Warehousing/Data Mining/Data Analytics ?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
12	Up to which depth would you like to work on Web Searching Techniques/Search Engine Optimization/Web Crawlers/Optimized Searching?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
13	Up to which depth would you like to work on Voice Processing/Natural Language Processing/Text to Voice/Voice to Text?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
14	Up to which depth would you like to work on Cloud Computing/Fog Computing/Internet of Things?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
15	Up to which depth would you like to work on Embedded Systems/System Software/Assembly Programming/Operating System Design/Process Design?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
16	Up to which depth would you like to work on Network Design/Routing Algorithms/Network Protocols/Networking Models?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
17	Up to which depth would you like to work on Decision Support	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area

	Systems/Management Information Systems/Business Process Analysis?				
18	Up to which depth would you like to work with other Electronic/Electrical/Mechanical devices?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
19	Up to which depth would you like to work on Applications of Computers in other fields as Agriculture/Food Processing/Production/Commerce/Arts/Music/Archaeology/Areas other than Science?	Would not like to work on	May use applications of it	Would like to work in depth	Would like to know about this area
20	Up to which extent would you like to work with experts from other disciplines?	Would not like to work with	Would like to take a little help	Would like to work	Would like to use outsourcing service from experts

5.2 User Response Analysis

The key sub component of user response analysis is inference engine. The inference

engine works in a forward chaining mode. It collects facts in terms of user input and generates the output. The model of inference engine is shown in figure 3.

User's Answer for Question 1	Test Condition and System's Output
A	<p>Test Condition: <div style="display: flex; align-items: center; gap: 5px;"> 1A AND 2A AND 4C OR 4D AND 5C OR 5D AND 6A OR 6D </div> </p> <p>System's Output: Development of a new model of a system OR conceptual idea which can be used to solve a problem (Strongly Recommended)</p>
B	<p>Test Condition: <div style="display: flex; align-items: center; gap: 5px;"> 1B AND 3C OR 3D AND 6B OR 6D AND 18C </div> </p> <p>System's Output: Machine Level Programming OR Design of Compilers OR Robotics OR API development (Strongly Recommended)</p>
C	<p>Test Condition: <div style="display: flex; align-items: center; gap: 5px;"> 1C AND 5C OR 5D AND 6A OR 6C </div> </p> <p>System's Output: Theoretical Computer Science OR basic concepts of Software Engineering (Strongly Recommended)</p>
D	<p>Test Condition:</p>

	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">1D</div> <div style="border: 1px solid black; border-radius: 10px; padding: 2px 5px;">AND</div> <div style="border: 1px solid black; padding: 2px 5px;">2B OR 2D</div> <div style="border: 1px solid black; border-radius: 10px; padding: 2px 5px;">AND</div> <div style="border: 1px solid black; padding: 2px 5px;">3C OR 3D</div> <div style="border: 1px solid black; border-radius: 10px; padding: 2px 5px;">AND</div> <div style="border: 1px solid black; padding: 2px 5px;">5C OR 5D</div> <div style="border: 1px solid black; border-radius: 10px; padding: 2px 5px;">AND</div> <div style="border: 1px solid black; padding: 2px 5px;">6B OR 6D</div> </div>
	<p>System's Output: Window OR Web based Application Development in suitable areas (Strongly Recommended)</p>
	<p>Test Condition: (Default Case) If none of the above condition matches</p> <p>System's Output: System does not recommend anything strongly but suggests as per choice of Q.1- A,B,C, OR D and the decision is based on answers of questions 7 to 20</p>

Figure 3: Model of Inference Engine

The output generated by inference engine will guide the student towards his/her aptitude regarding respective subject. For example, if the student has selected option 1- B which is low level programming or development of system software, but he/she has not selected 3- C or 3-D which means he/she is not having good programming skills, the system will not suggest him to carry research in the area of intensive programming. The decision will be based on his choices for questions 7 to 20, and student can think for other three options for question 1 in the area of his choice.

From question number 7 to 17, as shown in table 1, the user can select his favourite area of research. There are four possibilities student can go for; (i) If student selects first option for any of the questions, then that option is discarded from the list of areas for suggestions. (ii) If student is strongly interested in the area, then that area is added in the list of suitable areas of research and the output is merged with the results of inference engine. (iii) If student wants to use just an application of that area or (iv) want to know about that area then that area of research is

added as keyword in the final result, to search for.

Questions from 18 to 20 fetch the willingness of the students to work on interdisciplinary area of research.

The output of these components are merged to generate combined output to be sent to user interface, where student can read the analysis performed by the system. Furthermore, the same output will be processed by “Keyword Identification” module of the parent system as shown in figure 1, to identify keywords from the text generated.

RESULTS

The model shown in figure 2 is implemented in C#.NET. The system has generated output as expected and mentioned in section 5 of this paper. Figure 4 demonstrates the result obtained by the system. One can observe both, (i) structure of questionnaire by looking at question and its multiple choices and (ii) the analysis of the responses of student to these questions.

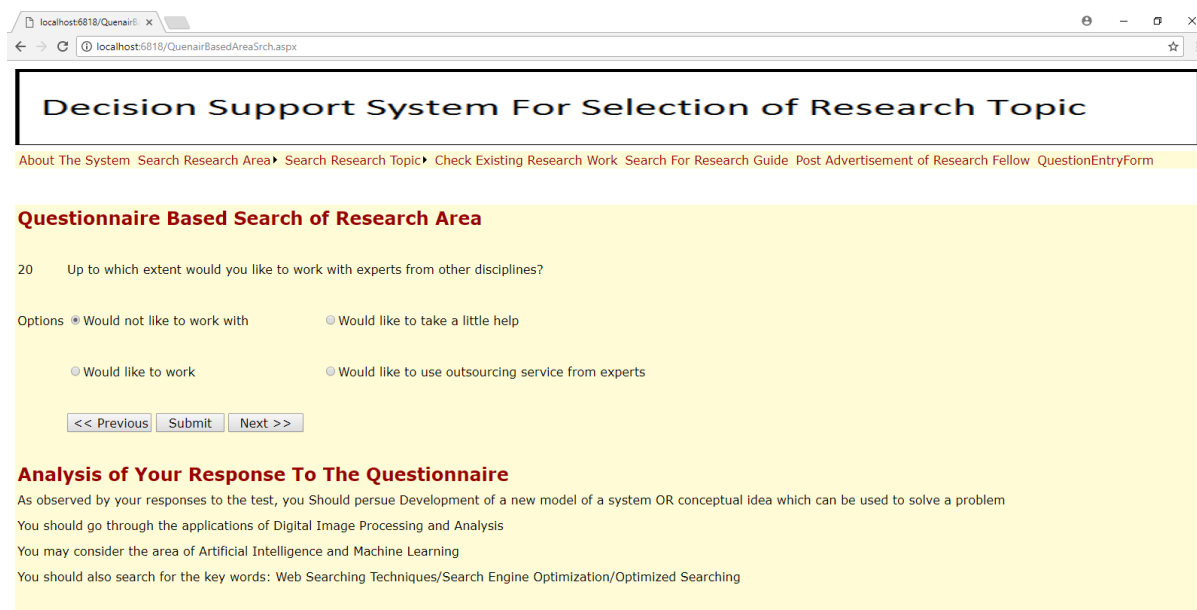


Figure 4: Output Generated by the Expert System for Selection of Research Area in Academia

CONCLUSION

Selection of research area and research topic is very crucial activity for a student opting for academic research. To assist the student in this intellectual task, a model of decision support system for selection of research topic is proposed. The expert system for assistance in selection of research area in academia is a component of the above mentioned decision support system. The working model of this expert system is explained and the results are presented. The analysis generated by the expert system is easy to understand for the student. Furthermore, the keywords can also be identified for further processing. Thus, the newly designed expert system is usable.

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