An Automatically Generated Computer-Assisted Question-Answer System to Acquire Knowledge.

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Abstract

This paper illustrates a progressive work done to implement a smart computer-assisted question-answer system, which combines different AI tools and techniques. The system is being implemented to overcome the problem raised if program developers insufficiently explore the expert's domain knowledge, which result an inadequate knowledge-based system to the task of providing good advice or making informed decisions. Thus, the best way is developing a computer-assisted question-answer system that can be generalized and used by experts themselves to transfer their ideas into a series of data, rules and knowledge. The system is automatically generated, thus experts in any domain, regardless of their computer knowledge, can use it. The system combines different AI tools and techniques to accomplish the mentioned task.

Introduction

Information and knowledge are extracted by six common ways, namely, literature searches, talking with people, focus groups, personal interviews, telephone surveys, and mail surveys. Literature surveys could be the only way that doesn't involve a questionnaire (Walonick , 2000). Questionnaires, are not a series of questions to be asnswered , but it is a scientific and inexpensive instrument to gather data (Berdie, Doug R 1984), and also could be the standard method for knowledge acquisition from experts. However, the questionnaire could be the bottleneck of developing a good system, ue to the lack of knowledge from the knowledge engineer in the expertise domain, or the lack of the expert in computer experience (Zanna 1990). However, most problems with questionnaire analysis can be traced back to the design phase. (http://www.statpac.com)

The aim of this paper is to illustrate a part of a new computer-assisted question-answer system, that is being implemented in Alexandria University, Egypt, as part of a Ph.D, which can be general to be used in different domains from tests to middle-scaled expert systems, without expert interference. The system is generated by the expert itself and also may be used by the profiteer. It combines different AI tools and techniques to accomplish this task

System General Features

The system falls under the computer-generated questionnaires softwares, that is it must provide an effective method for collecting, filing, storing, and abstracting data. It must fulfill at least one of the following arguments: increase in speed, reduction of costs, and improvement in data quality. (Saris 1988).

The system like any other a computer based question-answer can be an effective method of eliciting personal and sensitive information (Millestien 1987), and increases the rate of answering to them, which many people find difficult to discuss face to face (www.computing.dundee.ac.uk/projects).

This software like any other, conducts the questionnaire in any form (e.g. surveys, interviews) with perfect memory, patience, accuracy and consistency, and higher degree of objectivity. It must be programmed to resolve inconsistencies in responses, and also can check the answer against any kind of existing knowledge that may validate or invalidate the answer. It also improves the questionnaire quality by using the automatic skipping, branching and coding, errors reduction, which reduces the expert task to the minimal, and leaves for him the social work that most probably will be done better by humans (Feriter, 1993).

System Specific Features

- Designed by experts themselves, regardless of their computer knowledge, and questionnaire design literacy.

- The system is general and can be used in different domains.
- The system is multilingual, as it allows the user to automatically control required position, the font, formats, etc…
- The system use rules method to produce results not only scores or statistics.
- The system can be used directly by the interviewee or those who have to fill in the questionnaire.
- The system uses the weighted scores not only the absolute scores.
- System can be used for tests, surveys not only as knowledge acquisition tool.
- Incomplete data are processed by statistical methods as well as AI Tools and techniques such as Data Mining, and Case-Based Reasoning.
- Default values may be variable according to statistics of respondents, or according to data mining and Case-Based Reasoning, or related to another questions.
- Default and templates screens, cover letter, data type, questions, answer or both questions and answers system are available and may be added from the user himself.
- Creation of multi-variables, which means that the same question may measure two or more variables.
- Multimedia Answers are available such as image, sounds, clips, etc…
- Checklist of good questionnaire design with related example will be provided.
- Different Sampling techniques to advice the expert if needed, according to his requirements.

System Tools

This paper illustrates different AI tools and techniques to achieve the purpose of the system. Some other tools may be added according to future works. These tools don't work apart of each other, but they closely interact. The next figure illustrates some of these tools.

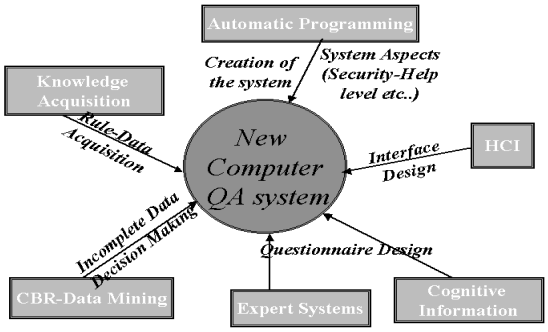


Fig. 1: The Question-Answer System Tool.

1. Automatic Programming

The system is based on the idea of automatic generation of algorithm. It will automatically generate the required questions and their answers, without writing a single code, which means that users with any level of computer literacy can use it. If the user lacks also the proficiency to design a questionnaire the system may provide him with the most suitable tools after a series of questions, which means that it doesn't only provide a flexibility of question-answer wording, but also recommends the best tool in the mentioned case. The system will automatically generate some different aspects such as the database structure, design, creation, and coding the processed rules, the possible questions and consistency checks, follow up question, branching, skipping, clarification for each question apart. Other issues concerning the overall system such as the security level, screen design and help level will also be automatically generated. An example of using the automatic programming is shown in the following screen:

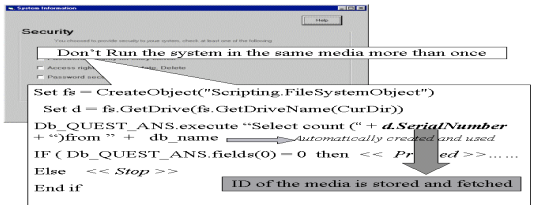


Fig. 2: Example Automatic Programming Tool.

2. Expert System

In this system, a new trend is adopted, which is using the expert system and cognitive studies in questionnaire design. The system will allow experts, who generally lack the knowledge of question-design issues, to get profit of principles of questionnaire design. Expert Systems and cognitive studies are those fields, which are concerning with the establishment of common ground and shared under-

standings that enable joint actions of both interview ‘s partners.

An example of rules used, and extracted from experts in designing computer questionnaire, is how to choose the suitable tool for presenting answers. The following example illustrates one of the simplest rules, to choose between “Option box “ & “check box “, when number of answers is equal to two.

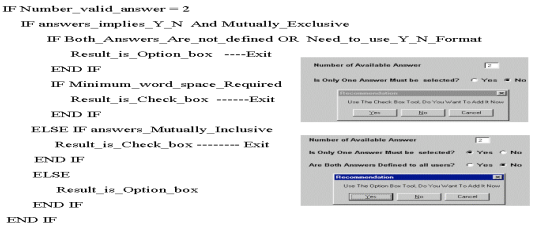
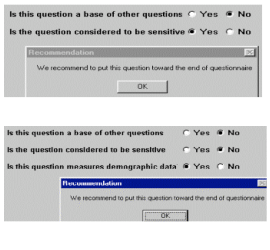


Fig. 3: An example of using the Expert System Tool.

3. Cognitive Information

There are a lot of researches concerning the cognitive studies about questionnaire design such as the researches accomplished by Schwarz (Schwartz, 1991), studying the cognitive and communicative question interpretation, and those of Redline & Dillman (Dillman, 1999) that aimed to develop principles for design about how information is perceived and cognitively processed by respondent, and also the model interpreted by Tourangeau (Tourangeau, 2000). Some of these researches are closely related to Human Computer Interaction, others deal with the respondent’s attitudes and the several tasks they perform to answer a question. Some of these issues are used as guidelines of a good questionnaire design, and are considered in the proposed system. An example of the use of cognitive studies, relating to questionnaire is shown in the following figure, which illustrates the questions that are asked to the user, and their interpretation defined into two simple rules of questionnaire design resulting from researches in cognitive sciences.



Literature surveys defining previously showed rules in questionnaire design:

•Sensitive questions should be asked towards the end of the questionnaire.

•In general, demographic questions are asked in the last part of the interview. However, it is sometimes necessary to obtain some demographic information early in the interview in order to determine how to proceed through sections of the questionnaire.

Fig 4: Example of Cognitive Information Techniques.

4. Human-Computer-Interactions

Introducing the new Human-Computer-Interaction field leads to the idea that a good computer interface including the display of information, availability, clarity and degree of consistency of design feature and system functions, will greatly affect the usability and ease of use of any computer systems including Computer-Assisted-Questionnaire. (Couper, 1999)

The planned system will fulfill a good interface design that meets the major concepts of HCI topics such as functionality, explicitness, comprehensibility, user friendly, consistency, efficiency… (Shneiderman 1992). It will give him recommendation about layout and format, and give him the possibility to design template to be used as a default of many other system. It will also give him the possibility to change the position, color, and fonts of questions, answers and instruction, and provide some recommendation when needed if colors don’t match or fonts are not clear.

The system also, may provide according to user requirements, the default format, which may provide flexibility in using date, number, currencies, logical data type, and assist the idea that the system can be used in multilingual environment.

It is planned that the system under study, will also give a high consideration to the number of question in page, according to the size of screen, and will take care of alignment, which may be considered to be one of the main problems, when designing computer-assisted questionnaire.

The one that will use the system will affect the frequency and level of the recommendation and instruction. Fewer recommendations will be provided if the designer is the same as the user, but much recommendation will be given if the designer and the user are different. Help and instructions are few if the user is the designer himself, much more if it is an entry clerk, and very precise if the user is the interviewee.

The following screen illustrates one of the previously discussed issues. In this example, the system provides the user recommendation about the font chosen.

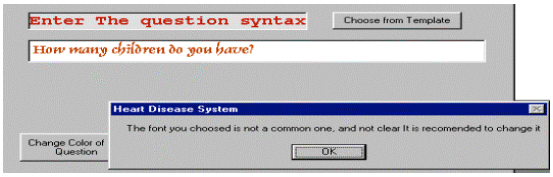


Fig 5: An example of using the HCI Tool.

5. Knowledge Acquisition

It is conventional to define knowledge acquisition as the process by which system developers question experts to discover the knowledge that they use to perform a task of interest (Prerau, 1987).

The user first designs the system; it provides the systems with all needed questionnaires, and the possible outcomes or results. Variables for questions, answers and outcome are created automatically, and

also a database is created according to these variable. Derived values, default values and any other needed information are gathered.

After the user finishes the questionnaire, he transfers his expertise to a set of IF-THEN rules, according to the answer and the questions provided. This will ensure that experts will put all his knowledge in his own logical way, according to his experience. The system will also give the user the possibility to put priorities of the rules, especially when one rules is a part of another. In this way if a rule is satisfied no need to search for more ones. Scoring and weighted scores can be used as a part of the variable needed to satisfy the roles if previously mentioned by the user. Profiteers may use the system; in this way, the expert may collect data, gather information, build cases, and globally build his own knowledge base. On the other hands, these data may be used for decision support. The system provides the operator tools, and after editing the rules, they are stored in term of variables and recommendation for future assistance. However, the system may be used, so upon the data entry, the relevant recommendation if any or the closest one (according to question importance) is displayed. The next figure illustrates the first step in acquiring knowledge from the experts, and how he can use the operators. He can also ensure the correctness of the rule when displayed.

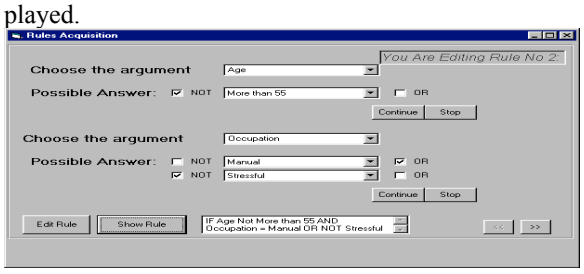


Fig 6: Example of editing Rules by the expert

6. Case-Based Reasoning & Data Mining

The above mentioned tools are used, as a preliminary choice. Other tools and techniques may be selected and used. These tools are required after the data entry by any mean. It is concerned with completing the missing data if any, the deduction of default values if required. Also they assist in decision-making, such extracting most close case, etc…This part was not yet exploited, during this phase, thus no further details is available.

Discussion

The previously discussed question-answer system will go beyond the act of information access, or data gathering, even it can be easily used for these purposes, and will be extended to work as a knowledge acquisition tool, designed by the expert themselves. It is considered to be a decision support tool besides the experience gained. It is noticed that each tool is not an isolated island, but all the tools interacting with each other to accomplish this roles. The next figure shows examples of such interaction.

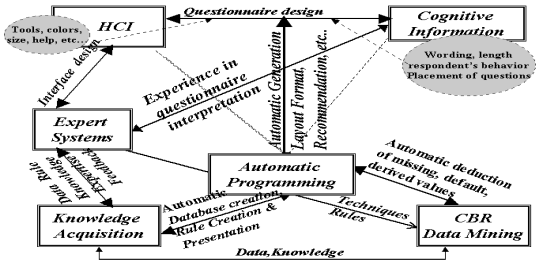


Fig 7: Tools Interactions

Conclusion

This paper defines a new computer-based question-answer system, which goes far beyond data gathering or information access to a knowledge acquisition tool that the expert himself, in different domains, can use. This system overcomes the problem of the misunderstanding that occurs between the expert and the system developer, due to the mutual lack of knowledge of each other's domain, given that the expert would have the requisite time and the required patience to answer all questions asked by the system developer.

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