

ANALYSIS OF WEB-BASED APPLICATIONS FOR EXPERT SYSTEM

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Convergence of technologies in the Internet and the field of expert systems have offered new ways of sharing and distributing knowledge. However, there has been a general lack of research in the area of creating web-based application for expert systems (ES). Our work will address the issues associated with the analysis of design, development, and use of web-based ES from a standpoint of the benefits and challenges of developing and using them. As a case study, the architecture of a Web site/application will be presented. The benefits and challenges in developing and using web-based application for Expert System will be mentioned by comparing them with traditional and existent web-based ES. Based on the gained experience, useful tips will be given on the construction of such Web sites applications.

Keywords: *WEB-based applications, expert system*

1. General

Expert systems are computer programs that are used to solve problems and answer questions in a problem domain that ordinarily requires human expertise. This goal is usually achieved by combining a logical inference engine with a knowledge base. The information in the knowledge base contains a set of known facts and a set of production rules that allow if-then inferences on the facts and other acquired information.

Expert systems are part of artificial intelligence and dynamic trend in its area, where fuzzy logic and neural networks are implemented in knowledge database of expert systems. Thus, expert systems – it is a new trend to develop expert system using soft computing in audit of information security belonging to security standards (ITIL, COBIT, ISO 2700). Firstly, little scientific research has gone into them. Generally, there is having been done some research in area of neural fuzzy algorithms. But none of them were implemented in developing knowledge database of expert systems. More over it is another way of using web based approach of implementing expert system interface.

Since research into expert systems using soft computing is fairly new, only one area will be researched.

Moreover, expert systems have been applied in a wide range of industrial and commercial problems. Typical applications include diagnosis, planning, scheduling, decision support, and process monitoring and control. There are few research have been done in this area.

Consulting companies that do an audit of Information Security always meets problem with high rotation of employers. Expert systems that will be enrolled to auditing process will help to solve this problem. In addition they will develop their own “knowledge database” of expert’s experience. [4], [5].

2. Analysis of Web Based Expert Systems

First and foremost, the web based expert systems will be analysed by some criteria’s: usability, security, data processing and knowledge (database) base. As for usability, it consists of several parts: fit for use, easy of learning, task efficiency, easy of remembering, subjective satisfaction, and understand ability. In order to analyse Web-based expert systems, we took two good examples of them (WITS and Fish Expert System), which satisfy to large amount of other expert systems by their functionalities, design and logics.

Example 1.

WITS is a Web-based Intelligent Training and Support system. It is developed for providing training and intelligent support for Small and Medium sized Enterprises (SMEs) on the use of Information and Communication Technologies (ICT). The research was inspired by the evidence from the literature that lack of adequate skills and knowledge is one of major barriers for SMEs in successfully adopting and running e-commerce and e-business. As a result of this deficiency, there is an emerging need for better

education and decision support to SME managers who are eager to embrace the technology and afraid of being left behind. WITS advisor has three subsystems, which are designed to facilitate SME managers' decision making process in e-commerce and e-business adoption. [1]

Table 1

Analysis of Web-based intelligent Training and Support System (WITS)	
Usability	Generally, it satisfies usability test criteria (fit for use, ease of learning, task efficiency, and ease of remembering, subjective satisfaction, and understand ability). Web-based ES makes the evaluation and implementation of WITS much easier; Easy to collect feedback from online forms; Use of Web design software makes the user interface design easier; HTML-based user interfaces allow the incorporation of rich media elements; E-mails, feedback forms and other Internet communication functions allow users to question and comment on the system, thus making an expert system more interactive and personal; Useful links are incorporated in the system which can help the user to understand and interpret the expert system's recommendations; It has certain limitations. It does not have an easy to use knowledge updating facility.
Security	Any attempt to update and modify domain knowledge has to be done by the system developers using the original programs.
Data processing and access	No need to install the system in advance; Easy to collect feedback from online forms; Hyperlinks in HTML provide an extra facility in enhancing ES explanation and help; functions as users can access the relevant Web site easily.
Knowledge base	Useful knowledge source for knowledge acquisition in constructing the WITS knowledge base; With a Web-based knowledge base, any knowledge updating and maintenance can be handled centrally, and no reinstallation needs to be carried out.

According to the graph (Figure 1), there is a 'Knowledge validation', which validated and verified against test cases until its quality is acceptable, whereas 'Knowledge representation' prepare the knowledge map and encoding the given knowledge in the knowledge base. 'Inferencing' component allows the computer to make inferences based on the knowledge and the specifics of the problem. As for 'Explanation and justification', it is a program that allows the system to answer questions about a specific piece of information or how a certain conclusion was derived. Moreover, direct arrows mean just one-side relation; others identify two-side connections.

Example 2: Fish-Expert

Fish disease diagnosis is a rather complicated process in aquaculture production activities. Fish-Expert is a Web-based expert system for fish disease diagnosis in China. This Web-based expert system can mimic human fish disease expertise and diagnose a number of fish diseases with a user-friendly interface. A fish disease diagnosis expert system contains a large amount of fish disease data and images, which are used to conduct online disease diagnosis. The system has been tested and is in pilot use in certain regions of North China. [2]

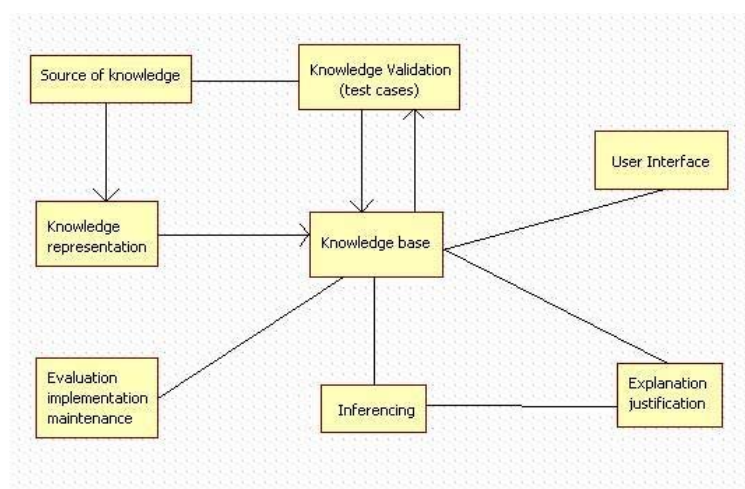


Figure 1. System Architecture of WITS

Table 2

Analysis of Web-based Fish Expert System	
Usability	Generally, it satisfies usability test criteria (fit for use, ease of learning, task efficiency, and ease of remembering, subjective satisfaction, and understand ability); The multimedia interface in Fish-Expert is effective in helping the user to query the system, but it slows down the access speed to it; A multimedia interface was used in the system. Matching of pre-defined text description and images of symptoms was provided to users who can choose text and/or images to describe the symptoms. Different interfaces were designed for pond inspection, fish inspection, etc. In the fish inspection interface, users can input information by selecting matching symptom pictures and descriptions from eight symptom groups (single or multiple selections are allowed); Online user feedback and evaluation of the ES was effective and popular.
Security	Knowledge engineer is still needed to check and transfer the knowledge into the knowledge base; the final responsibility of checking and updating the knowledge base still lies in his or her hands.
Data processing and access	Internet access speed is seen as a bottleneck for Web-based ES applications, especially in developing countries; Users can talk to a human expert via tele-diagnostic equipment in either a synchronous or asynchronous manner; Using HTML makes it easier to enhance the ES user interface. The multimedia interface was effective in helping the user query the system, but it slows down the access speed.
Knowledge base	Knowledge engineer is still needed to check and transfer the knowledge into the knowledge base; ES are known for their inability to deal with exceptions or complex problems due to the inflexibility and limits of the knowledge base; The knowledge base contains rules for disease diagnosis; Fish-Expert users can query the system using a forward chaining inference process that automatically matches facts against patterns to determine which rules are applicable.

The graph (Figure 2) consists of 6 main modules such as 'Explanation System', 'Farming System and Information System', 'Inference Engine', 'Fish Disease Database and its management', 'Knowledge acquisition tool', 'Fish Disease Knowledge Base and its management'. Moreover, we have such components as 'User', 'User Interface', and 'Human Expert'. Generally, the given graph is simple, because its relations are understandable; all connections are two-sided, instead of 'Knowledge acquisition tool'.

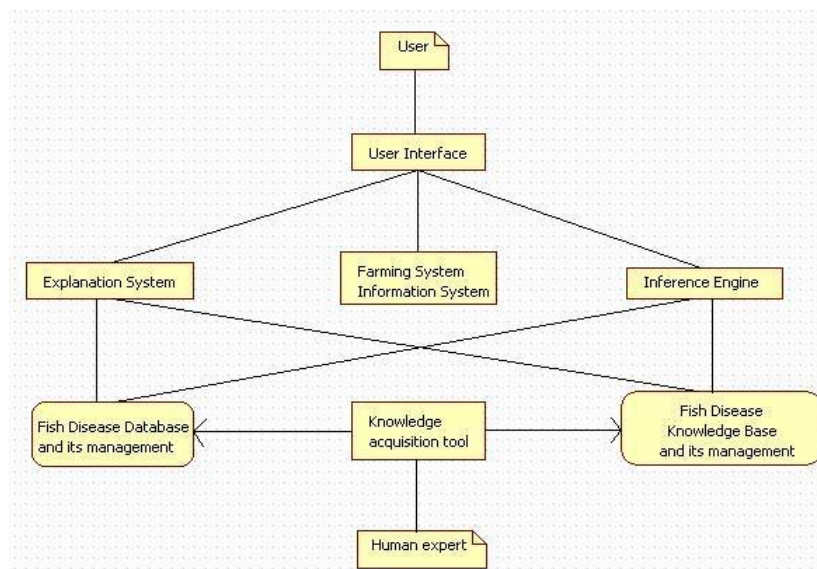


Figure 2. System Architecture of Web-based Fish ES

The main point of our issue is to clarify that Web based expert systems can be created by merging an expert system and a Web site/application developing subprojects. It means that in order to develop at least a rather "successful" Web based expert system the developer must follow basic expert system technology and Web engineering principals. The Web system consists of a Web based fuzzy expert system, databases and a set of dynamic and static Web pages. Moreover, we have analysed few Web-based Expert systems, and we want to provide an advice aiming to prevent the operational problems

occurrences and to minimize their unwanted effects of their consequences. Furthermore, some useful tips for the development of analogous Web systems will be given.

During developing your own web based expert system, you should satisfy some plan, which is given on the Figure 3.

Firstly, 'Identification of requirements and specifications' component is given, because all projects start from this point. Next, we have, Design of data, which is important for Web application notions in order to identify, analyse and describe data structures for displaying that for users. 'Design of Hypertext' component is necessary for html code to be written and some object, which are important for Web pages, are identified. The good examples of these are tables, frames, layers and images. The forth vital part of graph is 'Design of Architecture', where we can identify the main software and hardware components. Other components such as 'Implementation', 'Testing and assessment' 'Maintenance' also have to exist in developing process of Web Site for Expert System.

It is certainly true today that the developers of Web based Expert systems should spend more time on functional requirements, just after that on design, beauties and other factors of Web Site. So, there are some requirements in right creating the Web site for Expert System.

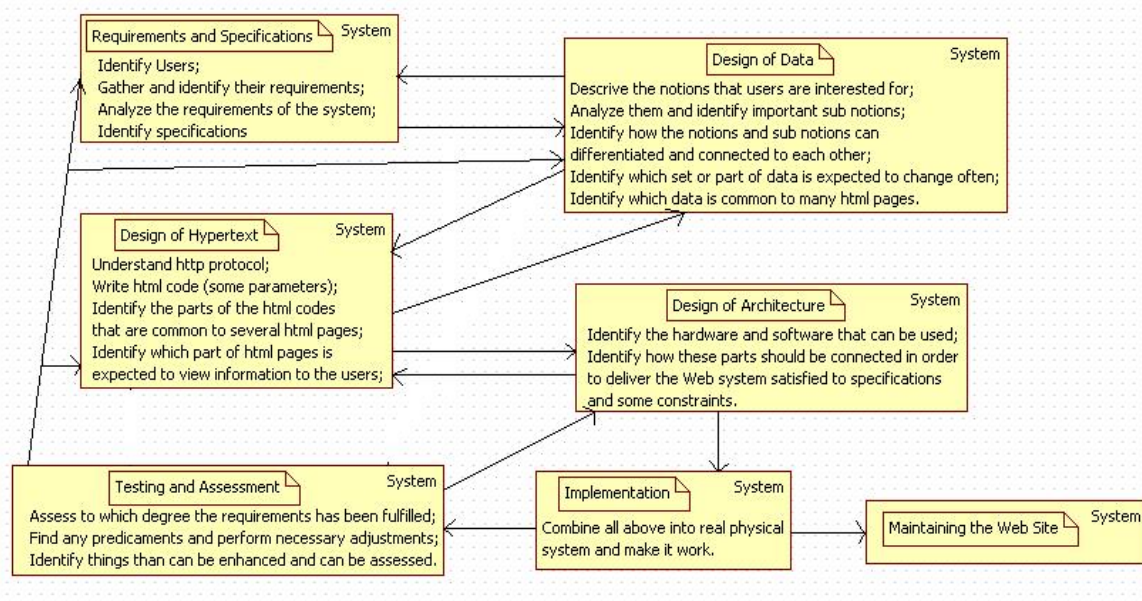


Figure 3. Architecture relating to Web Site developing process

3. Functional Requirements

1st fact: The Web application must provide the means that will allow to users to make queries regarding the direct extraction of a specific problem advice, without activating the Web based expert system.

2nd fact: Users would like to know and understand the reasoning of the expert system and based on which formula it calculates the operational problem occurrence possibility.

3rd fact: Users would appreciate and assess the fact that the Web application is providing information regarding the:

- Knowledge acquisition process;
- Tools that were used in the creating of expert system; c) Basic notions of the Web application (e.g. what is expert system, knowledge acquisition, etc.).

4th fact: The Web application must provide the means that will allow to users to make comments and to submit their proposals and experiences. Specifically, domain experts proposed to have the opportunity to describe how an operation problem/accident occurred in a landfill and based to their description the developer of the system to be able to update the knowledge base of the Web expert/knowledge based system. [3]

4. Non-Functional Requirements

The developers should know that the Web site/application must be as follows:

1. Aesthetically beautiful and at the same time serious and simple design.
2. Ease in use (easy of learning, task efficiency, easy of remembering, subjective satisfaction, and understand ability) and in navigation (usability).
3. Fast, regarding the time duration of the Web system response to a request (performance).

Moreover, the developers of the Web site/application should want it to be:

1. Constantly available to the users (availability).
2. Easy to maintain and to perform necessary changes (maintainability).

5. Conclusions

The aim of the article is to provide an overview of Web-based Expert Systems and present the developing process of those systems. Based on the fact that Web-based Expert System consists of two parts such as Expert System and large Web Site/Application, this issue is devoted to creating an appropriate Web Site for Expert System. The analyses of two such systems were given in the article and according to them it can be recommended aiming to prevent the operational problems' occurrences and to minimize their unwanted effects of their consequences. Furthermore, some useful tips for the development of analogous Web systems were given. Currently, we write our research work relating to development of Web-based Expert System for information security audit. All plans, schemes and tips given above we are trying to involve in our project.

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