EXPERTSHELL - A SHELL FOR DEVELOPING AND SHARING OF EXPERT SYSTEMS ON INTERNET

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Abstract: Expert Shell is a toll developed to assist in the construction of Expert Systems (ES). With an interface simple and intuitive, allows the construction of Knowledge Bases (KB) with figures facilitating the creation of expert systems on biomedical area. Also was developed a web portal that makes possible the sharing of knowledge bases, so that several human experts participate at the developing process of an ES. Moreover, it allows a remote consult to a KB using a Java Applet what distribute the experts' knowledge on Internet.

Introduction

Artificial Intelligence (AI) is the study of the mental faculties through the use of computational models [1]. A technique of IA that it is based on this concept is the Expert Systems (ES). The ES's are systems based on knowledge that uses humans' experts's knowledge to decide problems in one determined domain, like the human experts do. The systems based in knowledge are structuralized through a base of knowledge and an inference engine [2]. It must be remembered that in no moment, this kind of system as the intention to substitute human expert, but it can be used as alternative when human experts are not present.

ES generally are based on the extracted knowledge of the human specialist, which, organized in a knowledge base, can be consulted with the purpose of assisting in diagnosis process. The inference machine has the function, to analyze the user entrances and makes a relation with the KB elements; so that it finds a solution in accordance the rules implemented in the BC.

This kind of system can be applied in diverse areas, such as: credit analysis, engineering, education, diagnostic - however since the first publicly available medical expert system MYCIN in 70's , doctors and knowledge engineers have resorted to many clinical decision support systems to generate clinical alerts, interpretations or diagnosis [3].

This type of program easily manages to appear intelligent, allowing also the easy use of the so-called decision tree, very frequently applied in modern medicine. In areas of limited domains, such programs have shown themselves to be fairly effective [4].

ES generally are developed with the knowledge engineers help, software developers and experts in the domain of the problem, who, are searching a solution. In the beginning of the construction of this system type is necessary to understand the KB scope, determined by the task, and to understand the really characteristics of domain [5].

The development of SE's for the medical area, generate the creation necessity of specific tools that helps on construction of this system type. These tools are called Shell's.

The Shell's possess a generic inference machine and proposes a friendly interface simplifying the construction and knowledge bases tests.

The KB building is a critical point at the elaboration of an ES. There are diverse forms to represent the expert's knowledge. A form used to make this representation is called Rules of Production, which possess a format (IF - THEN), allowing the use of logical connectives (AND, OR, NOT), this way, allows the treatment of uncertainties, providing legibility to the KB [6].

It has been long recognized that medical diagnosis is a complex cognitive process. Sometimes it is difficult, if not impossible, for medical experts to even formalize their knowledge and experiences. The acquired knowledge accuracy tends to be questionable as the information is collected from a very limited number of medical experts with their expertise refrained in very specific and narrow fields [3].

The Internet has been considered an excellent way of knowledge dissemination. This way, ExpertShell proposes the utilization of WWW for that KB can be shared and built, making possible the participation, on-line of specialists and developers in the ES elaboration. This will be possible through construction of a web portal, where the users will have access to all the KB that had been developed or are in development in this site.

The portal will make possible that experts in various knowledge areas, mainly the medical experts, become able to collaborate each other on construction of KB's, so they can create KB that can generate trustworthy results.

Besides creating more trustworthy systems the portal for sharing KB, this will contain a mechanism so that the users, duly registered in cadastre, can make consultations of some knowledge base. Unfortunately experts can not be present at every required location. It

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is increasingly expensive to transport an expert to the location where they are required. One possible solution for providing distributed expert systems is the World Wide Web (WWW). The WWW permits the expert's knowledge to be provided at such distributed locations [7].

Also it can be said that to divulge KB's in web, is a form to distribute expert knowledge organized in a systemize way the production rules and becoming the portal, an important source for research in diverse specialties for which had been created ES's.

Expert Shell a tool for developing of Expert System

The main function of this tool is to assist in specialists' systems construction, supplying to developers a graphical environment for the ES creation, speeding some development stages of these systems.

The Expert Shell intends to join through Internet, specialists and connoisseurs in diverse areas of the scientific knowledge mainly in the medicine area, with the purpose to create KB shared spreading out the use of ES's on Internet, distributing the experts knowledge in web.

The Expert Shell is composed of three modules distinct:

1. Knowledge Bases Editor
2. Web Portal for Sharing Knowledge Bases
3. Knowledge Base Advisor.

Knowledge Bases Editor (KBE)

The Knowledge Bases Editor was developed using the tool Delphi 7.0, it is responsible for interface of development of the Shell. This module has the finality to organize the components of the knowledge base (rules, variables and questions) to later be exported in an archive in format XML e interpreted for the inference machine. Figure 1 shows the interface of Knowledge Bases Editor.

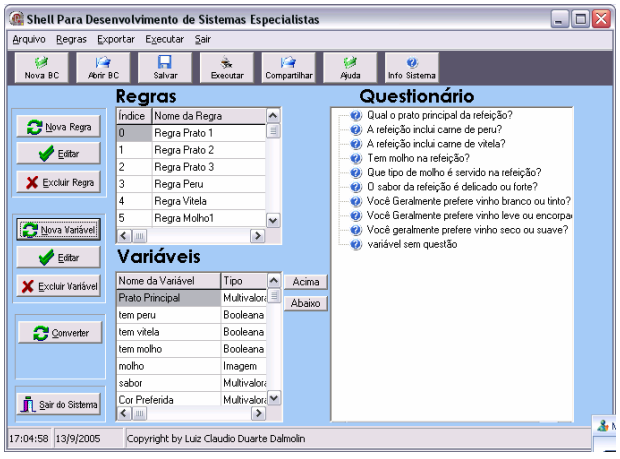

Figure 1: Knowledge Bases Editor.

All data referring to KB are stored in data archives of data in a specific format created by the system. When an archive is opened, or is created a new ES, the variables are placed in a dynamic vector where the modifications are made.

When the user decides to save his KB, the data of these vectors they are recorded in the archive. When the user decides to create a new KB, the KBE create a folder with the shortened name of the system, in this folder will be all archives that compose the KB.

The base knowledge is formed by variable, for the questions associates to each variable and for the rules with its had factors of certainty associates.

The types of variable that are associates in a KB on Expert Shell are:

- **Boolean**: it can assume one between two values (Yes/Not).
- **Numerical**: it receives any value numerical
- **Multivalorada**: this kind of variable can receive different values (strings or numericals).
- **Image:** figures of type JPEG.

Shell's what allow to use images in its KB are rare. The use of images in some types of KB can increase quality of the answers presented by the system. To user it is notable, when he is answering the questions made during the consultation, is much more practical to identify to an image than analyze the subjectivity of a description for writing of a specific characteristic inside of the domain. The figure 2 shows an example of a image type variable. Where it is possible to easily identify a cell with an abnormal format.

Figure 2: Interface of creation variable screen.

The Representation of the Knowledge and Treatment of Uncertainties in the Creation of Rules and the Inference Process

The functioning ES depends a lot of its knowledge base. So, to be created BC's is necessary to find a form to represent the knowledge of human expert. The BC's of the servants in the Expert Shell is composed for production rules of type IF-THEN, also allowing the

ISSN: 1727-1983

use of logical operators (AND/OR). An example is shown on figure 3.

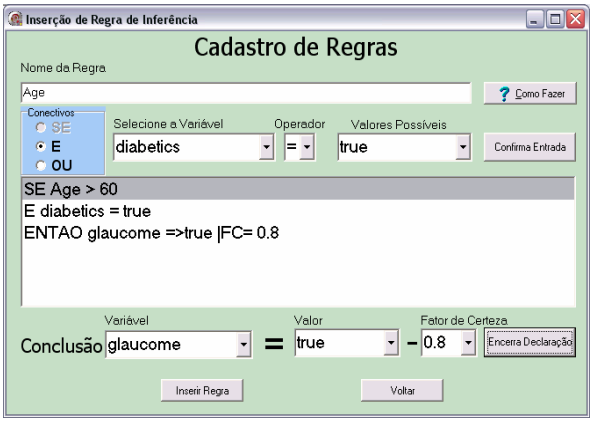

Figure 3: Example of a rule.

To each rule is associate conclusion variables is associated a Certain Factor (CF), CF can receive values from 0 the 1. Thus the expert, based on his own knowledge of domain can define how relevant is the answers of users.

The conclusion variables are invocated in according with users answers. It is of responsibility of the machine of inference to verify which rules had been called and to make the combination between CF's. To arrive at a final CF the Expert Shell it uses the following express formula in equation 1 [8].

$$FC_{(Final)} = (FC1 + FC2) - (FC1 * FC2) \qquad (1)$$

The knowledge base consulter

The inference process follows the model FORWARD. This method starts with basic facts and then applies a set of rules until gets a new set of facts which will be the base for the suggestions proposals for the system specialist.

The inference machine of ExpertShell was implemented in language JAVA. The inference machine is an Applet, what has function to load the archives .XML generated for the knowledge base editor, and after this, to make the questions to the user, store the answers and effecting the calculations of CF's in accordance with the users answers associating with the rules implemented. Figure 4, shows the example of a done question to a user and the options to be chosen.

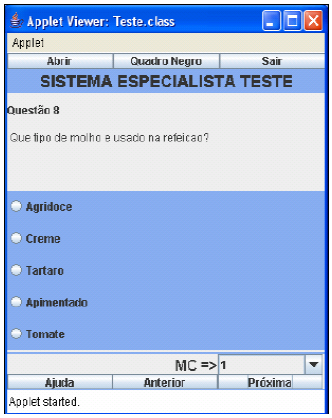

Figure 4: Module knowledge base consulter

Once that the consultation to the KB is an applet, developed in java, it becomes viable its applications in remote environments. The applet loads the information of the web portal where have been stored the KB's facilitating the distribution of ES's, allowing that they are executed in the users' browser.

In this module also have been added depuration functions. These functions has been implemented in the form of a black board. The black board has the function to store the answer choose by user on consulter KB. This option can be of great value for the specialist because it allows to him analyzes the KB and certify that the results are being satisfactory.

The black board is an important tool for depuration of the system because it shows to the developer clearly how inference process is being executed, allowing the identification of possible imperfections in the knowledge base.

Once that ES works with uncertain information. When the user is not right about his answer, in objectives questions (YES or NOT) for example, this user may use a different Measure of Belief to affirm his reply. The user he can answer the question with a degree of lesser certainty between 0.5 the 1.0. This way, a variable of conclusion from the rule receives a different value of the stipulated one in BC, this value are gotten parting by following expression presented in equation 2.

$$FC_{(Final)} = (FC_{(anterior)} * (1 - MC)) + MC \qquad (2)$$

The Web Portal for sharing of Knowledge Bases

The Web portal has the objective to share created bases of knowledge in the Expert Shell. In this portal, will be able, a lot of information about expert systems, shell's and new features in the field of AI.

Figure 5, presents the portal web when a user effects login.

ISSN: 1727-1983

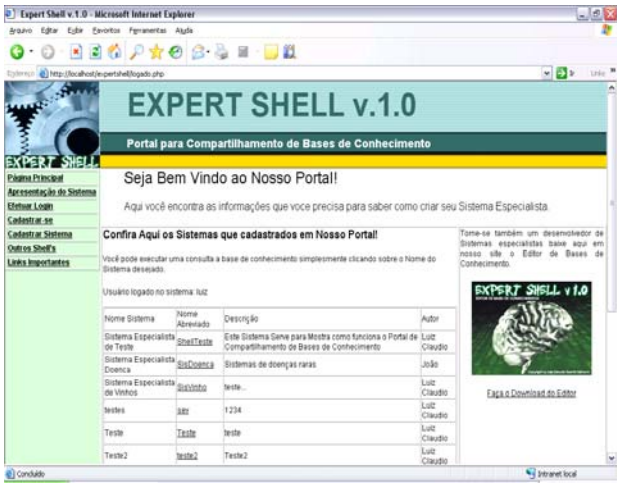

Figure 5: The Web portal for share KB

Accessing the portal the user can to execute na ES, just if he has done the register and having the Virtual Java Machine.

In the portal the user also will be able to make a register as chief developer of a ES and then, he will have the privileges to choose who can make download of his KB, who might collaborate in the creation of his KB, and who might actualize the KB on portal.

For a user become chief developer, he just need to fill a cadastre and then download the applicative file what contain the Knowledge Base Editor, which, runs locally at client machine. A base will be send to portal via FTP connection any moment depending of client requisition.

The portal also allows that the users they create different versions of one same one ES, adjusting his KB in accordance with its individual necessities and experiences. For example: If a medical specialist does not agree to the rules of a colleague who is developing one ES in set, this can create and edit rules its way and to use in its doctor's office.

The process to share a base of knowledge is defined by the following steps:

- For the publication of a new Knowledge Base is necessary to fill the cadastre has a chief and specify the characteristics of the system what will be developed.
- The chief developer controls the alterations that could be made by it or other users. It also fits to authorize other users to make alterations in the KB of his domain.
- The sending of the archives that compose the KB of the system will be sent for serving via ftp. To send a new base the user will have to be registered in cadastre in the portal and process is made from the Knowledge Bases Editor carrying through communication with the server of the portal.
- The Knowledge Bases Editor must be duly configured to send the data for the server. When clicks user in Sharing some configurations will have to be duly made right. (Address of ftp of the Server, name of the user, password).
- For a visitor of the portal if to become an user authorized, it it needs to ask for the authorization for the chief developer, that it will receive an acknowledgment from solicitation when to connect itself in the portal with its password.
- To make an alteration in the base that is published in the site the chief developer or an allowed user will have first to make download of the complete archive, contend the base of knowledge, to local make the alterations in its machine.
- download the user does not need to be connected InterNet to make the alterations.
- A visitor also will be able to consult a base knowledge and able in the site through a Java Applet, I contend inference machine and the archives xml with the data of the base knowledge created. It will be necessary that it has installed in its machine the JVM Virtual Java Machine.

Results

To make the validation of the system it was implemented the same ES in the Expert Shell and the Expert Sinta [9]. It was opted to the Expert Sinta because this tool very is used in half academic and advertising having its endorsement guaranteed for scientists e professionals of the area.

The implemented system was a system that it makes the suggestion of wines in accordance with the tastes of the user and the type of meal that it intends to make. Same questions e had been implemented placed same FC s for the rules.

In this test the answers of the user had been equal, so that an accurate comparison of each one of the machines was made of inference.

The figure 6 and table 1 show results gotten for both the systems.

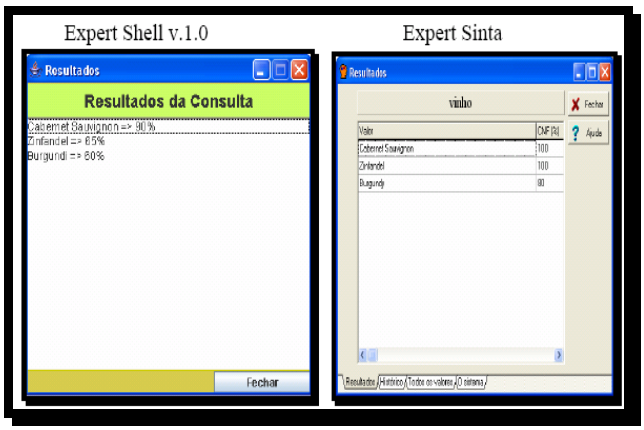

Figure 6: Comparisson between systems

ISSN: 1727-1983

Table 1: Comparison between Shell's

Expert Shell		Expert Sinta	
Wine	FC	Wine	FC
Cabernet Suvignon	90%	Cabernet Suvignon	100
Zinfandel	65%	Zinfandel	100
Burgund	60%	Burgund	80

These results if show in such a way one divergent but they are satisfactory a time that the inference process is different and formulas also used had been adapted in different ways.

The Expert Shell still meets in phase of validation and new tests with other more complex SE's they are being made so that it is possible to validate its machine of inference.

Conclusions

It was verified that when creating a new tool must be reached objectives still not reached, reinvented what have already done its not possible. So, in this work, the portal to share knowledge bases it came to add the differential of the work, considering the spreading of knowing specialized in the Internet and allowing that using they can execute systems specialists saw Internet.

The contribution of several was concluded that scientists and experts in the creation of knowledge bases can assist in validation of such bases, becoming them each time more trustworthy, improving its answers and reaching the objectives of ES that the human Specialist is auxiliary to identify problems of a specific domain inside.

One concludes the systems specialists in hypothesis some aims at to substitute the specialist, but with certainty they are one excellent alternative when it does not have no specialist for close beyond to assist the specialist remembering it of possible solutions that these can to be unaware of or not to lead in consideration in definitive cases.

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