



Expert System, its Research and Applications

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ABSTRACT: An expert system is problem-solving software that enacts a human expert in specialized area. It utilizes the acquired knowledge of the human expert to draw inferences to various problems. It has been widely used in major fields like science, engineering, education, medicine, agriculture, geology, judiciary, space technology, etc. This paper describes the research areas of expert system and its applications.

KEYWORDS : Expert System, Knowledge Base, Inference Engine.

I. INTRODUCTION

Expert system is a branch of artificial intelligence and is one of the largest areas of applications of artificial intelligence. Expert systems store the vast knowledge from the specific area in their software in the form of data and rules. The knowledge is gathered by interacting with human expert of particular domain. The expert system simulates the human reasoning process by applying specific knowledge and interfaces. The expert system can solve complex problems and they are proficient as human expert to advice, demonstrate, diagnose, explain, justify, suggest in specific areas. The expert systems arrive at conclusions by reasoning abilities. Expert systems also provide analysis of the problems and recommend users for various actions in order to perform improvements and rectifications. The expert system has gained much popularity in various fields since it is fast and consistent.

II. ARCHITECTURE OF EXPERT SYSTEM

The expert system is consists of three major components namely Knowledge Base, Inference Engine and User Interface.

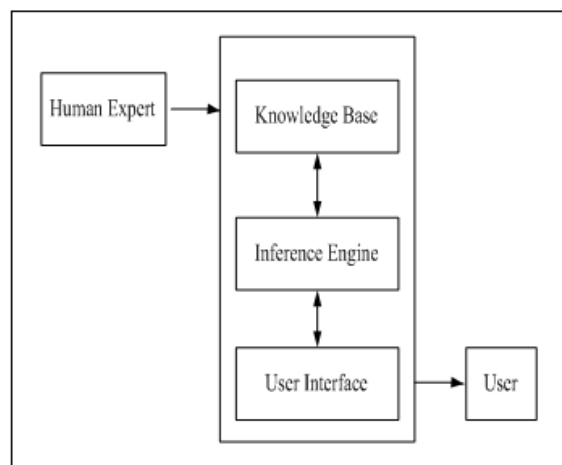


Figure 1: Architecture of Expert System

A. Knowledge base: The knowledge base is a collection of rules or facts derived from the human expert. The knowledge is gathered by interviewing the human expert and is then encoded in the knowledge base by using any of the knowledge representation technique. It contains domain specific and high-quality knowledge. The success of any

expert system depends on the collection of highly accurate and precise knowledge. The most commonly used technique used today for representing knowledge in an expert system is rules.

B. *Inference Engine*: The inference engine is the major component of expert system which acts as a processing tool. It co-ordinates with knowledge base and interprets and evaluate the facts, rules to provide solutions for the problems. Inference engine can draw conclusions with respect to diagnosis, planning, suggestion, justification, etc.

C. *User Interface*: The user interacts with the expert system through a user interface. The interaction can through question answer or data input. Also expert systems can interact with computer applications.

III ADVANCES IN EXPERT SYSTEM

A. *Expert System to Update Forest Maps*

The expert system to update forest maps is an emerging application uses expert system technology to help users in updating forest maps. This is done through three tasks: selection of appropriate images and ancillary data for updating a map; processing of the selected image and data to generate interpretable output (e.g., classifying them into thematic regions); interpretation of the output. This is achieved by developing software SITI which is written in Java which has five modules (Figure 2): interfaces, an image processing library, IDSA, ASA and CI2A. [8]

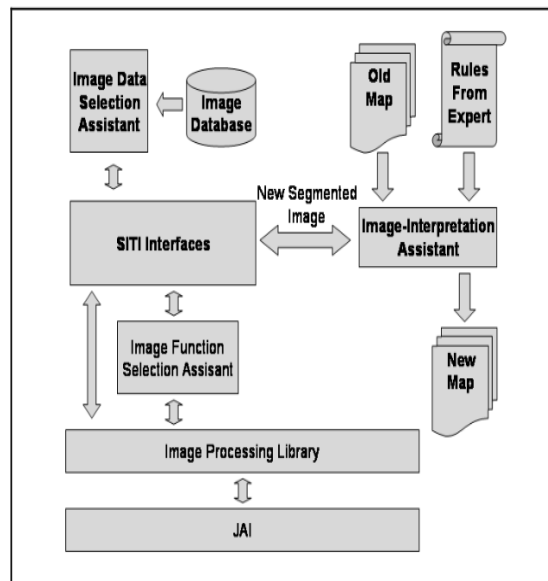


Figure 2: SITI Architecture

Figure 3 shows a snapshot of SITI GUI, with a loaded image and on the bottom its histogram view.

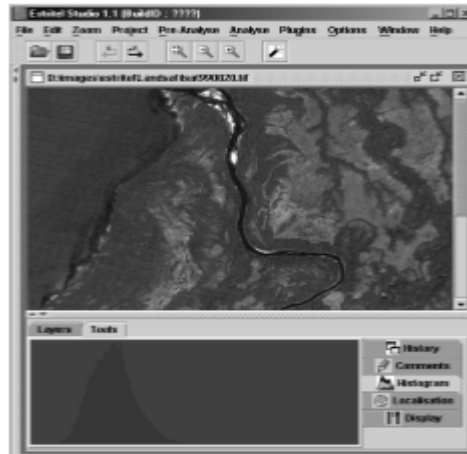


Figure 3: SITI GUI

B. Expert systems for Selection of Data Mining Method

The expert system for selection of data mining method is used to find the best and appropriate data mining methods for solving to derive useful conclusions. This system suggests the best technique or algorithm to be applied for data in specific area. The knowledge base of this system contains the following rules: a) if business area is retail, task is space optimization and association rules are applied; b) if taxonomies are present in dates, generalized association rules are applied; c) if method is association, database is transactional and categorical, size is medium then Apriori algorithm is applied; d) if the method is association and data is quantitative the it must undergo transformation of data by discrimination into categorical data before appropriate algorithm is applied. [5]

C. Expert Systems in Agriculture

Expert system is extensively used in agriculture exclusively to diagnose and manage pests. Mango Expert System Prasad et al. (2006) is developed viz., AMRAPALIKA to diagnose 14 different pests, eight diseases and six insects in mango variety. The expert system is developed for important diseases like Powdery mildew, Black spot, Anthracnose, Red rust, Die back, Bacterial spot, Sooty mould and Malformation and insects like Shoot-borer, Red ants, White ants, Mealy bug, Mites and Fruit fly. The knowledge base of the system is encoded with symptoms and remedies of 14 pests of Indian mango tree appearing during fruiting season and non fruiting season. It also contains the pictures of symptoms which are displayed in querying process. The system diagnoses based on the knowledge base and queries posted for user and draws appropriate conclusions with suggestions.

A web based tomato crop expert information system is developed by Babu et al. (2010) in India. The system contains two main parts viz., tomato information system and tomato crop expert system. The user can access all the static information regarding species, diseases, pests, symptoms, preventions and chemical controls. The advisory system has the interaction between user and expert system. The system queries the user and responses with specific disease or pest and suggests the control measure [7]. The figure 4 shows the architecture of tomato expert system.

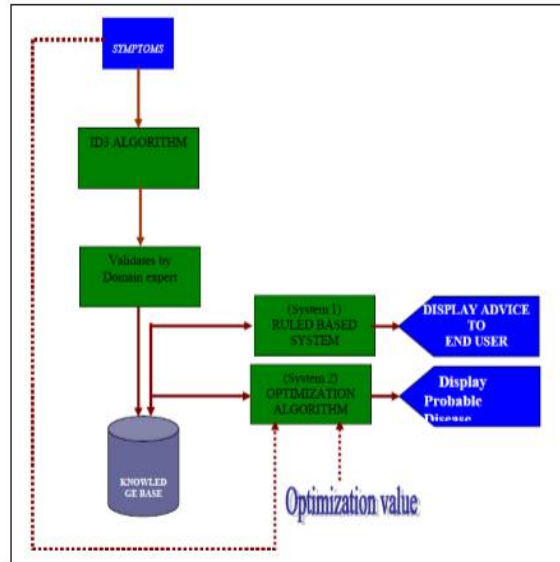


Figure 4: Architecture of Tomato Expert System.

D. Expert System for Satellite Data Selection

The expert system for satellite data selection helps the users to select appropriate satellite data product depending on their application. The system is designed and implemented as a web based application which helps the user to navigate and obtain precise data suitable for their research. The system uses the forward chaining mechanism to implement inference engine rules. The rules are implemented in JESS a java expert system shell. The figure 5 shows the selection result.



Figure 5: Selection Summary

At present the system is designed for agriculture, water and urban applications.



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E. Expert Systems for Identifying Children's Severe Malnutrition

The expert system is developed to identify the severe malnutrition on children from the age of 0 – 5 years old. The system helps the people to make consultation since the knowledge of nutritional expert has been adapted to this system. The system is developed using php and mysql and uses forward chaining method to identify the disease of malnutrition. The expert system quires the user and then prepares the goal regarding nutritional status, then the system undergoes nutritional diagnosis and gets the solution for the disease [9]. The figure 6 shows the diagnosis result of the expert system.

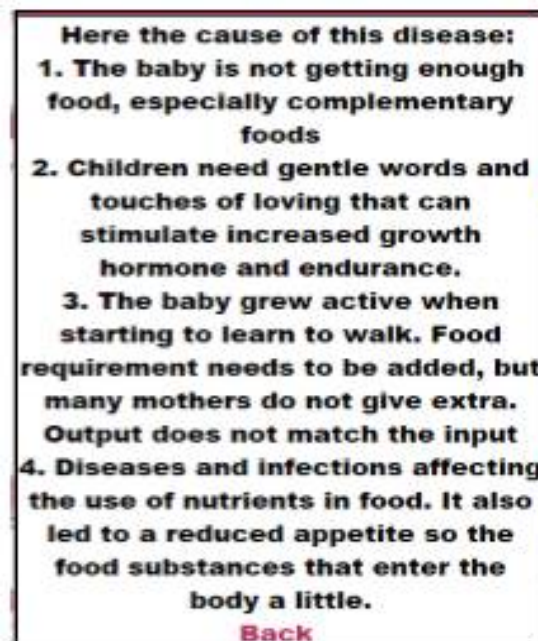


Figure 6: Diagnosis result

The system also includes the important information about malnutrition and latest news about health of children.

F. Expert System for Education

The expert system ARTIMAT was designed to develop mathematical problem solving skills in students. In this system the user could access the lecture or enter the problem solving system or can use the test exam. If the user logs into problem solving system and starts to with moderate random questions from the pool of questions that groped according to the level of difficulty, the expert system makes the routing according to the level of user. The system makes this routing by asking the sub questions for every step of the process. If the user gives a correct answer for a sub-problem, the system directs the user one at a time to the next step until finding the final result. If the answer is wrong, it prompts the user to give new answer. If user again gives wrong answer, the system asks the easier question ascertaining that particular question is hard for the level of the user. The difficulty level of the questions increases as long as the user correctly answers the questions and decreases if the user gives wrong answers to them [10].

IV. CONCLUSION

Expert system has made tremendous contribution in various fields. It has been helpful to draw accurate, consistent solutions to problems with less time. Expert system has proved its excellence in providing suggestions and advice. This paper has provided a few applications and advances of expert system. Expert system will have very large scope of application in upcoming years.



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BIOGRAPHY

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