Expert System for Agriculture Extension

Sujai Das, Laxmikanta Nayak

NIRJAFT (ICAR), 12 *Regent Park, Kolkata - 700040, India.*
sujai_das@yahoo.com

Abstract

This paper is meant to provide required information and expert advice to the farmers and extension workers according to their needs & available resources. For an example, on the basis of symptoms supplied by the farmer, diseases affecting the crop can be detected and those practices that should be adopted according to the geographical locations or climate for a better yield. Thus, the work is to categorize agriculture in sub-areas & collect relevant information for these areas and feed into database. Second to make decision rules to process the information. Finally to design & develop the web based expert system for extension people. This expert system is expected to provide required information to the farmers and extension workers to take decisions in the agricultural enterprise.

Keywords: Agricluture extension, Information, ICT.

1. Introduction

Expert system can be defined as a tool for information generation from knowledge. Information is either found in various forms or generated from data and/or knowledge. Text, images, video, audio are forms of media on which information can be found, and the role of information technology is to invent, and devise tools to store and retrieve this information. Statistical information is a good example of information generated from data while advises generated by an expert system is a good example of information generated from knowledge. At the beginning, the concentration was mainly on textual information. Information technology used for textual information ranged from paper archiving tool to the sophisticated electronic computer software tools such as data base management systems, and hypertext tools. Images were very difficult to be included in an information system just few years ago till the scanners technology has been advanced together with the invention of the optical storage devises which have the capacity to store hundreds of mega bytes. This technology has enabled the developers to include images in their systems. The need of expert systems for technical information transfer in agriculture can be identified by recognizing the problems in using the traditional system for technical information transfer, and by proving that expert systems can help to overcome the problems addressed, and are feasible to be developed.

2. Information Transfer Problems

Static Information: Examining the information stored and available in the agriculture domain revealed that this information is static and may not respond to the growers need. All extension documentations give general recommendations because there are many factors if taken into consideration; so many different recommendations should be included in the document.

Specialties Integration: Most of the extension documents handle problems related to certain specialty like plant pathology, entomology, nutrition, or any other specialty. In real situations, the problem may be due to more than one cause, and may need the integration of the knowledge behind the information included in the different extension documents and books.

Combination of more than one information source: Images may need sometimes an expert to combine other factors to reach an accurate diagnosis, and even if a diagnosis is reached, the treatment of the diagnosed disorder should be provided through extension document.

Updating: Changes in chemicals, their doses, and their effect on the environment should be considered. Updating this information in documents and distribute them takes long time. The same arguments can be made for audio tapes that are another form of extension documents but in voice instead of written words. Video tapes are more stable than other media as the information provided through the tape describes usually well established agricultural operations. However, if the tape includes information as what is commonly included in documents and audio tapes, this information should be updated.

Information unavailability: These are cases, where Information may not be available in any form of media. It can be obtained only from human experts, extensionists, and/or experienced growers. In addition, the information transfer from specialists & scientists to extensionist and farmers, represents a bottle neck for the development of agriculture on the national level. The current era is witnessing a vast development in all fields of agriculture. Therefore, there is a need to transfer the information of experts in certain

domain to the general public of farmers, especially when the experts are fewer than the actual demand.

3. Domain Application Aspects

The agriculture domain can be classified into subdomains namely: plant production, animal production and management of natural resources related to the agricultural operations such as soil and water. Expert system has been applied in the three subdomains. Expert systems for field crops are implemented for : diagnosis of Soybean diseases (Michalski et al., 1983), crop management for cotton (Lemon, 1986) and (Plant, 1989) and weed identification for wheat (Schulthess et.al., 1996). Expert systems were also implemented for horticulture crops: apple orchid management (Roach et al,, 1985 and Gerevini et al., 1992), cucumber production management (Rafea et al., 1995). Agroforestry is another area in plant production where expert systems have been developed (Warkentin et al. 1990). Some other applications cannot be categorized commodity wise such as the expert system developed for selecting evapotranspiration estimation methods (Mohan and Arumugam, 1995). Another way for classifying agricultural expert systems is the domain specific task that this system performs such as: irrigation, fertilization, pest management, diagnosis of plant diseases, and others. There are mapping between the domain specific tasks and the generic tasks. For example irrigation application is mainly a special case of scheduling whereas diagnosis is a special case of classification.

4. Ontology Based Expert System

In earlier systems, a vast amount of knowledge was stored in the knowledgebase as rules. Rules were extracted manually and stored in the expert system. In our OBES, domain knowledge is stored in ontology, which is easy to create using available GUI editors. OBES have the advantage of distributive development and maintaining of knowledgebase over traditional expert systems. The system allows users to classify the crop ontology and checking its consistency.

5. Knowledge sharing and reuse

Knowledge sharing and reuse is one of the topics that have attracted the attention of the AI researchers in the last few years. The research in knowledge sharing in agriculture can be directed toward identifying common knowledge that can be shared among different expert systems such as identification of agriculture ontology, knowledge related to common resources namely: soil, water and climate, knowledge related to the same taxonomic category of a set of crops, etc. The research in knowledge reuse can be directed to building a library of domain specific tasks in agriculture such as: irrigation, fertilization, integrated pest management, etc.

6. Intelligent retrieval of agricultural data

Meteorological data are very important for agronomists as forecasting weather data helps in giving recommendations to growers. A system that serves as an intelligent assistant for meteorologists to locate and analyze historical situations of interest, has been developed using case based reasoning (Jones and Roydhouse, 1995). This work has been oriented to be used by meteorologists but not agronomists. The basic idea could be investigated to retrieve historical situations that are important for managing different crops.

7. Multimedia and expert systems

Integrating multimedia with expert systems is a hot topic that is booming nowadays. The integration with images was frequently done to more efficiently acquire the user inputs, whereas other types of media such as sound, and video are also addressed. An example of integrating multimedia with expert systems provided by Rafea et al., (1995). It was found that describing symptoms in words is very difficult and sometimes is very confusing. Therefore, images are identified to be used for two main purposes: describing a disorder symptom, and confirming the diagnosis of the cause of a certain disorder. Detailed images for all symptoms, and unique images that confirm the occurrence of disorders at different stages should be collected. Although images are very useful in acquiring the user inputs, the uncertainty problem is still there. Therefore, giving the user the option to select an image with a degree of certainty should be provided. Providing more than one picture for the same symptom can reduce the user uncertainty, but this will lead to exerting more efforts in collecting and classifying the images. As the output of an expert system for crop production management, is a set of agricultural operations, describing how to perform an agricultural operation in words, is very hard and one can never guarantee that the user can understand what has been written. Displaying a video for a professional doing the recommended operation would be very educational. The sound is essential because sometimes, it is not easy to write terminology used by growers in daily life. In addition, combining the video with sound is also recommended to comment on how the operation is done. Although the given example proved the possibility of integrating multimedia with expert systems, there are still some problems which needs further research such as the intelligent selection of the appropriate media for presentation taking into consideration the user level., getting input data from images, for example providing the expert system with an infected leaf of a plant for diagnosis, and/or enhancements of all input devices interfaces, which is a general research issue, in order to provide expert system with data in different forms.

8. Summary

This paper has discussed the needs of expert systems in agriculture and revealed their importance as tools for information transfer through information generation from knowledge and expertise. The advantages of an expert system can offer better than traditional methods. It provides the growers with dynamic information related to their actual situations, taking into consideration different specialties and different sources of information, shortening the update time of information especially if the expert system is centralized and accessible from different locations and transferring real experience that is not documented in any form of media by acquiring it from its sources: extensionists, highly experienced growers, and/or researchers.

9. References

1. Agrawal et. At, Mining association between sets of items in large databases, Proc. Of ACM SIGMOD, Int. Conf. On Management of data, Washington DC, 1993
2. Abdullah, A., Brobst, S., M.Umer M. (2004). "The case for an agri data ware house: Enabling analytical exploration of integrated agricultural data". Proc. of IASTED International Conference on Databases and Applications. Austria.
3. Cunningham S.J., G. Holmes. (2005). "Developing innovative applications in agriculture using data mining". Proc. Of 3rd International Symposium on Intelligent Information Technology in Agriculture. Beijing, China.
4. Inmon, B (2005). Building the data Warehouse Fourth edition, john Wiley, New York.
5. Osmar R.Zaiane (1999). CMPUT690 principles of Knowledge discovery in Data bases, department of computer science, University of Alberta.
6. Gerevini, A., Perini, A., Ricci, F., Forti, D., Ioratti, C., Mattedi, l.(1992). POMI: An Expert System for Integrated Pest Management of Apple Orchards, AI Applications, 6(3): 51-62.
7. Jones, E., Roydhouse, A. (1995). Intelligent Retrieval of Archived Meteorological Data, IEEE Expert, 10(6): 50-57.
8. Kamel, A., Schroeder, K., Sticklen, J., Rafea,A., Salah,A., Schulthess,U., Ward, R. and Ritchie, J. (1994). Integrated Wheat Crop Management System Based on Generic Task Knowledge Based Systems and CERES Numerical Simulation. *AI Applications* 9(1):17- 27.
9. Lemmon, H. (1986). COMAX: An expert system for cotton crop management. Science 233:29-33.
10. McQueen, R., Garner,S., Manning, C., Witten, I. (1995). Applying machine learning to agricultural data. Computers and electronics in agriculture 12(4): 275-293
11. Michalski, R., Davis, J., Visht, V. and Sinclair, J. (1983). A computer-based advisory system for diagnosing soybean diseases in Illinois. Plant Disease 67:459-463.
12. Mohan, S., Arumugam, N. (1995). An intelligent front-end for selecting evapotranspiration estimation methods. Computers and electronics in agriculture 12(4): 295-309.