PANI * : An Expert System for Irrigation Management

(PANI* : It is a Hindi (National Language of India)
Word Means water)

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Abstract: *Expert System is one of the important application branches of Artificial Intelligence. Expert system is a computer program that is different from the conventional computer programme. Expert Systems are also referred as knowledge based systems. Expert system development is very often an expensive process which requires time and effort. These are designed to assist and not necessarily to substitute the experts. The development of any expert system must help the end-user and domain knowledge person. Efficient management of existing irrigation systems is very important to achieve optimal utilization of available water resources. Selection of crops, accurate estimation of irrigation demands and operation are the major challenging tasks in irrigation management. This paper deals the suitability of application of expert system technology in agriculture and proposes the development of rule-based expert system name PANI, for the effective irrigation management of the crop. The proposed system uses the knowledge of moisture levels in the soil to get the time of irrigation. The system has been developed in the Visual Basic 6.0 environment. The results given by the system have been found to be consistent and sound.*

Keywords : *Expert System, Visual Basic Application, Irrigation.*

1. INTRODUCTION

Expert Systems is one of the important application oriented branches of Artificial Intelligence in last four decades, a great deal of expert systems had been developed and applied to many fields such as office automation, science, medicine and agriculture. All of us directly or indirectly depend on agriculture from where come commodities to feed the living beings. In the developing countries like India, Pakistan, Bangladesh, Israel, Egypt etc agriculture is the occupation of major portion of population. However, agricultural practices are more manual and technically non-advanced in comparison to developed countries. The rest of the paper is organized as follows. Second section presents importance of Expert Systems in Agriculture, Section 3 presents architecture and development environment, Section 4 presents the implementation, Section 5 presents related work and Section 6 presents conclusion and future work.

2. Importance of Expert Systems in Agriculture

Agricultural production has evolved into a complex business which requires the accumulation and integration of knowledge and information from many diverse sources. For decision making the modern farmer often relies on agricultural specialists and advisors for providing critical information. Agricultural specialist assistance is not always available when the farmer needs it. Hence, Expert Systems were identified as powerful tool with extensive potential in agriculture. Knowledge based agricultural. Expert System becomes more powerful since it collects expertise from not one, but a number of experts. An Expert System or a Knowledge Based System, is a computer program designed to simulate the problem-solving behavior of an expert in a narrow do main or discipline. Expert systems combine the experimental and experiential knowledge with the intuitive reasoning skills of a multitude of specialists to aid farmers in making the best decisions for their crops. The modern time

agriculture requires information and application of knowledge from different interacting fields of science and engineering to do appropriate decision-making. Expert Systems, if developed accordingly, can suggest the right crop on the basis of type of soil, Irrigation scheduling, available resources and climatic conditions; can suggest the right variety, appropriate agronomic practices depending on the field situations; can help in identifying the pests, diseases, nutritional deficiencies and other imbalances, and can suggest suitable control measures. Thus the Expert Systems can as powerful tools of agricultural extension which will be of immense utility to the extension functionaries in timely transfer of information and technologies and efficient problem solving, which in turn will be highly beneficial to the farming community.

3. Architecture and Development Environment

Rule based programming is one of the commonly used techniques to develop expert system and the same has been used in the present work too. A typical rule-based expert system integrates a problem domain specific knowledge base, an inference engine and the user interface. The system is capable in using its internal knowledge and rules to formulate its own solution procedure based on problem definition.

System Architecture

The following components constitute the main parts of the PANI:

- Graphical User Interface (GUI)
- Data base interface
- Expert systems interface

As shown in Figure 1, the system components are tightly connected into an integrated system, transparently interacting with each other as needed, without any user intervention. The user selects the desired action and the system is responsible to carry it out asking the user for any data required and are not found in the system database.

3.1 Graphical user interface

The user interacts with the system through a specially designed unified interface which assimilates the peculiarities of the various components. A graphical user interface (GUI) provides a user friendly and comfortable environment in which he/she works and communicates with PANI. The GUI presents interactive forms and command menus to retrieve and update system parameters and steering variables, to enter user constraints and preferences and to prevent relevant DSS information back to the user after simulations have run and knowledge based inferences occurred. The GUI provides only appropriate sets of choices and warns user about potential erroneous implications of its actions. The user always feels in control of the software, rather than feeling controlled by the software.

3.2 Expert System Interface

The expert components of the system use a vast amount of information concerning detailed data for the individual sows, distribution, classification and frequency data coming from specialized statistical components. All these data either form the knowledge of the systems' continuously evolving KB or formulate the particular problem which may disrupt farms normal function. It is then the system that proceeds on a dialog with the farm manager aiming at providing the optimum solution concerning the particular problem. Various ES can be used as decision aids in Irrigation management. Four are under development for the needs of our system, according their usefulness and their potential use. The first which evaluates the farm performance

and the second which estimates farm performance inference about the farm considering it as a whole entity.

4. Implementation

PANI is being developed on Microsoft Windows operating system platform. MS Windows operating system is chosen because of its standalone characteristic and its wide availability.

We selected MS Visual Basic 6.0 as our development tool for its power and object based characteristics. An object oriented approach on computer software evelopment led to improved maintainability and understandability of the software (Booch, 1986). Exploitingthe object oriented features of Visual Basic and conforming to the principles of object oriented programming, the reusable code is maximized and the development time is reduced. For the RDBMS support of the system we used the capabilities of Microsoft Jet Database Engine. The connection to the Jet Engine is achieved through Direct Access Objects (DAO) is used in connectivity of the database. This approach has the advantage that many off-line management tasks can be carried out by using Microsoft Access DBMS. Using the classes in the development of our system we are able to incorporate easily into it many of the features offered by the MS-Windows graphical user interface. The skeleton of our user for any data required and are not found in the system database.

5. Related Work

Knowledge system technology has been applied to a variety of agricultural problems since the early 1980s. Generally, we can classify agricultural activities into Activities that are done on the farm prior to cultivation and activities, which are done during cultivation operations. The scope of this paper concentrates on an activity type that is done during cultivation. Specifically, this paper focuses on the irrigation scheduling activity.

5.1 Methods In Determining The Moisture In The Soil

The dominant method of irrigation practiced in large parts of the country consists of diverting a stream from the head of a field into furrow or borders and allowing it to flow down the grade by gravity. Generally, under these surface irrigation methods, the crop utilized only less than one half of the water released. A good part of the applied water is lost in conveyance, application, runoff and evaporation and hence the efficiency of surface irrigation method is low. Tensiometers can provide the information required to make proper irrigation decisions. The correlation area method (CAM) was used to combine in situ measurements and airborne gamma remote sensing estimates to obtain areal averages of soil moisture.

6 Conclusion And Results

PANI aims to make farm management easier, more efficient and more profitable for farmers to operate, using state of the art modeling and information technology tools. The system combines the facilities found in ordinary record keeping and management systems with the advanced capabilities offered by the decision support and expert components, into an integrated decision support system. Its functions can be utilized trough the friendly GUI without unnecessary overlapping or repetition of operations and data. Till now the data entry and management module, which constitutes the backbone of the system, are completed. Knowledge acquisition is an issue and a time consuming process and it acts as a restriction to our efforts in development of the other expert components. The system can be installed in a number of farms. Thus, the evaluation process will be undertaken in real farm environments and possible

modifications and improvements will be also performed during this stage. PANI can be easily extended incorporating new decision support models and expert components. We aim to extend our system, in the future, incorporating new expert components (Henderson, 1984).

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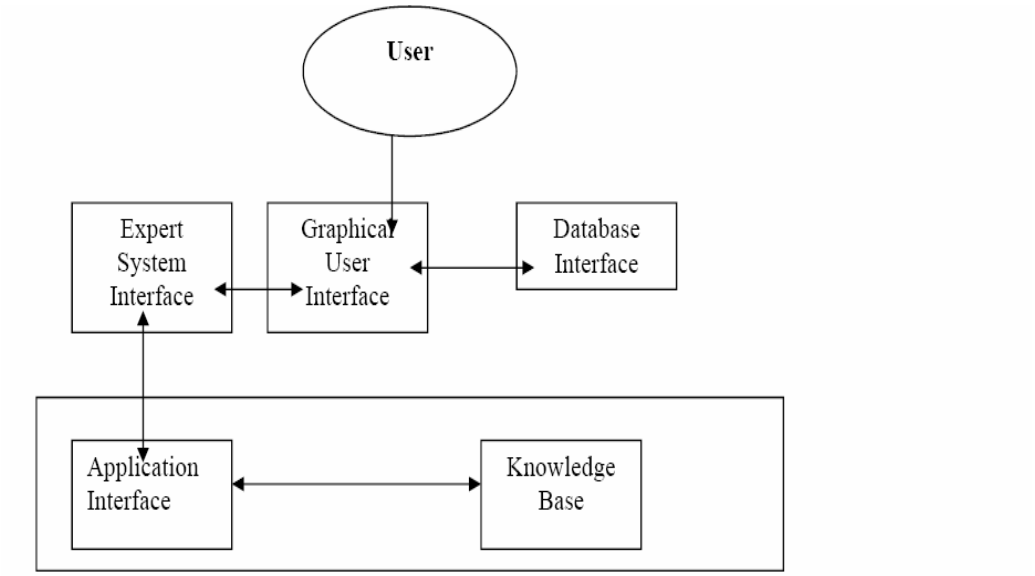

Figure 1: Abstract Architecture Of PANI

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